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LEVERAGING EMERGING TECHNOLOGIES IN SOUTHERN THAILAND

by

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Since 2001, the Kingdom of Thailand has seen a resurgence of ethno-religious (Malay-Muslim) violence that has killed approximately 800 people, causing obvious disruption within the nation and instability in the region. As one of the US' staunchest allies in Southeast Asia and with the potential for this violence to intensify further, it behooves the US government to offer solutions to help mitigate or reduce the violence in southern Thailand.

This thesis examines the history of southern Thailand, analyzing the political factors behind the Malay-Muslim rebellions of the past, tracing the roots of their rebellion back to the era of Patani Raya and the "Siamization" of the south. It explores the various trends and actors and other antecedent conditions (external influences) during the recent violence. Information on the various separatist groups operating in southern Thailand is provided along with an analysis of the porous Thai-Malay border and the role of PAS in southern Thailand. Lastly, this thesis examines an NPS field experimentation program entitled "Coalition Operation Area Surveillance and Targeting System" (COASTS). COASTS provides tactical, actionable information to remote and local decision-makers by integrating commercial-off-the-shelf (COTS) technologies such as unmanned aerial vehicles (UAVs), lighter than air vehicles (LTA), and unattended air and ground sensors, and wireless meshed networks technologies. If deployed to problematic areas, systems like COASTS can assist the Royal Thai government in reducing the violence in the south.

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LEVERAGING EMERGING TECHNOLOGIES IN SOUTHERN THAILAND

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ABSTRACT

Since 2001, the Kingdom of Thailand has seen a resurgence of ethno-religious (Malay-Muslim) violence that has killed approximately 800 people, causing obvious disruption within the nation and instability in the region. As one of the US' staunchest allies in Southeast Asia and with the potential for this violence to intensify further, it behooves the US government to offer solutions to help mitigate or reduce the violence in southern Thailand.

This thesis examines the history of southern Thailand, analyzing the political factors behind the Malay-Muslim rebellions of the past, tracing the roots of their rebellion back to the era of Patani Raya and the "Siamization" of the south. It explores the various trends and actors and other antecedent conditions (external influences) during the recent violence. Information on the various separatist groups operating in southern Thailand is provided along with an analysis of the porous Thai-Malay border and the role of PAS in southern Thailand. Lastly, this thesis examines an NPS field experimentation program entitled "Coalition Operation Area Surveillance and Targeting System" (COASTS). COASTS provides tactical, actionable information to remote and local decision-makers by integrating commercial-off-the-shelf (COTS) technologies such as unmanned aerial vehicles (UAVs), lighter than air vehicles (LTA), and unattended air and ground sensors, and wireless meshed networks technologies. If deployed to problematic areas, systems like COASTS can assist the Royal Thai government in reducing the violence in the south.

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I. INTRODUCTION

A. BACKGROUND

Thailand is one of five US treaty allies in the Asia-Pacific region, the only US treaty ally in continental Southeast Asia and is a major non-NATO ally. Therefore, it should be understood that maintaining a close relationship with the Kingdom of Thailand is critical to US policy throughout the region.

US-Thai relations boast a long history. The first diplomatic ties were established through the Treaty of Amity and Commerce in 1833 and during the reign of King Mongkut, who offered President Abraham Lincoln elephants to use in battle during the U.S. Civil War.[1] Thai troops fought alongside American soldiers in World War I, Korea, and Vietnam.

Throughout the Cold War, Thailand enjoyed a uniquely positive relationship with the United States because it was viewed as a front-line state in the war against communism.[2] During the Vietnam War, basing rights in Thailand at locations such as Korat Air Base (AB), Utapao AB, and Nakorn Phanom AB were critical to US mission accomplishment during the war. As a result of their role, Thailand was given substantial military and development assistance, in the form of grant aid for training[3] and the building of infrastructure and roads throughout the country.

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1 Asia Foundation, "Bilateral Conference on United States-Thailand Relations in the 21st Century," (Washington DC, 11-13 March 2002), 1.

2 Ibid.

3 Until today, Thailand is still one of the leading recipients of grant aid funding for training under the International Military Education and Training (IMET), formerly known as the Military Assistance Program (MAP); Thailand has trained close to 25,000 military personnel in the US under these program; Thailand's IMET program has consistently been ranked in the top five, largest programs in the world; in 2000 & 2001, Thailand's IMET program was the largest in the world, receiving $1.730M USD and $1.852M USD respectively; the author was the US' training manager to Thailand from 1999 to 2004, where he managed Thailand's IMET, Foreign Military Sales (FMS) and other training programs, such as Regional Defense Counter-Terrorism and Asia Pacific Center for Security Studies (APCSS).

After Vietnam, US-Thai relations weakened.[4] In the period of 1975 to 1976, Thai bureaucrats advanced a policy of "equidistance" and during the 1980s Thailand commenced with an "omnidirectionality" policy, by which Thailand not only recognized the US, but also recognized the importance of ASEAN, China, Vietnam, and the Soviet Union.[5] More issues would cause US-Thai relations to oscillate during the last decade of the century, the Persian Gulf War, the 1992 Black May massacre, China's military aid to Thailand, and the 1997 economic crisis.[6] However, despite what may have occurred in the political sphere, US-Thai military relations have always been close.

In recent years, upon the request from the US, Thailand has participated in several missions, proving the closeness of US-Thai military relations: East Timor, Operations Enduring Freedom (OEF), and Iraqi Freedom (OIF). After East Timor announced its intentions to secede from Indonesia and form an independent nation in 1999, Thailand, while still recovering from the Asian economic crisis[7] sent peacekeepers to East Timor under the United Nations operation International Force in East Timor (InterFET) and more troops during UN Transitional Administration in East Timor (UNTAET).[8]

Immediately after the events of September 11th, Thailand's cooperation was key during OEF when the Royal Thai Government (RTG) allowed the US to pre-position US Air Force (USAF) KC-135 tankers at Utapao AB, a Royal Thai Navy aerial port, in Chonburi province. The mission of the tankers was to support the "air bridge" during the USAF's B-2 bombing campaign of Afghanistan. On 14 December 2001, while meeting

4 After the USS Mayaguez incident, 12 May 1975, Thailand officially protested the act of the US using Thailand's sovereign territory to launch attacks on the Khmer forces who seized the USS Mayaguez; in Bangkok rioting occurred outside the US Embassy, America flags were burned, and the Royal Thai Government (RTG) ordered the cessation of the use of its bases by the US; op cit, Ralph Wetterhahn, *The Last Battle*, (NY: Penguin, 2001), 256.

5 Paul Chambers, "US-Thai Relations After 9/11: A New Era in Cooperation?" *Contemporary Southeast Asia*, (December 2004), 461.

6 Ibid., 461-463.

7 During the crisis, Thailand's currency, the Baht, was devalued by over 50 percent, fifty-eight financial firms were closed in one day, and the RTG received $17.2B USD in loans from the International Monetary Fund (IMF) to bolster their currency reserves, op cit, Chris Baker and Pasuk Phongpaichit, *Thailand's Boom and Bust*, (Thailand: Silkworm Books, 1998), 124.

8 During the InterFET phase, Thailand provided a battalion-sized task force, RTA MG Songkitti Jaggabatra was named deputy commander of the InterFET mission; in 2000, Thailand was selected to lead the UNTAET mission and sent another battalion-sized element; commanding general was LGEN Boonsang Niampradit.

with President Bush and Secretary of State Colin Powell, Thailand's Prime Minister (PM) Thaksin Shinawatra, expressed the Kingdom of Thailand's willingness to provide troops and equipment in support of OEF. The result was the deployment of a 130-man Royal Thai Army construction engineer company in 2003, the first non-NATO, out-of-region country to provide forces to the global war on terrorism (WoT).[9] On 30 September 2003, Thailand sent another signal to the US and the world that they were committed to the US' efforts to combat world terrorism by sending the first Thai troops to Iraq. The RTG sent a battalion-sized task force, composed primarily of construction engineers and medical teams to Karbala Iraq.[10]

Following the attacks in the US, the world witnessed a significant rise in militant Muslim insurgency around the world, to include a rise in militant Islamic radicalism in southern Thailand. The Royal Thai Government (RTG) once again found itself embroiled in counter-insurgency operations with Malay-Muslim separatists at their southern border. This rejuvenated insurgency is once again threatening stability throughout the country and the region.

Over the past 30 years, approximately 800 people have been victimized by criminal acts associated to separatist operations in southern Thailand-mostly in the provinces of Yala, Pattani, and Naratiwat. The inhabitants of this region, the Malay-Muslims, are ethnically and religiously closer to Malays than Thais. The Malay-Muslim population in Thailand's deep-south has historically been deprived and neglected and the area is grossly underdeveloped. Poverty, drug addiction, and violence are rampant. The result to this depressed region, in concert with the new global emergence of Islamic

9 Their primary mission was to repair Bagram Airbase, Afghanistan; secondary missions included, but were are not limited to, providing general horizontal and vertical construction capabilities with organic personnel and equipment. Unit members were handpicked and training was robust. Reports after their return were very favorable, stating that the Thai's commitment there greatly improved the operational capability and quality of life for over 30 coalition countries in the area.

10 Mission while in Karbala was to build and repair new and existing infrastructure; additionally, the RTG sent six, level-one medical teams who worked to provide humanitarian assistance to the Iraqi people through coalition civil affairs engagement and provided cross-training to third country national medical units.

militancy has witnessed a renewed intensity to an insurgency problem believed to have been eliminated more than a decade ago.

B. PURPOSE

This research focuses on historical, strategic, and geopolitical issues facing the US and Royal Thai governments in combating southern Thai separatism and how leveraging emerging technologies – such as an NPS field experimentation program entitled the Coalition Operating Area Surveillance and Targeting System (COASTS) - can assist with counter-insurgency operations in southern Thailand. This thesis analyzes how employing technologies such as those used by the COASTS program, i.e. unmanned aerial vehicles (UAVs) and lighter-than-air vehicles (LTA), unattended air and ground sensors, and wireless network technology, can assist the Royal Thai Government (RTG) in tracking suspected separatists and possibly international terrorists in the southern Thai provinces of Yala, Pattani, and Naratiwat.

C. IMPORTANCE

In essence, Thailand's southern separatist problem has resurfaced after a two decade hiatus. For several decades, from Cold War insurgency operations through Thailand's recent struggles with drug and human trafficking, sealing Thailand's porous border has been one of the Royal Thai Government's top national security objectives. Understanding the "openness" of their borders, the RTG has asked NPS to assist them in designing a border defense system that incorporates the use of UAVs and meshed networks.

Therefore, as one of Thailand's staunchest allies in Southeast Asia, it is imperative that the US government (USG) assist the Royal Thai Government (RTG) with their request. In fact, assisting the RTG in securing Thai borders directly supports one of the USG's primary national security objectives, mainly the War on Terror (WoT). It also advances US national security interests by promoting stability in the region and a close relationship with the RTG provides present and future access to Thai airfields and ports for our forces to conduct contingency missions as required. Thailand's cooperation in allowing the US to use their airfields and ports is not only essential to support WoT, but counter-drug, anti-piracy operations, activities of the Joint Task Force Full Accounting

and POW/MIA missions, and they provide the location for the annual Cobra Gold exercise, the largest overseas joint/combined training opportunity for US forces in the Pacific area of operations (AOR).

D. MAJOR QUESTION AND ARGUMENT

Thailand shares a porous 4,800 kilometer border with Burma, Laos, Cambodia, and Malaysia. Will leveraging emerging technologies assist in securing Thailand's historically porous borders, specifically, their southern border with Malaysia, and assist the RTG in tracking suspected separatists (and possible international terrorists) in the southern Thai provinces of Pattani, Yala, and Naratiwat?

For decades, from communist insurgency operations during the Cold War period through its on-going drug war, Thailand's "open borders" have been a direct threat to their internal security and an indirect threat to US security interests. With the recent increase in southern unrest and the capture of Riduan Ismuddin, a.k.a. Hambali, suspected leader of Jemaah Islamiah (JI), al-Qaeda's branch in Southeast Asia, these events have reemphasized the importance of developing a system to assist in securing Thailand's borders.

Realizing the US military has the resources and technical ability to devise a border defense system, various US coalition partners (to include Thailand) have approached NPS regarding such a capability. One potential answer was the development of the NPS COASTS program, which incorporates commercial-off-the-shelf (COTS) technologies that strive to address DOD and coalition partner requirements associated with the WoT and other security missions. COASTS aims to provide a capacity to assist the RTG with securing their borders, specifically in areas that are designated national priority by the RTG.

E. METHODOLOGY AND SOURCES

Using a combination of primary and secondary sources this thesis analyzes the southern separatist problem facing the RTG once again. Additionally, first-hand knowledge of emerging and COTS technologies and their capabilities was established during two COASTS field experiments in Thailand during the past twelve months.

While the author was in Thailand for the two COASTS experiments, several interviews were conducted. These interviews added insight to some of the issues facing the RTG. Dr. Suchart Bamrungsuk, RTG National Security Council (NSC) member and national security expert, Chulalongkorn University, was interviewed in March 2005. As a member of the RTG's NSC and with his background in academia, Dr. Suchart's insight into the history of southern Thailand and his recommendations for resolving the issues in the south were invaluable. Additionally, the author visited the Royal Thai Armed Forces' (RTARF) Directorate of Research and Development (DRDO) to discuss the nature of the problem in the south and to learn about their plans for trying to reduce the tensions in the south.

F. CHAPTER-BY-CHAPTER REVIEW

Chapter II, "The Current Security Situation in Southern Thailand," analyzes the security concerns facing the RTG. It gives a detailed history of southern Thailand, focusing on four elements: the resurgence of Patani Raya or the Greater Patani State, Patani's conversion to Islam, the role Patani played in ancient times, and the claims to southern Thai separatism by the Malay-Muslims. Lastly, this chapter analyzes the resurgence of recent southern Thai violence and the possible associated actors.

Chapter III, "Thailand's Border Security Challenge and the Malaysia Connection," focuses on the physical and political relationship between Thailand and Malaysia, analyzing the border region between the two nations, particularly the porous nature of the Thai-Malay border. It then examines how dual citizenship aggravates the situation in southern Thailand. Lastly, Chapter III discusses the "Malaysian Connection," and the role of external players, in particular the *Parti Islam se-Malaysia* (PAS) in the southern Thailand problem.

Chapter IV, "Emerging Technologies," provides a detailed explanation of emerging technologies will be presented. This chapter will introduce the various technologies at the disposal of the RTG, demonstrating how commercial-off-the-shelf (COTS) technologies can be integrated to fuse and display information into a real-time, tactical, coalition enabled command and control (C^2) center. All of which can be done at relatively low-cost and with very little burden placed on the logistics system.

COASTS will be introduced and each of the major elements of COASTS will be discussed, such as unmanned aerial vehicles (UAVs), lighter-than-air (LTA) platforms, various sensing elements, the wireless meshed networks (802.11b and 802.16 systems), and some of the tactical devices such as tacticomps and language translation devices to name a few.

Chapter V, "Conclusion," summarizes the research, highlighting the reasons COASTS should be considered as a possible solution to reducing the violence in southern Thailand.

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II. SECURITY SITUATION IN SOUTHERN THAILAND

Thailand's southern region has once again erupted in violence after two decades of relative tranquility. Not since the late 1970s has the Royal Thai Government (RTG) had to contend with the issue of separatism as currently being experienced. The complexion of the attacks, the tactics, and the manner in which the operations have been conducted are significantly different than previously witnessed.[11] In one year, from January through December 2004, more than 600 Thais were victimized by acts of violence and terror in southern Thailand, all occurring in the three southernmost provinces of Pattani, Yala, and Naratiwat.[12]

This chapter analyzes the current security situation in southern Thailand. Doing so, it is prudent to examine how Islam overcame the Hindu-Buddhist region of insular Southeast Asia, and parts of continental Southeast Asia, specifically the Malay Peninsula. The following sections describe the history of southern Thailand, focusing on four elements: the resurgence of Patani Raya or the Greater Patani State,[13] Patani's conversion to Islam, the role Patani played in ancient times, and the claims to southern Thai separatism by the Malay-Muslims. Lastly, this thesis analyzes the resurgence of recent southern Thai violence, and the possible associated actors.

A. HISTORICAL PERSPECTIVE: SOUTHEAST ASIA AND SOUTHERN THAILAND

The region of Southeast Asia is at the crossroads for culture and religion within the core. Every major religion is represented in Southeast Asia, from Roman Catholicism, which is the predominant religion in the Philippines, to Theravada Buddhism in continental Southeast Asia, to Hinduism on Java. However, Islam is the major religion in insular Southeast Asia, with small Muslim minority groups located in

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11 Anthony Davis, "Thai Militants Adopt New Bombing Tactics," *Jane's Intelligence Review*, http://www4.janes.com/ (accessed on 4 Feb 2005), 1.

12 Anthony Davis, "No End in Sight for Southern Thailand's Escalading Insurgency," *Jane's Intelligence Review*, http://www4janes.com (accessed 29 Mar 2005), 2.

13 The English rendering of the name "Patani" is based on Malay spelling, while the Thai government usage of "Pattani" is based on Thai spelling, *op cit.,* Thanet Aphornsuvan, "Origins of Malay Muslim "Separatism" in Southern Thailand," Asia Research Institute Working Paper Series No. 32 (October 2004), 1.

continental Southeast Asia. Insular Southeast Asia is home to the world's largest Muslim country, Indonesia, where approximately 200 million Muslims reside. In fact, of the approximate 1.2 billion Muslims in the world, nearly 20% reside in Southeast Asia.[14]

Table 1. Muslim Population Numbers in Southeast Asia[15]

Country	*Total population*	*% of Muslims in country*	*Muslim population*	*% of total SEAn Islamic community*
Indonesia	212,195,000	87.0	184,609,605	89.50
Malaysia	22,229,040	55.0	12,225,927	5.93
Philippines	82,841,518	4.6	4,142,076	2.00
Thailand	61,797,751	3.8	2,348,315	1.14
Burma	41,994,678	3.8	1,679,787	0.81
Singapore	4,300,419	14.0	602,059	0.29
Vietnam	79,939,014	0.7	531,000	0.25
Cambodia	12,491,501	2.4	299,796	0.14
Brunei	343,653	67.0	230,248	0.10
Laos	5,635,967	1.0	57,000	0.10
Southeast Asia	468,011,411		206,725,858	

Islam was brought to the region by Arab merchants traveling to and from China, as far back as the seventh century. As the Indians did before them, Arab merchants used the ports of Malaya (Malacca) and Northern Sumatra (Aceh) as ports-of-call or stopping points along their journeys to China, Canton to be specific. One of the earliest Islamic relics in insular Southeast Asia is the headstone of a Javanese woman dated 1082 AD.[16] However, some experts dispute this reference. What is not disputed is the spread of the religion from about the end of the thirteenth century to about the seventeenth century. Islam was introduced to the region only after it had taken hold in India around the late 1200s.[17]

The conquest of Malacca (and Java to some degree) was one impetus for religious change in Southeast Asia from their animist, Hindu, and Buddhist traditions to Islam that spurred the spread of Islam in Southeast Asia. From ancient times until today, the straight of Malacca has been a strategic location and prime real estate for any merchant

14 Suzaina Kadir, "Mapping Muslim Politics in Southeast Asia after September 11," *The Pacific Review*, Vol. 17 No. 2 (2004), 203.

15 Ibid.

16 Barbara Watson Andaya, Nicholas Tarling, ed., *The Cambridge History of Southeast Asia* (Cambridge, UK: Cambridge Press 1999), Volume 2, Chapter 4, 169.

17 D.R. SarDesai, *Southeast Asia, Past & Present* (Boulder: Westview Press, 2003), 58.

ship passing into or out of East Asia. Malacca's straight is narrow and provides protection and shelter during the annual monsoons. Therefore Malacca's conversion to Islam made trade among the merchants of the time much easier. Once Malacca converted and its relationship with neighboring Sumatra improved, the flood gate opened for Islamic conversion throughout the archipelago.[18]

The other impetus for change came with the conversion of the ruling elites within the region. Robert Hefner states, "conversion was not conquest or religious warfare, but trade and interethnic intercourse."[19] Therefore, the conversion to Islam was not forced upon the indigenous peoples of Southeast Asia, but was made through conscious choice mainly for survival and to facilitate trade.

Figure 1. The Spread of Islam in SEA from the 13th to 18th Centuries[20]

B. HISTORY OF SOUTHERN THAILAND

1. The Emergence of Patani Raya

The conversion of Patani to Islam began in Aceh. Due to its location, on the northwest corner of the island of Sumatra, Aceh was the first to come in contact with the west. It developed into the region's center for culture and religion. In terms of religion,

18 D.R. SarDesai, 61.

19 Robert Hefner, *Islam in an Era of Nation-States*, (Honolulu: University of Hawaii Press, 1997), 8.

20 University of Calgary, http://www.ucalgary.ca/applied_history/tutor/imageislam/Seasia.gif (accessed 4 August 2005).

as with most areas in the archipelago, prior to Islam arriving, the religion was a mixture of animism, Hinduism, and Buddhism.[21]

Prior to the land that was once known as Patani Raya, or Pattani today, there was an ancient kingdom called Langkasuka.[22] From about the eight century AD, the coastal areas of Langkasuka became very important commercial ports. Because of Langasuka's location, situated at the isthmus, with access to two coasts, it was suitable for ships to dock on its eastern shores, along the Gulf of Thailand, unload goods, and transport these goods overland to the western coast, where other merchant ships would be waiting for the cargo. The cargo could then be safely taken to ports in India and the Middle East. Thus, merchants could save time and money and could avoid the risk of losing cargo to raiders when passing around the Malay Peninsula.

The dissolution of the Majapahit kingdom around the late 1400s allowed religious prostilization to occur, especially from neighboring Pasai Sumatra. Therefore, Patani Raya emerged around this time. The exact date of when Patani Raya was formed is still debated. However, some Thai scholars believe the Greater Patani Region was formed 15 June 1457, when Langkasuka, under the leadership of Tu Antara, officially announced its conversion to Islam.[23] Upon converting to Islam, Tu Antara assumed a Malay name, Sultan Ismail Shah, to show his conviction to Islam.[24] This conversion to Islam, granted Patani certain trading rights with Muslim merchants who controlled the western trade at the time.

The Greater Patani State was one of the first Malay states to convert to Islam, certainly well before Malacca. Patani was known as *the* center for culture and religion in

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21 Anthony Shih, "The Roots and Societal Impact of Islam in Southeast Asia," *Stanford Journal of East Asian Affairs*, Spring 2002, Volume 2, 114.

22 The exact location of Langkasuka is of historical debate. Old Chinese texts describe Langkasuka as a kingdom that existed in the second century AD on the east coast of the Malay Peninsula, south of Songkla (Thailand) up to the Patani River, *op cit*., Rattiya Sale, "Patani Darul-Islam (Malay-Islam Patani) Encountering the Making of Pattani, Yala, and Naratiwat," *The Pattani State in Srivijaya*, translated by Albert Valentine (Bangkok: Matichon Printing, 2004), 241.

23 General Kitti Rattanachaya, *Southern Flames, The Start of the Patani State*, translated by Albert Valentine (Nonthaburi, Thailand: Pichit Publishing, 2004), 21.

24 Legend states that Tu Antara converted to Islam after he was cured of leprosy, *op cit.*, Ibrahim Syukri, *History of the Malay Kingdom of Patani*, trans. Conner Baily and John N. Miksic (Ohio University Center for International Studies, 1990), 22.

the region. Some Thai scholars, such as W.K. Che Man, have stated, "Patani has been held to be one of the cradles of Islam in Southeast Asia."[25] Patani Raya has even been called the Veranda or Window to Mecca.

Patani's history can be divided into several periods or eras:

1. The Golden Era (1457-1776)
2. The Era of Change (1776-1816)
3. The Era of Ruin (1816-1901)
4. The Era of Dissolution (1901-1991.)[26]

No one can dispute what Patani grew to be in terms of development. During the Golden Era period, there were 16 sultans and governors and 17 other rulers or lords.[27] Patani led the region in various ways, becoming *the* center or institute for Islamic studies. Patani was also known for its mosques, madari (*pondoks* or Islamic schools), and the Islamic court. Patani was a center for Arabic studies as well. Additionally, Patani was known for its crafting of military weapons, such as swords, bows and arrows, the Kris (the Malay dagger) and the production of artillery (cannons).

Unfortunately, the end of the Golden Era came in 1776 when Sultan Muhammad united the "nation" after a 47 year civil war.[28] In 1786, Patani fell to Siamese rule, fought for its freedom from Siamese rule several times after this, in 1789 and again in 1791, with little success.

In 1816, under Rama II, Patani entered into the Era of Ruin or what some call the period of the "Seven Districts." Siam adopted a divide-and-conquer strategy to control Patani more effectively. The Patani Kingdom was divided into seven areas or provinces: Patani, Nongjik, Raman, Ra-ngae, Saiburi, Yala, and Yaring.[29] Siam controlled the

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25 W.K. Che Man, *Muslim Separatism* (New York: Oxford University Press, 1990), 32.

26 Rattanachaya, 22, *op cit.*, Patani was in civil war from 1729 to 1776, see Sale, Pattani State in Srivijaya, 248.

27 Ibid.

28 Sale, The Pattani State in Srivijaya, 248.

29 Rattanachaya, 24.

region by sending central government officials, who were Buddhist, to administer the southern Muslim-Malay areas. Additionally, there was a campaign to relocate Buddhists to the area to balance the population, therefore counterpoising the power.[30] From 1831 to 1832, the south erupted in war; the central government deployed some 300,000 Siamese troops to the region and defeated the Malay-Muslims.[31] In 1839, another revolt ensued and the result was the same, the Malay-Muslims were defeated.

Externally, from about 1816 to the end of the century, vast changes occurred in Southeast Asia. Battles between two of the world's most dominant imperialists (England and France) took place. England had control over most lands from India to Burma, including the Malay Peninsula. France had Indochina (Vietnam, Laos, Cambodia). This left Siam as a buffer state sandwiched between two hegemonic powers. This was a crucial development that contributed to the demise of the Patani Kingdom. The turn of the century was a watershed time for the region. By 1909, the Patani Kingdom would be dissolved forever.

In 1901, the region's administration was renamed once again by Rama V, from the "Seven Districts" to the "Area of the Seven Provinces."[32] Patani's old system of allowing the local governors certain freedoms was dashed. Malay-Muslims had to recognize the Siamese king as the leader of the area, and they had to obey the laws established by the central government. This lead to the permanent dissolution of self-governance in the south.

Even more changes in the administration of the area occurred in 1906. The area was now called "Metropolitan Patani" (*Monthon* in Thai) after Rama VI's redesignation. This change saw the seven areas meld into four: Patani, Yala, Saiburi, and Satun.

By 1909, the entire southern region would eventually fall under total control of the central Siamese kingdom. In March 1909, Siam and England signed the Anglo-Siamese Treaty, which in effect legitimized Siamese control over the once great

30 Sale, The Pattani State in Srivijaya, 250.

31 Ibid., 251.

32 Rattanachaya, 25.

Kingdom of Patani.[33] After pleading with British administrators to allow their lands to fall under British rule, local leaders regrettably recognized Siamese sovereignty over the area. Therefore, Siamese rule over what was once the Greater Patani Kingdom or Patani Raya, had officially begun.

The 1800s, through the turn of the century, was a turbulent time for the Malay-Muslims of southern Thailand. It was also during this period their identity was formed. After a century of conflict, marginalization by the central government (the divide-and-conquer strategy and using central Buddhist officials to administer the south), and by campaigns to balance the region, the Malay-Muslims' identity was molded. This identity is one of distrust and dislike for the central Buddhist government, an identity that lasts until today. Additionally, an ethno-religious nexus[34] between the Thais and the Malays formed due to their reluctance to assimilate into the central Siamese state. This identity was shaped and manipulated by the Siamese further in subsequent years and is still a point of contention today.

2. Claims to Muslim Separatism in the South

The roots of southern separatism began during the various rebellions and uprisings after Patani fell to Siam in 1786. Rebellions occurred in 1789, 1791, 1831 to 1832, and again in 1839. However, the formal succession of Patani into Siam in 1909 began the "Siamization" of Patani, which would usher in modern-day separatism in Thailand.

During the turbulent times of 1901 to 1909, the Patani region saw its first serious separatist movement emerge. *Rajas* Tengku Abdul Kadir Nilebai of Saiburi, Tuan Tengah Shamsuddin of Ra-ngae, and Tengku Abdul Kadir Qamaruddin of Patani were at the forefront of the resistance movements. They protested against various administrative and governmental regulations and changes levied against Patani. They refused to concede their power as governors or *chaomuang* and resented the fact that Muslims had to follow Buddhist centric Bangkok. They also opposed changes to the Islamic courts.

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33 Andrew Cornish, *Who's Place Is This?* (Bangkok: White Lotus Press, 1997), 3.

34 Joseph Chinyong Liow, "The Security Situation in Southern Thailand," *Studies in Conflict & Terrorism* 27 (2004), 534.

The Siamese government, in order to squelch the rebellion from the various religious leaders and *rajas*, deposed and arrested several prominent southern leaders. In 1901, Tuan Tengah Shamsuddin of Ra-ngae was exiled to Songkla, only to be released after pledging to refrain from politics.[35] In 1903, Tengku Abdul Kadir Qamaruddin of Patani was arrested and sent to Pitsanulok, where he spent 33 months in prison.[36] Upon his release from prison, he pledged not to engage in resistance movements, but later reneged on his pledge.

After 1901, during the "Siamization" of Patani, southern Thailand changed drastically, and threats against the south intensified. The ever-increasing threat against the south by Bangkok was met just as equally by the inhabitants of southern Thailand. During this period, in Patani and southern Thailand the tradition of *chaomuang* or governors disappeared. The *raja* also disappeared, along with the linage rights that accompanied the *chaomuang* and *raja* systems. This period also ushered in the abolition of Islamic laws, along with the threat and abolition of Malay customs and traditions.

a. Assimilation and the Various Policies

Over time, Bangkok exerted more and more pressure, in the form of laws and policy, to gain a stronger grasp over the southern region. Some examples of what the southern Malay-Muslims considered to be the first official attempts at forced assimilation came with the Compulsory Primary Education Act of 1921 and in 1939 with the Thai Customs Decree.

The passing of King Chulalongkorn (Rama V) in 1910, and the coronation of King Vajiravudh (Rama VI) in December 1911, Bangkok imposed more changes on the ever-changing Siam.37 Rama VI instituted educational reform under the 1921 Compulsory Primary Education Act because of his scholastic abilities, his great love of education and literature, and the length of time he spent in England as a student. This act introduced limited seven-year compulsory education in the country.[38] Therefore, all

35 Che Man, 63.

36 Ibid.

37 Stephen Greene, *Absolute Dreams*, (Bangkok: White Lotus Press, 1999), 36.

38 Ibid., 144.

Malay-Muslim children were required to attend Thai primary schools. From the central Thai government's perspective, this was one way of introducing and promoting the Thai language throughout the country, to include the south. This mandatory education was also another way of conducting nation building through a common language. However, from the Malay-Muslim lens, the policy was just another way of eliminating the teachings of Islam.

By this time, Siam had officially changed its name to Thailand (Land of the Free), under the leadership of the dictator and ultra-nationalist, Field Marshall Pibun Songkram. The next major edict was the passage of the Thai Customs Decree in 1939. However, the south assumed Bangkok was only trying to control them. The Thai Customs Decree was a policy that changed cultural practices and customs of various minority groups and reshaped the social habits of the entire population.39 Specifically the Malay-Muslims of southern Thailand were now forbidden to dress in Malay fashion, use the Malay language, and follow various Islamic customs and traditions. Additionally, some were even required, forced, to worship Buddhist images.40

Outside of these two acts, there would be two other major attempts at controlling the south that would augment the distrust and intensify the fight for separation. Both occurred in the 1960s under the leadership of the Thai Premiere, Field Marshall Sarit Tanarat. In 1961, GEN Sarit reformed pondok schools and instituted a southern settlement project.

Field Marshall Sarit along with other Thai bureaucrats thought Pondok schools were a hindrance to the central assimilation policy; therefore, reform had to take place. Pondok schools teach in Malay and Arabic, emphasize religious education, and have no system of assessment. Hence these schools are not accredited by the government.41 Because the school's curricula taught only Islamic subjects, which also perpetuated the Islamic and Malay customs, the schools were deemed a threat to the

39 Che Man, 65.

40 Rattanachaya, 26.

41 *Asia Times* Web Page, http://www.atimes.com/atimes/Southeast_Asia/FI03Ae04.html (accessed April 29, 2005).

central government and reform was necessary. The Thai government forcibly changed pondok schools to match the instruction in Thai primary schools. Prior to the reform in 1961, there were 535 pondok schools in the region. By 1991, after 30 years, only 189 pondok schools remained.[42]

Field Marshall Sarit also instituted his settlement project. The program emphasized balancing the number of Thai-Buddhists against the number of Malay-Muslims in the four southernmost provinces. Thai-Buddhists from all over the kingdom were encouraged to move to the south into communes provided by the central government. People who made the move were guaranteed seven to ten acres of land.[43] The project was successful in increasing the number of Thai-Buddhists, but it failed to balance the region.

When Field Marshall Sarit died in 1963, he was succeeded by Field Marshall Thanom Kittikhachon. During the rule of Prime Minister Thanom Kittikhachon, the aforementioned polices remained in use and no major changes transpired. The Malay-Muslims were treated as second-class citizens; they were exploited, social ills and injustices were common; and more importantly, killings and punishment persisted without legal repercussions.[44]

b. Emergence of Organized Groups

Throughout the decades and the many generations since Thailand assumed control of the southern area from the Malay-Muslims, southern Thais have been "fighting" for their independence from Bangkok. The roots of the modern southern Thai separatist movement date back to the reign of Field Marshall Pibun in the 1930's. Some reports state that by the 1960s, approximately 60 or so separatist groups existed, all dedicated to the Muslim-Malay movement.[45]

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42 Rattanachaya, 27.

43 Ibid.

44 Chidchanok Rahimmula, "Peace Resolution : A Case Study of Separatist and Terrorist Movement in Southern Border Provinces of Thailand," *Songklanakarin Journal of Social Sciences & Humanities*, Vol. 10, No. 1 (Jan - Apr 2004), 105. http://www.geocities.com/bluesing2001/media/peaceresolution.htm

45 International Crisis Group (ICG) Report. "Southern Thailand: Insurgency, Not Jihad," ICG Asia Report N˚98, May, 18, 2005-6.

The first "organized" group dedicated to the southern situation was GAMPAR (*Gabungan Melayu Patani Raya* or the League of Malays of Greater Patani). GAMPAR was an outgrowth of frustrated attempts by Patani nationalists in Kelantan to declare the independence of the state of Patani immediately after the Second World War.[46] Established in 1947, GAMPAR's objective was to found an autonomous Patani state. The group's leadership was dominated by religious leaders, and this was vastly different than prior resistance movements, which were spearheaded primarily by the southern aristocracy. GAMPAR had a five point agenda:

1. To bring together all Thai, Malay-Muslims for one cause;
2. To build a relationship among Thai-Malays by which they could grow stronger and increase their living standards;
3. To build a self-support network for their cause;
4. To increase the living standards of the people who sought refuge in the deep-south;
5. To develop Malay culture in the southern border provinces.[47]

If there was ever a time in modern Thai history when Patani could have escaped from the control of the central Thai government in Bangkok, it could have come during GAMPAR's establishment in the late 1940s. Along with the Patani People's Movement, which also started in the late 1940s, the security situation in southern Thailand took a turn for the worst. Violence between the southerners and the Thai police started to escalate. In September of 1947, police units burned a village in Naratiwat, displacing 40 families. Several prominent religious leaders were implicated by the police, were arrested, and charged with treason. This outraged the population so much

46 Liow, 536.

47 Colin Anwar and Supaluk Kanchanakhundee, *The Southern Fire, Who Started It?* Translated by Albert Valentine (Bangkok: Indochina Publishing, 2004), 59.

that one month later, the southerners retaliated and violence ensued in the south resulting in eight Patani policemen being killed.[48]

The situation in Patani and in other parts of the south continued to worsen. On 26 April 1948, villagers from Dusongyaw, Naratiwat, rose up against the perceived persecution of Muslims by government officials. The protests became violent and a 36-hour clash ensued between armed villagers and security forces. Reports of bomber aircraft and warships being sent to the region by the central Thai government started to circulate.[49] The rebellion was crushed on 28 April 1948 (an important date that haunts the Thai government, and one that is discussed later in this thesis). The government of Field Marshal Pibun claimed that between 30 and 100 Muslim villagers were killed on that day. However, other sources state that somewhere between 400 to 600 villagers were killed in the crackdown.[50]

Understanding their plight would not garner the attention it needed in Bangkok, the Malay-Muslims sought help from the international community. Close to 250,000 Patani Muslims petitioned the United Nations to allow Patani and the other Malay-Muslim areas to secede from Thai control and to fall under the newly formed nation of Malaya. Their pleas were not met favorably. In January 1949, a treaty was signed between Thailand and England (Anglo-Thai Agreement) for joint control of the Thai-Malay border region. With this treaty and the condemnation of GAMPAR by the British, the time for Patani to secede had passed.

Communist Insurgency

Following World War II and the Korean War, came the emergence of the Cold War and the threat of communism. It was the policy of the US to contain its spread. Southeast Asia was at the front lines of this new battle and Thailand found itself, once again, directly in the middle. The threat of communism affected Thailand on all its

48 Che Man, 67.

49 Syukri, 92.

50 Ibid. and Counter Currents Web Site, http://www.countercurrents.org/hr-achr060504.htm, (accessed 12 March 2005).

borders, including the south. Indigenous communist parties arose in both Thailand (Communist Party of Thailand, CPT) and in Malaysia (Malaysian Communist Party, MCP).

Toward the end of the 1950s and into the 1960s, Thailand's separatist problem increased. In fact, Malay-Muslim separatism in Thailand reached somewhat of a peak in the late 1960s. Some experts attribute this spike to increased Thai military activity in the region (attributed to the fight against the communists) and in part to the economic recession engineered by the decline in world rubber prices.[51] Regarding communism and separatism, what concerned the RTG the most was the linkage of the two movements. In fact, that threat came in 1963 when the guerillas of the Malayan Peoples Liberation Army, the military wing of the MCP, began to seek recruits from the Thai Malay population.[52] The linkage between the two movements never really materialized. The attributed reason was the suspicion of "outsiders" by the Muslims in the south.[53]

Policies developed by the prime minister of the time, Thanom Kittikachorn, were effective in temporarily reducing separatist activities. He instituted policies to develop the economy and to extend basic utilities, such as access to electricity and water. This forced the separatists to find other means to finance themselves and their activities and thus they resorted to extortion and kidnapping. The response by the RTG was to rid the nation of these groups.

By 1970, the RTG either killed or jailed most of the southern separatist movement leadership. This in turn, once again, escalated the violence between the separatists and the central government throughout the 1970s. One incident that incensed the Muslim community occurred in 1975 when a bomb was thrown into a crowd of 40,000 protesters in Pattani, killing 11 and injuring 44.[54] On that day, southerners were protesting the killing of five Muslim villagers by government troops when the bomb was

51 Andrew Forbes, "Thailand's Muslim Minorities, Assimilation, Secession, or Coexistence?" *Asian Survey*, Vol 22, No. 11. (Nov 1982), 1061.

52 Ibid.

53 Astri Suhkre, "Irredentism Contained," *Comparative Politics*, Vol 7, No. 2, (1975), 199.

54 Forbes, 1062.

thrown into the crowd. Reportedly, the perpetrators were right-wing Buddhist sympathizers. This led to more reprisals by the separatists. Two bombs were detonated at Don Muang airport, but no one was injured. However, it was the attempted assassination of the King and Queen on 27 September 1977 that really signaled how serious and how dangerous the southern situation had become. On that day, five spectators were killed and 47 others injured, but the King and Queen were not harmed.[55]

From the 1980s to the 1990s, under the leadership of Prime Ministers GEN Prem Tinsulanonda and Chatichai Choonvahan, a conciliatory posture was taken toward the south. This brought some semblance of peace to the region. In particular, it was GEN Prem's leadership that caused the violent death spiral southern Thailand was on to subside; in political science terms, there was a decrease in the security dilemma between the RTG and the separatists under GEN Prem's leadership.

While still dealing with the communist insurgency within Thailand, GEN Prem instituted Order Number 66/23 ("The Policy to Win Over the Communists") and Order Number 65/25 ("Plan for the Political Offensive").[56] Order Number 66/23 was primarily used to establish the political offensive against the CPT and Order 65/25 was more for implementation. GEN Prem also established the 43rd Civil-Police-Military Joint Headquarters (CPM 43) and the Southern Border Provincial Administration Center (SBPAC). These two organizations were established in Yala province to solve problems relating to *both* the communist and separatist movements in the southern border provinces. The CPM43 was assigned to suppress and to subdue all terrorist movements. The SBPAC was designed to supervise and oversee all problems that either had a political tone or a psychological-social aspect.

GEN Prem's policies had an immediate effect. By the mid-1980s, the CPT was basically defeated. Reports of CPT activity started to disappear by the early 1990s. The exact fate of the party is really not known. Terrorist attacks or separatist violence against the state during the same period significantly decreased as well. Liow lists three developments that reduced southern violence in the 1980s and early 1990s: It

55 Moshe Yegar, *Between Integration and Secession*, (Lanham: Lexington Books, 2002), 151.

56 Rahimmula, 108.

was the establishment of the Southern Border Provincial Administration Center (SBPAC), the attempts to develop the region economically and industrially, and the democratization of Thai politics in the 1980s that afforded a voice to the Malay-Muslim community in government.[57]

Throughout the 1990s, southern separatism was not an issue for the RTG. Attacks were sporadic and not that eventful. Therefore, a decision was made by PM Thaksin Shinawatra in May 2002 to disband both of the organizations that were responsible for keeping the peace in the south, CPM43 and SBPAC.[58] Subsequently, he handed over authority to the Royal Thai police, giving them the upper-hand in managing the south, creating an even deeper chasm between the RTA and the police. The reasons for dissolving these organizations remain unknown.

One possibility for giving the Royal Thai Police the lead role in managing the southern situation could be Prime Minister Thaksin's affinity for the police force. As a former police officer himself, he still maintains an extensive network of contacts within the force. This close relationship with the police and the repeated feedback that the situation in the south was "quiet," could have caused Prime Minster Thaksin to be lulled into a false sense of peace by the Royal Thai police. The other possibility is his cooptation of the military apparatus has led to the creation of military "yes men." In an interview with *Konkarnmuang* magazine, August 2002, GEN Kitti talks about this cooptation of the military, he is quoted as saying, "commanders of each of the military departments wait for orders from the politicians. There are no recommendations given to the government. This will negatively affect the state."[59]

Since becoming PM in 2001, PM Thaksin has affected the Thai polity in many ways. One such way is the "repoliticizing"[60] of the military, returning them to the political sphere. Seemingly, this had a debilitating effect on them professionally. Not

57 Liow, 535.

58 Desmond Ball, *The Boys in Black*, (Bangkok: White Lotus Press, 2004), 109.

59 GEN Kitti Rattanachaya, "Former 4th Area Commander Points to Solutions for the South." *Konkarnmuang*, translated by Albert Valentine, August 2002, 16.

60 Duncan McCargo and Ukrist Pathmanand, *The Thaksinization of Thailand*, (Copenhagen: NIAS Press, 2005), 134.

allowing professional officers to speak their minds for fear of reprisal (such as being passed over for promotion or being removed prematurely from post) obviously corrodes loyalty and effectiveness of the corps.

C. RECENT RESURGENCE OF VIOLENCE IN SOUTHERN THAILAND

1. Trends

As mentioned in the introduction, southern Thailand has erupted in flames once again. The violence occurring in recent years can be traced to their beginnings in 2001. By 1999, many pundits stated the security situation, the separatist operations in Southern Thailand, was finally over. After years of silence, generally no major incidents of violence had occurred in a decade or so in southern Thailand. However, the silence was broken in April 2001 when bombs erupted at the Hat Yai train station in Songkhla province and in a separate attack, a bomb exploded at a hotel in Yala province. Throughout 2001, sporadic violence continued to percolate. However, by December 2001, the southern insurgents seemed bolder and brasher. As in the past, the militants had begun to strike directly against Royal Thai forces, specifically Royal Thai Police forces. On 24 December 2001, five well coordinated attacks took place in the three troubled border provinces, Patani, Yala, and Naratiwat. The attacks were nearly simultaneous, and displayed much greater sophistication than previous raids.[61]

By July 2002, "19 policemen were killed and seven seriously injured while the casualties of other non-police officers and workers were three deaths and three injuries. The weapons seized by the gangsters include 54 rifles, shotguns and pistols, with approximately 4,000 rounds of ammunition and two two-way radios."[62]

Throughout 2002 and 2003, random acts of violence occurred. Schools were targeted and burned. In August 2003 alone, 34 schools were set ablaze.[63] Additionally throughout the year, more police were shot and killed. However, the most violent period, since the resurgence of violence in the south, was in the one-year period from January through December 2004; more than 600 Thais, civilians, military, religious leaders, and

61 ICG, 16.

62 Virtual Information Center, "Primer: Muslim Separatism in Southern Thailand," (Honolulu: USPACOM, 2002), 21.

63 Liow, 542.

separatists alike were victimized by acts of violence and terror in southern Thailand. All the acts of violence occurred in the three southernmost provinces of Pattani, Yala, and Naratiwat. Tracking statistics, from 1993 to 2003, there were 722[64] insurgency related incidents (rising from 50 in 2001 to 75 in 2002, and 119 in 2003[65]). In 2004 alone, from January to November, there were 1,253 violent incidents in the south.[66] The reason for the drastic increase in 2004 follows.

During the early morning hours of January 4, 2004, southern Thailand was once again under siege. At about 0100 hours, simultaneous attacks occurred throughout the southern provinces of Naratiwat, Yala, and Pattani. When sunrise finally came, it was evident what happened-over 20 schools were torched, several police posts fire-bombed, and more importantly, over 400 small arms, mostly M-16 automatic rifles, were stolen from a Royal Thai Army (RTA) depot in Naratiwat at the Rajanakarin Army camp in the Joh Airong district.

Estimates are that 100 to 150 insurgents overran the RTA depot in a remarkable display of operational sophistication. A coordinated event such as this had never taken place before in the south. The unknown group used diversionary tactics, such as false bombs and setting tires on fire in alternate locations, to mask the heist at the RTA armory. Since the heist, no one has been captured or indicted in connection with the January incident. Additionally, the weapons have yet to be recovered.

Only four months later, on 28 April 2004, the next major event took place. In a single day, Thailand lost over 100 citizens in probably the second bloodiest day in modern Thai history. On that day, 107 insurgents were killed, 17 arrested, and 5 Thai security officials died.

As in January, insurgents, many of them apparently suicidal teens, launched simultaneous pre-dawn raids on 10 police outposts and a police station in a military-style operation. Wielding machetes, and some carrying guns, the insurgents attacked police

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64 Supara Janchitfah, "A Reporter's Memoir: The Unseen South," *Sarakadee Magazine*, translated by Albert Valentine, February 2005, 61.

65 ICG, 16.

66 Janchitfah, 61.

posts in the three provinces of Pattani, Yala, and Naratiwat. During the attacks, there were reports the insurgents were overheard yelling, "We are ready to die for God!" as they stormed outposts.[67] Not knowing how to respond to the attacks, Thai security forces defended themselves by returning fire on the attackers. After the incident, reports surfaced that excessive use of force was used by Thai police and RTA personnel

During that day's events, the most disturbing incident took place at one of the south's most sacred mosques, the Krue Se Mosque. Thai security forces were faced with a severe dilemma. Within the mosque, were 32 insurgents armed with rifles and other weapons poised to secure their position. In a miscalculated decision by the deputy commander of the Internal Security Operation Command, General Pallop Pinmanee, gave the order to attack the mosque. In doing so, all 32 insurgents were killed on site. He was later quoted as saying, "I was afraid that as the crowd got bigger, the situation would pose an even greater security risk. I had no choice. I was afraid that as time passed the crowd would be sympathetic to the insurgents, to the point of trying to rescue them."[68] In a stroke of bad irony, it was on this day, some 56 years earlier, in 1948, this same mosque had witnessed violence that exceeded the violence in 2004.

The last major event in 2004 was the Tak Bai incident in October 2004, when 85 Thai protesters were killed by the Thai government, 78 dying of suffocation during transportation to a military detention center. On that day, approximately 3,000 or so local citizens of the Tak Bai district, in Naratiwat province, were protesting the arrest of a several locals who where detained by the RTA on suspicion of providing state-issued weapons to local Islamic militants.[69] After the crowd became rowdy and aggressive, shots were fired. It is unknown who shot first, but Thai security officials returned fire, killing five of the protestors, thus escalating the situation.

Once the crowd had subsided, Thai officials apprehended approximately 1,300 protesters and prepared to transport them 130 kilometers to the 4th Army Region Forward Command in Pattani's Nong Chik district. While in custody, the protestors were

67 *Nation Newspaper* On-Line Edition, http://www.nationmultimedia.com/search/april.2004, (accessed 11 March 2005).

68 Ibid.

69 VIC Web Site, (accessed 8 March 2005).

bound and stuffed into awaiting military vehicles and taken to Nong Chik district. During transport, 78 of them suffocated.

By the end of 2004, approximately 600 Thais either directly related to or associated with violence in southern Thailand were killed. It would turn out to be one of the bloodiest years in modern Thai history. The most unfortunate part is there has yet to be any concrete leads as to who was behind the violence. Moreover, no signs exist that the violence is near the end of its life-cycle either.

2. The Actors

As previously discussed, GAMPAR was the first "organized" group dedicated toward the plight of the southern Malay-Muslims. However, the first truly organized *separatist* group to form was the Barisan National Pember-basan Patani (BNPP). The BNPP was formed in 1959. Their aim has been to establish an independent and sovereign Islamic state of Pattani through political, psychological, diplomatic, and military means.[70] The BNPP is the oldest Muslim separatist organization in Thailand. Recruitment was conducted primarily through religious teachers who have extensive connections outside Thailand in Malaysia and the Middle East, including Egypt, Saudi Arabia, and even Palestine.[71] By 1990, the name of the movement was changed to the BIPP (Barisan Islam Pember-Basan Pattani). The major reason for the name change came after the Iranian uprising in 1979. By adding the word "Islam," they stressed the point of "Islamization." BIPP is believed to have been involved in some attacks during the most recent violence in southern Thailand.

The next group to form was the BRN (Barisan Revolusi Nasional). They emerged on the separatist scene in Thailand in the early 1960s in response to the RTG's educational reform program, which made the traditional schools, *pondoks*, teach secular subjects. The BRN was more focused on political organization than guerilla tactics; however, this did not mean they were adverse to violence. The aim of BRN has been to

70 J.F. Isaacson & C. Rubenstein, *Islam in Asia: Changing Political Realities*, (New Brunswick, New Jersey: Transaction Publishers, 2002), 74.

71 ICG, 7.

create an independent republic of Patani out of the four majority Muslim provinces in southern Thailand (Patani, Yala, Naratiwat, and Satun).[72] The BRN are still in existence today.

The most well known group is the Pattani United Liberation Organization (PULO). PULO came into being in 1968 and has emerged as the largest and most well known separatist group in Thailand. Their ideology lies somewhere between BNPP and BRN. They believe in "Religion, Race/Nationalism, Homeland, and Humanitarianism" and have stated their goal was an independent state characterized more by ethno-nationalism, than Islamism.[73] As with the other groups, PULO is well connected regionally and overseas. In fact, most of PULO's senior leaders were based in Mecca, Saudi Arabia, and their military operations headquartered in Tumpat, Kelantan, Malaysia.

A newer player on the Thai separatist scene is Gerakan Mujahideen Islam Pattani (GMIP). They were formed in 1995 by a Thai national who fought in the Afghan War as a Mujahidin fighter. The founder, Nasoree Saesang, trained with Nik Adili Nik Aziz, son of PAS Chairman Nik Abdul Aziz Mat.[74] (More information about this relationship is discussed in Chapter III, "Thailand's Border Problem and The Malaysian Connection.") GMIP's goal is to also create an independent Patani, and it appears to be more closely linked to international Islamists than the other Thai separatists groups. In fact, reports state this group was behind the distribution of leaflets in Yala province in 2001, calling for a *jihad* and for support of Osama bin-Laden.[75]

Finally, there is Bersatu (the United Front for the Independence of Pattani). This is an umbrella organization, which was initially established in 1989,[76] went dormant for a

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72 Ibid. (ICG), 8.

73 Peter Chalk, "Islamic Factor in Southern Thailand, Mindanao, and Aceh," *Studies in Conflict & Terrorism*, 24 (2001) : 243.

74 Anthony Davis, "Southern Thai Insurgency Gains Fresh Momentum," *Jane's Defense Intelligence Review*, (August) 2004.

75 ICG, 8.

76 VIC.

while, but resurfaced in 1997. Bersatu loosely coordinates political issues and sets the ideology for four of Thailand's separatists groups: PULO, New PULO, GMIP and BRN.[77]

New PULO was established in 1995 as a dissident faction of PULO, whose goal is self-autonomy, but achieved through less dramatic albeit more consistent means.[78] From 1995 to 1998, New PULO conducted regular small-scale bombings, incendiary attacks, and shootings on a regular basis. A favorite target is schools, symbols of Thai oppression. It is reported that New PULO hires young drug addicts to conduct the majority of their attacks.[79] This makes tactical and strategic sense, since there is an abundant number of "available" youth in the south and if one of them is captured, it is highly unlikely he would possess any real knowledge of the group's operations. A quote from Peter Chalk about the linkage of PULO and New PULO: "The organizations did agree to form a tactical alliance in mid-1997 in an attempt to refocus national and regional attention on the southern question."[80]

No one, not the RTG, the USG, nor academia, knows who is behind the latest resurgence of violence in southern Thailand. However, by analyzing the methods, past history, and tactics of the attacks, and by looking at what targets were hit and their ideologies, as well as the means of delivering the violence, all indications apparently suggest that PULO, GMIP, and New PULO as being behind the recent upsurge of violence in the south.

D. CONCLUSION

History is a major factor behind the violence in southern Thailand. The Royal Thai government has been dealing with the situation in the south for nearly two centuries. W.K. Che Man has proposed a hypothesis for the causes of Muslim separatism in southern Thailand, which is supported by the aforementioned analysis. Che Man first states that the problem is derived from what is perceived as "internal colonization" by the

77 Rattanachaya, 69.

78 Chalk, 244.

79 Ibid.

80 Ibid.

Thai-Buddhists over the Malay-Muslims, or what some scholars have referred to as the "Siamization" of the south. Che Man notes that Siam's main concern in Patani was not religious conversion, but political domination.[81] He concludes that the problem is more a "conflict of cultures" that is inspired and legitimized in religious terms, therefore giving it more of a cultural hue, than an economic one.[82]

Disputing Che Man's conclusions is easy. However, what is not disputable is that the violence has returned and has returned with a vengeance. If using the data provided by Supara Janchitfah and the ICG report, violence in the southern has increased by about 1000% and that is in just one year, 2004. The actors who are suspected to be behind the violence (possible, PULO, GMIP, and New PULO) do not seem to be decreasing their activity. One aspect that seems to exacerbate the problems in the south is the linkage to regional players. Specifically, southern separatists being linked to Malaysia's radical, Islamic political party, *Parti Islam se-Malaysia* (PAS), which is based in Malaysia's northern province of Kelantan. This linkage is discussed in the next chapter, "The Malaysia Connection."

81 Che Man 44.

82 Ibid. 174-5.

III. THAILAND'S BORDER SECURITY CHALLENGE AND THE MALAYSIA CONNECTION

This chapter focuses on the physical and political relationship between Thailand and Malaysia and analyzes the border region between the two nations, particularly the porous nature of the Thai-Malay border. It then examines how dual citizenship aggravates the situation in southern Thailand. Lastly, it discusses the "Malaysian Connection," and the role of external players, in particular the *Parti Islam se-Malaysia* (PAS) in the southern Thailand problem.

This thesis argues that securing the Thai-Malay border is vital to reducing the violence in southern Thailand. Additionally, this thesis also contends that the Malaysian government is generating an "enabling effect" on the southern Thai separatism and the Malaysian government must be active participants in order to reduce the violence in the south.

A. THE POROUS THAI-MALAYSIAN BORDER & DUAL CITIZENSHIP

General Discussion on Transmigration in Southeast Asia

The free flow of people throughout Southeast Asia is not a new phenomenon. It is a common practice especially for migratory workers between Indonesia and Malaysia or the Philippines and Indonesia. Additionally, this movement of people occurs at border crossings throughout the region. For instance, merchants cross the border to buy and sell food products and materials daily. This practice generates a serious problem for the nations of Southeast Asia. It forces them to choose between national security and economic consideration.

Regarding national security, it behooves Southeast Asian countries to ensure that terrorists or criminals are not freely crossing their borders. Yet, economically, if these nations tried to limit the number of migratory workers, whether legal or illegal, the cost to secure their borders could severely strain their fiscal resources. Additionally, the economic strain would not simply come from the money spent regulating their borders, but possibly from lost foreign remittances as well. Therefore, ironically, sealing their borders is not in the best interest of Southeast Asian nations.

A report by the Human Rights Watch Group, titled, "Help Wanted: Abuses against Female Migrant Domestic Workers in Indonesia and Malaysia," estimates that around two million Indonesians may currently be working in Malaysia and that Indonesia receives up to U.S.$5.49 billion in remittances from migrant workers per year.[83] How many of these workers are there legally is difficult to verify, as more than half may be undocumented workers without valid work permits or visas. As for Thailand, in 1999 total foreign remittances accounted for approximately 56 billion Baht, which is equivalent to about $1.4B USD.[84] Also, during that same year, close to 18,000 Thais found migrant work in Malaysia.[85] Therefore the economic strain of sealing these borders could adversely affect the countries involved. This is especially true for countries that share a common border, in this case the Thai-Malay border.

As with most countries in the region, Thai authorities face the daunting challenge of controlling several thousand kilometers of difficult-to-monitor borders. Located at Thailand's west and northwest is Burma. In the 1980s, around 50% of Asia's opium was produced in Burma, along with approximately 70% of Asia's morphine and heroin production.[86] Burma is also a mass producer of methamphetamines that primarily caters to the large markets in Thailand.[87] Laos is to the north and northeast. Its border often facilitates easy access into and out of Thailand by smugglers, drug dealers, and other

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83 Human Rights Watch Report, "Help Wanted: Abuses against Female Migrant Domestic Workers in Indonesia and Malaysia," (July 2004 Vol. 16, No. 9 (B)), 11.

84 *Asian Migration Atlas Web* Site, http://www.scalabrini.asn.au/atlas/thailand.htm (accessed on 24 August 2005).

85 Migrant Thai workers in Malaysia by year: (1999-17,716), (2000-20,541), (2001-3,457), (2002-13,220.) There were no statistical data for the amount of remittances received from Thai workers in Malaysia op cit National Statistics Office, Royal Thai Government, Key Statistics of Thailand 2003 (Bangkok, Statistical Forecasting Bureau, 2003), 35.

86 Pierre-Arnaud Chouvy, Joel Meissonnier, Yaa Baa (Singapore: Singapore University Press 2004), 24.

87 The United Nations Drug Control Program estimated that in the year 2000, some 200,000 to 300,000 Bangkok workers spent a total of almost one billion baht per year on *yaa baa* (methamphetamines), see Chouvy and Meissonnier, 25.

criminals.[88] Finally, Cambodia runs along Thailand's lower northeast border and Malaysia occupies the southern border.

1. The Porous Thai-Malaysian Border

The possibility of suspected terrorist, guerilla, and/or criminal groups seamlessly moving across borders creates a security dilemma for Southeast Asian countries and is a challenge to WoT. Border security is a widespread problem throughout the region and at the Thai-Malay border. Border security is difficult for many reasons: limited defense and police budgets, lack of operational capability in border-defense techniques, and a lack of equipment and/or technologies, just to name a few.

The current situation in southern Thailand is exacerbated by the fact that the border between Thailand and Malaysia is somewhat of a no-man's land. In fact, Paul Smith calls the area around Thailand's Kolok River "a sieve" for Thailand.[89] Therefore, one of the crucial issues in alleviating the problem of cross-border operations by southern Thai militants is controlling the border between Thailand and Malaysia. (See Figure 1 for a map of the Kolok River region).

88 The most notorious suspected terrorists to enter Thailand to date is Riduan Isamuddin, aka Hambali, reported operations chief for the terrorist group Jemaah Islamiyah (JI) and the only man from Southeast Asia to sit on al-Qaeda's military committee. Hambali was captured on 11 August 2003 in Ayutthaya Thailand. He reportedly used a fake Spanish passport to enter Thailand from Laos before his capture, op. cit. Maria Ressa, Seeds of Terror, (NY: Free Press, 2003), 215.

89 Paul Smith, "Border Security and Transnational Violence in Southeast Asia," chapter in *Terrorism and Violence in Southeast Asia*. (NY: M.E. Sharpe, 2005), 217.

Figure 2. Kolok River Region[90]

Over the years, the RTG has repeatedly stated that southern insurgents use the border for various reasons, such as conducting operations, and the RTG has accused the Malaysian government of not fully cooperating.[91] In fact, the RTG has claimed on several occasions that the region just over the border is a training area for southern Thai militants, a claim the Malaysian government has vehemently denied on several occasions.[92]

The RTG reports that insurgents cross the Thai-Malaysian border into Thailand, commit acts of violence, such as a car bombing, the burning of a school, or something as brash as the January 2004 arsenal heist, and immediately return to Malaya unabated by Malaysian authorities. Besides the RTG's claims of harboring training sites in the "no-man's land" between Thailand and Malaysia, it has also accused the Malaysian

90 National Imagery and Mapping Agency, ARC Digitized Raster Graphics, series ARC1, Item ONCXXL10, Edition 001.

91 Amitav Acharya, *Constructing a Security Community in Southeast Asia*, (NY: Rutledge, 2001), 130.

92 *Nation Newspaper*, http://www.nationmultimedia.com/search/page.arcview.php?clid=3&id=110170&date=2004-12-19&usrsess= (accessed 19 December 2004).

government of allowing the militants to receive sanctuary and logistics support in Malaysia, specifically in the northern Malaysian states of Kelantan and Kedah.[93]

In June 1985, W.K. Che Man, while writing his doctorial dissertation, was taken on a seven-day visit of BNPP headquarters located just within the Malaysian border.[94] With the approval of BNPP leadership, he was allowed access to the inter-workings of the organization. During his visit, he documented a plethora of information that corroborates the RTG's claims that southern insurgents are actively operating within Malaysia.

Che Man observed the writing of pamphlets and propaganda in both Malay and Arabic. Also, the Chairman of BNPP and other leaders reportedly were engaged in conducting political orientation and military training.[95] Che Man attended a lecture given by BNPP's chairman to a group of approximately 15 recruits who were attending a two-week orientation course. Moreover, during the visit, he was told how BNPP's military arm had taken 12 other recruits out to a camp for a two-week guerilla training program.[96]

Compounding the situation further is external funding. Sources allege that funds transferred from at least two undisclosed Middle Eastern states have funneled to southern Thai militants or insurgents.[97] The payments were deposited into Malaysian bank accounts and then carried as cash into Thailand and disbursed.

2. Dual Citizenship

In his essay, "Dual Ethnic Minorities and the Local Reworking of Citizenship at the Thailand-Malaysian Border," Alexander Horstmann provides insight on dual citizenship and its affects on the people of southern Thailand, northern Malaysia and the Thai and Malaysian governments. He reports that from the states' perspective, holders of

93 *Matichon Newspaper*, translated by Albert Valentine, http://www.matichon.co.th/adm/wars/show.php?ndate=2004/12/18&news=1&cshow=01p0101181247 (accessed 11 July 2005).

94 Che Man, 109.

95 Ibid.

96 Ibid.

97 Anthony Davis report, *Jane's Defense*, "No End in Sight for Southern Thailand's Escalating Insurgency," http://www4.janes.com/subscribe/jir/doc_view.jsp?K2DocKey=/content1/janesdata/mags/jir/history/jir2005/jir01193.htm@current&Prod_Name=JIR&QueryText= (accessed 18 August 2005).

dual citizenship are seen as "trouble makers whose practices of participating in more than one national polity are violating the concept of sovereignty."[98] Horstmann also discusses the unfortunate peripheral entities and the constructed inferior races at the border when he says, "The Patani Malays, the Thai-speaking Muslims in Satun in Thailand and the Kelantan Thais in Malaysia can be conceptualized as trapped minorities, who are trapped on the national border between a host but hostile state [Thailand], which reluctantly offers them citizenship, and an absent, scattered mother nation [Malaysia] with little political and economic weight."[99]

This "trap" took place when the Anglo-Siamese Treaty was signed in the first decade of the 20th century.[100] Whether or not the practice of dual citizenship is just and should be kept in place is not contested and is beyond the scope of this thesis. This region was divided when imperialism was at its peak. Today the countries involved must deal with the lingering problems of colonization.

Horstmann highlights the major source of contention in the Thai-Malay case: the movement of people across the southern Thai border, which happens almost despite state(s) regulation.[101] Additionally he describes how the people of southern Thailand and northern Malaysia benefit from the compliance of the state, whose agents cooperate in border trade and in the barter of identity cards and work permits.[102] This substantiates Paul Smith's point about the border region as this "sieve" or no-man's land where people, money, and goods flow freely without the governments seriously considering the consequences of their actions.

Horstmann introduces an important point about dual citizenship: The states may see their diasporas as an extension of their cultural territory and hence ignore the practice

98 Alexander Horstmann, "Dual Ethnic Minorities and the Local Reworking of Citizenship at the Thailand-Malaysian Border," http://www.qub.ac.uk/cibr/WPpdffiles/CIBRwp2002_3_rev.pdf, (accessed 11 July 2005), 2.

99 Ibid, 3.

100 See Chapter II of this thesis for background information on the Anglo-Siamese Treaty of 1909.

101 Horstmann, 6.

102 Ibid.

of dual citizenship.[103] Both governments understand there is a border problem; however, they also understand dual citizenship is so controversial that neither government is ready to take on the fight that would ensue if they proposed a plan to abolish the practice. Horstmann concludes by saying, "The Malaysian government has a more ambiguous relationship to the Muslim Diaspora in Thailand." The reason for the Malaysian government's "ambiguity" is it understands it must stay neutral on the issue of minority rights in southern Thailand. This is an internal Thai problem that must be dealt with according to Thai law.

Without the proper mechanisms in place to control the flow of people and/or the materials that cross the Thai-Malay border, both governments will continue to be affected adversely. This unabated flow of people across the border provides the conditions for insurgents to across the border and it allows them to conduct the types of operations that were discussed in Chapter II.

Because the acts of violence are not occurring on Malaysian soil and according to the ASEAN norms of non-interference, [104] the Malaysian government cannot and should not become involved in rectifying what is an internal Thai problem. However, this does not exclude the Malaysian government from sealing its side of the border to assist the RTG when called upon.

Malaysia's perceived *lassie-fare* attitude toward the problem carries heavy implications for the RTG, especially when incidents occur along the border or within the provinces of Patani, Yala, or Naratiwat. If the central Malaysian government does not dedicate manpower, police, or military forces, or intelligence gathering to assist the RTG, the situation will worsen before it becomes better.

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103 Horstmann, 6.

104 The Treaty of Amity, signed in Bali, Indonesia in 1976 outlines five tenets that the ASEAN community should up-hold: 1) Mutual respect for independence, sovereignty, and territorial integrity, 2) The right of every state to lead its national existence free from external interference, 3) Non-interference in the internal affairs of one another, 4) Settlement of differences and disputes by peaceful means, 5) Renunciation of the threat of use of force, op cit, Amitav Acharya, Constructing a Security Community in Southeast Asia (NY: Routledge, 2001), 47.

The *Nation* newspaper summed it up perfectly when it reported:

> Today, an artificial border - a legacy of the colonial past but a very important entity of any sovereign state-divides them. But for Bt10, one can cross the Kolok River on a small boat instead of going through the time-consuming immigration checkpoint on the nearby bridge. In some locations, like Narathiwat's Waeng district, villagers walk back and forth, passing boundary markers as if they weren't there. And so when an incident occurs on either side of the border, it takes no rocket scientist to figure out where a state's jurisdiction ends and where the border of another country begins.105

B. THE MALAYSIAN CONNECTION

1. Thai-Malay Relations

Critical to the RTG's success in dampening the affects of cross-border operations is a close working relationship with the Malaysian government. This bilateral relationship must be strong in order for either side to put forth a serious and successful counter-insurgency operation. This next section analyzes the "Malaysian Connection," the current bilateral relationship between the Thai and Malaysian governments and the role PAS plays in southern Thailand.

Thai – Malaysian Bilateral Relations

Historically, Thai-Malaysian relations have been fairly amicable. In terms of fighting for a common cause, Thai-Malaysian relations were probably at their peak during the communist insurgency in the 1970s and 1980s. As briefly discussed in Chapter II, they understood in order to defeat communism, as they did, it was essential to have strong bilateral cooperation. This relationship allowed them to draft agreements that led to highly successful counter-insurgency operations.

One of the agreements was the decision to allow "hot pursuit" into each other's territory.[106] Another successful arrangement came on 4 March 1977 when they signed the Thai-Malaysia Border Agreement.[107] This agreement made possible unilateral

105 *Nation Newspaper* On-Line Edition, 2 Apr 2004, http://www.nationmultimedia.com/search/page.arcview.php?clid=4&id=96395&date=2004-04-02&usrsess= (accessed 19 August 2005).

[106] Acharya, 62.

107 Moshe Yegar, *Between Integration and Secession* (NY: Lexington Books, 2002), 159.

military strikes against the MCP across either side of the border for short periods of time and of limited depth as authorized by the regional Border Committee. The agreement also combined military operations under a joint commander acceptable to both sides.

Therefore, this proves that putting aside differences and making a concerted effort to solve a common problem or having a common goal has positive results. The communist insurgency in both Thailand and Malaysia was eradicated by the mid-1980s.[108]

However, their relationship has also had its low points as well. There have been numerous disagreements between the two nations over their history and there are issues that are still lingering until today. Illegal migration (briefly discussed in this chapter), piracy in the Gulf of Thailand and the Andaman Sea, illegal fishing, and concerns over territorial claims are just a few of these disagreements.[109] However, the gravest problem for Thai-Malay relations in recent history, especially after the events of 2004, is Muslim-separatism and militant insurgency in southern Thailand.

Even during the communist insurgency campaigns of the 1970s and 1980s, the Malay-Muslim chasm had to be handled very gingerly. Malaysia was opposed to introducing anti-Muslim overtones into any agreement with the Thais.[110] They were fearful that agreements containing such overtones would create difficulties in public opinion within Malaysia and possibly damage international relations, especially with other Islamic countries. Additionally, anti-Muslim overtones could have created the allusion that the Malaysian government was collaborating with Thailand against Muslim coreligionists.[111] The RTG understood this concern and did not add anti-Muslim caveats into their agreements.

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108 Paul Battersby, "Border Politics and the Broader Politics of Thailand's International Relations in the 1990s," *Pacific Affairs*, 74 (Winter 1998): 476.

109 Both countries have claims to the Kolok (sometimes spelled Golok) river area, which is located in Naratiwat province in Thailand. It is the region referenced in Figure 1, op. cit. see Ganesan, Bilateral Tensions in Post-Cold War ASEAN, 25.

110 Yegar, 158.

111 Ibid.

It is important to keep in mind that the communist movement was an ideological movement whereas the issue of Muslim separatism takes on more of an ethno-religious[112] feature. It could prove disastrous to the Malaysian government if they were perceived to be siding with the RTG on how to deal with the problem of Muslim insurgency.

An effective counter-insurgency operation requires a strong Thai-Malay relationship. To prove this point, as described in his recent article, "Unrest in Southern Thailand: Contours, Causes, and Consequences Since 2001," Aurel Croissant states that in respect to the Malay-Muslim situation in southern Thailand, it may take the support of other nations, in particular, Malaysia, for conflict resolution.[113]

After about 30 months or so into this new wave of violence in southern Thailand, indications are that Thai-Malay relations have hit another low. The first real signs of stress occurred in early April 2004 when Prime Minister Thaksin accused Malaysia of not doing enough to assist Thailand with its border problems. This was about three months after the January 2004 armory heist incident and before the events of 28 April 04 (the militant uprising where over 100 Malay-Muslims were killed and the Krue Se Mosque incident).

Without hard evidence, PM Thaksin accused Malaysia of harboring terrorists and allowing militant training camps to exist just within the border of Malaysia.[114] Accusations of harboring terrorists and allowing training camps are an ongoing debate in Thai-Malay relations dating back decades. However, what was surprising and shocking was the strong reaction from senior cabinet members of the Malaysian bureaucracy. Malaysian Defense Minster, Najib Tun Razak said, "You have made the remarks; now

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112 Syed Serajul Islam, "Ethno-Religious Conflict and Political Violence in Southern Thailand: Climax in the Early Twenty First Century," in Aurel Croissant, Sascha Kneip, and Beate Martin, eds., *The Politics of Death. Political Violence in Southeast Asia* (forthcoming).

113 Aurel Croissant, " Unrest in Southern Thailand: Contours, Causes, and Consequences Since 2001," *Contemporary Southeast Asia* (April 2005), 36.

114 *Nation Newspaper*, "Thaksin Misquoted," 21 December 2004, www.nationamultimedia.com (accessed 7 February 2005).

give us the information." He also stated, "If you give us information, we can act on it what is necessary now is not more statements but accurate and timely intelligence."[115]

The Malaysian government wanted proof that militants or insurgents were being sheltered in Malaysia. However, the RTG could not deliver the evidence. From this point forward, a new round of finger pointing between the two nations ensued and PM Thaksin showed the first real signs of frustration from what he perceived as a the lack of cooperation (or *lassie-fare* attitude) from Malaysia.

As 2004 progressed and as the violence continued, more barbs were thrown at each other. Accusations by the RTG against the Malaysian government were becoming more frequent. The response from the Malaysian government and from prominent Malaysian officials was out of the ordinary. Both sides began to show signs of weariness over the southern Thai problem.

Malaysia's concern for the situation in southern Thailand emerged after the Tak Bai incident. More outraged Malaysian officials spoke out, bucking the ASEAN norm of non-intervention, and condemned the actions of the RTG.

Malaysia's former Prime Minister Dr. Mahathir Mohamad proposed autonomy for the south. He stated, "This is like the Palestinian issue, if settled early, there will be no problems. But the situation will get difficult if it is left to the command of the local army."[116] Another leading figure in Malaysian politics, Anwar Ibrahim, formerly jailed Malaysian opposition leader said, "Thaksin's initial reaction seems to be pathetic-to completely ignore the problems, and to be so arrogant."[117] Anwar's statement was in reference to PM Thaksin's remark, "Protesters died because they were in a weak physical condition resulting from fasting (Ramadan). They just collapsed in the crowded situation and anti-riot forces did not touch them."[118]

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115 *The Straits Times*, Malaysia, http://www.nst.com.my/ (accessed 6 February 2005).

116 Ibid.

117 Ibid.

118 *Nation Newspaper*, http://www.nationmultimedia.com/ (accessed 8 February 2005).

Then in December 2004 a mysterious photo was printed in the Thai media that displayed several men dressed in fatigues, wearing head scarves, and one man touting what seemed to be an automatic weapon. The Thai government believes this photo substantiates their claim Thai separatists are actively training in northern Malaysia. Thai deputy interior ministry at the time, Sutham Saengprathum, told reporters, "We have the pictures to prove that they have militia training in Kelantan state."[119]

However, as of today, the exact location of the picture is still unknown. Additionally, there is no evidence the picture was taken at a site either in southern Thailand or northern Malaysia. Further, there is no evidence the personnel in the picture are Thais or Malaysians. What the picture does prove is the fear that is instilled by the border area.

2. The Role of the Malaysian Government

As alluded to in this chapter, an ongoing academic debate exists concerning Malaysian support for the southern insurgents. The debate is the Malaysian government, more precisely members of the Malaysian polity, the "fervent"[120] Islamic party *Parti Islam se-Malaysia* (PAS) are either a major backer of, or at the very least, contributing to the perpetual violence and the unabated flow of activity over the Thai-Malay border. Because of their long historical ties to the Malay-Muslims in southern Thailand, this thesis supports the debate that PAS is involved and that they are providing some form of cover for the insurgent's operations.

a. History and Ideology of PAS

Over the years, PAS has transformed itself from a moderate Islamic-nationalist party in the 1960s and 1970s into what it is today, a more radical Islamic party. According to PAS' rhetoric, they have developed into a party that wants to establish an Islamic state, implement *Sharia* law and *Hudud*, and wants the primacy of the *Ulama* in society.[121] Throughout their development, PAS has successfully politicized

119 Channel News On-Line, http://www.channelnewsasia.com/stories/southeastasia/view/123378/1/.html (accessed 8 July 2005).

120 Clark D. Neher, *Southeast Asia in the New International Era* (Boulder CO: Westview Press, 2002), 146.

121 Joseph Chin Yong Liow, "Exigency or Expediency? Contextualising Political Islam and the PAS Challenge in Malaysian Politics," *Third World Quarterly*, Vol 25, No. 2, 360.

Islam in Malaysian politics, especially against its rivals, the United Malays National Organization (UMNO) party, the senior partner of the National Front.[122]

PAS broke away from UMNO in the late 1950s. They started as the Pan-Malayan Islamic Party (PMIP) and changed their name to PAS in 1971.[123] Therefore, PAS was formed from the same "crucible"[124] as the dominant UMNO party, but as they progressed, their ideology changed.

PAS started out as a marginalized party struggling for a home in Malaysian politics. But, over time, they developed a complex and dynamic ideology combining progressive Islamism, nationalism, and anti-colonialism, transforming the party into a fairly leftist, Islamic Malay-Muslim opposition party.[125] PAS was the first Islamic party in Asia to win a democratic election when in 1959 they took the two northern Malaysian states of Terengganu and Kelantan.[126]

Because Malaysia is a multi-ethnic society, where ethnic Malays constituted just under 50% of the population in the 1960s, deep cleavages emerged within the National Front over matters such as education and minority representation in federal elections. In 1969, PAS used these cleavages to establish a following and further capitalized on the ethnic, racial, and social nexus that emerged within Malaysia after the race riots of that year. At the 1969 elections, PAS was successful in gaining a considerable grass-roots following by reiterating its "crusade for Malay rights into which Islam was subsumed"[127] and by establishing an Islamic state based on Malay supremacy.[128]

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122 Neher, 145.

123 Dr. Kenneth Janda, Professor of Political Science, Northwestern University Home Page http://janda.org/ICPP/ICPP1980/Book/PART2/5-AsiaFarEast/58-Malaya/Malaya.htm (accessed 16 August 2005).

124 Joseph Chin Yong Liow, "Exigency or Expediency? Contextualising Political Islam and the PAS Challenge in Malaysian Politics," *Third World Quarterly*, Vol 25, No. 2, 360; op. cit. For information on UMNO, see William Case, *Politics in Southeast Asia*, Chapter 4, Malaysia, (London: Curzon Press, 2002).

125 Farish Noor "Blood, Sweat, and Jihad: The Radicalization of the Political Discourse of the Pan-Malaysian Islamic Party (PAS) from 1982 Onwards," *Contemporary Southeast Asia*, Vol 25: No 2, 203.

126 Ibid.

127 Liow, *Exigency or Expediency?*, 363.

128 Ibid.

In the 1970s, PAS lost some of its focus and some of their support. They were more preoccupied with Malay communitarian rights then focusing on progressive Islamism and anti-colonialism.[129] In order to reorient their party, PAS leadership looked abroad for models to emulate. PAS looked at both Pakistan and Iran as examples. This allowed the "*ulama* faction" of the party under the leadership of men like Yusof Rawa, Nik Aziz, Fadzil Noor, and Hadi Awang to take control. Subsequently, PAS' ideology was "Islamicized" once again and party leadership was centered under the *ulama*.[130] Until today, PAS remains the main opposition in Malaysian politics.

The following is PAS' ideology taken from their *The Islamic State Document*:[131]

PREAMBLE:

> 1. Islam is both a belief system and a deen - which is a complete and comprehensive way of life.
>
> 3. PAS takes full cognizance of the reality and sensitivity of this country's multi-ethnic, multi-religious and multi-cultural makeup. Hence from its inception, PAS has stated in no uncertain terms, its stance on the status and position of Islam as a comprehensive system of life embracing the entire domain of socio-political life.
>
> 5. As an Islamic political party, PAS advocates the implementation of Islam as a comprehensive way of life, utilizing the vast principles and provisions of the *Shari'ah,* as a method to establish the Islamic State and Government.
>
> 15. Unless an Islamic State is established, the true import and demands of this conviction could not be realized in its entirety.
>
> THE CONCEPTION (TASAWWUR) OF AN ISLAMIC STATE:
>
> From the understanding that Islam is a comprehensive way of life that pertains to both its character as a religion and a state (Deen and Daulah), the conception of an Islamic State is derived.

129 Noor, *Blood, Sweat, and Jihad*, 203.

130 Ibid.

131 "The Islamic Party of Malaysia (PAS)," The Islamic State Document, 14-19.

> It is an embodiment of the principles and ideals of Islam in all aspects of life, both at the national and international levels. A typical conception of the state includes:
>
> - The Shari'ah is the main source of guidance and governance in conducting the affairs of the state.
> - The implementation of Shari'ah, *hudud* being a part of it, provides the much required peace and security as crimes would be reduced to its minimum.
>
> *"As to the thief, male or female, Cut off his or her hands: punishment by way of example, from Allah. For their crime: And Allah is Exalted in Power, Full of Wisdom." – Surah Al-Maaidah :38*
>
> The above stated injunction is mandatory and must be implemented.

PAS' idea of an Islamic state is in direct conflict with the central Malaysian government's ideology for the state. Because of PAS' close proximity with Thailand and its shared history, PAS' ideology significantly influences the border population of southern Thailand, and it has negatively affected the southern separatist movement as well. Southern Thai separatist ideology mirrors PAS' ideology. They want to develop an "Islamic State" based on *Sharia* law and *Hudud*. Therefore, it is no surprise that southern Thai separatist ideology is in direct conflict with the Buddhist dominant central Thai government.

b. PAS' Political Links to Southern Separatism and Militancy

Politically, PAS has always been very attentive to the ethnic struggles of the Thai Malay-Muslims. In the past, Patani Muslim leaders who held Malaysian citizenship joined PAS and expressed support for Patani to separate from the Kingdom of Thailand. In a rally in Kelantan in 1969, PAS President, Dato Mohammad Asri Haji Muda openly discussed "the prospect of an alternative Malay nation, comprising the Malay states of Malaya and those of Southern Thailand, should Malay collapse as a country."[132] At that same rally, he also stated that an alternative Malay nation should be comprised of the sultanates of the Malay Peninsula and of the Patani region in southern Thailand.[133]

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132 Che Man 159.

133 Yegar, 164.

In 1970, Dato Asri wrote an article in the London publication, *The Muslim*, claiming the struggle against Thai rule in southern Thailand was a holy war (*jihad*) and therefore deserved world-wide Muslim support.[134] In June 1974 the issue of separatism was broached again in Malaysian politics when Dato Asri, who was now a cabinet member of parliament stated, "In our considered opinion, the demand for autonomy subject to certain conditions, for the southern Thai provinces, which the liberation front has put forward, deserves to be given a favorable reception. It could constitute a sensible step towards peace and tranquility."[135]

Each time PAS has made overt statements concerning Thai separatism, the central Malaysian government has stepped in to repair any damage caused by PAS. PAS' involvement on these issues has obviously generated much consternation for the Malaysian government over the years. The Malaysian government sympathizes with the plight of the southern Thais, but they understand becoming involved would be tantamount to political suicide and violates ASEAN norms.

In the 1980s, the RTG was also suspicious of the central Malaysian government's support for the separatists, especially with the arrival of Dr. Mahathir bin Mohamad as Malaysia's new prime minister in 1981. Dr. Mahathir was considered an extremist Muslim because of his abrasive style and his staunch nationalistic approach. The RTG feared him and feared his appointment would negatively influence the Muslim south. Thai officials were quick to point out during the early 1980s southern Thai separatists were wearing uniforms and had food supplies that closely resembled those of the Malaysian Army.[136] Dr. Mahathir assured the RTG that its suspicions were just that, suspicions, and that the militants were not being supported by the Malaysian Army.

Outside of the political linkages between PAS and southern Thailand, the linkages between PAS and southern militancy are also fairly extensive. A RAND Corporation report, "Muslim Separatist Movements in the Philippines and Thailand," stated the external dimension of the separatist struggle "essentially relates to backing

134 Yegar, 164.

135 Che Man, 159.

136 Yegar, 166.

from Islamic militants in northern Malaysia."[137] The RAND report also details the RTG's repeated allegations that the groups in the south benefit from the provision of a "safe haven" in the state of Kelantan and support has come with the sanctioning of the province's ruling Islamic Party (referring to PAS) as well as the official indifference of the Kuala Lumpur government.[138]

For much of the 1990s, PULO and New PULO reportedly received most of PAS' support.[139] Thai intelligence alleges and the Malaysian government denies that several of Thailand's southern insurgent groups, including PULO, are allowed to maintain operational and logistics bases in Kelantan.[140] There is one more link to PAS that must be made, the linkage of the Aziz family, GMIP, and the Afghan war.

As mentioned in Chapter II, in 1995 a new southern Thai separatist group, GMIP, emerged under Nasoree Saesang. Nasoree was formerly trained in Libya and fought with the Afghan *mujahidin* in the early 1990s during the Afghan-Soviet War. While fighting with the *mujahidin* he gained crucial expertise and developed deep contacts with other Islamic organizations and separatist movements around the world. However, when in Libya he met another native Southeast Asian who shared the same ideology as him and the connection to PAS was strengthened. Nasoree trained alongside Nik Adili Nik Aziz, the son of PAS Chairman Nik Abdul Aziz Nik Mat.[141] Since 1991, Nik Abdul Aziz Nik Mat has been detained in Malaysia under the Internal Security Act for involvement in a *jihadist* group, the Kelompok Mujahidin Malaysia (KMM).[142]

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137 RAND Corporation Report. "Muslim Separatist Movements in the Philippines and Thailand." http://www.rand.org/publications/MR/MR1344/MR1344.ch9.pdf (accessed 11 August 2005), 97.

138 Ibid.

139 Peter Chalk, "Militant Islamic Extremism," chapter in *Terrorism and Violence in Southeast Asia*. (NY: M.E. Sharpe, 2005), 23.

140 *Jane's Defense Intelligence* Web Site, Jane's World Insurgency and Terrorism, Active Asia Groups – Thailand, http://www2.janes.com/ search word: PULO/New PULO (accessed 26 August 2005).

141 See footnote 64 in Chapter 2.

142 ICG, 13. KMM is often represented as the paramilitary wing of PAS. Many of the alleged KMM members arrested by authorities are also PAS associates; however, there is no definitive proof linking the two organizations and PAS leaders have denied any connection, accusing the Malaysian government of fabricating the KMM issue to undermine PAS politically, op cit http://www2.janes.com/ search KMM.

This furthers the point that the connections between southern militancy and members of PAS are deep, have long historical roots, and reach the highest echelons of PAS hierarchy.

C. CONCLUSION

Three main points were raised in this chapter: the porous nature of the Thai-Malay border, the role of dual citizenship, and the Malaysian connection, each having its own peculiar effect on the current and historical nature of the southern Thai insurgency issue.

It can be concluded that the current dual-citizenship policy gives the southern insurgents an advantage by allowing them to move seamlessly across the southern Thai border despite the regulations of the state. Abolishing this policy is out of the question however. If the RTG proposed to abolish the policy, this could add to the already long list of alleged central Thai government "abuses" against the Malay-Muslims.

Until concrete evidence surfaces that PAS is actively engaged in southern Thailand, it behooves the RTG to reduce their accusations of PAS' support. Accusing elected officials of backing suspected separatists or militants can undermine bilateral relations, as witnessed in 2004. What is most important to the RTG at this time is maintaining close bilateral relations with Malaysia.

Therefore, there is only one course of action the RTG has total control over, their side of the border. It cannot be stressed enough how vital border security is to the region, internal Thai security, and reducing southern violence.

By eliminating the border issue from the equation, the RTG can concentrate on other issues to resolve the southern problem, issues such as relative deprivation, the political exclusion of the Malay-Muslims, just to name a few. Chapter IV discusses how emerging technologies can aid the RTG to manage their side of the border effectively.

IV. EMERGING TECHNOLOGIES

Chapters II and III of this thesis described the current separatist movement in southern Thailand, analyzing the history of the southern separatist problem, the issue of the porous border between Thailand and Malaysia, the role of dual-citizenship, and some of the external factors that have aggravated the problems in the south. The separatist situation in southern Thailand can be categorized as very dynamic, enveloping multiple dimensions: historical, ethno-religious, economic, political, and security.

Chapter IV focuses on the security dimension of the conflict and proposes that leveraging emerging technologies against the southern separatists will provide another layer of protection, which could possibly reduce the instances of violence in southern Thailand. Additionally, this technology can provide another measure of security at the Thai-Malay border, sealing it to some degree.

Each of the technologies discussed in Chapter IV demonstrates how commercial-off-the-shelf (COTS) technologies can be integrated to fuse and display information into a real-time, tactical, coalition enabled command and control (C^2) center - all of which is accomplished at relatively low-cost and with very little burden placed on the logistics system. The emerging technologies that will be discussed are as follows:

- Unmanned Aerial Vehicles (UAVs)
- Lighter than Air (LTA) Platforms
- Unattended Air and Ground Sensors
- Wireless-LAN, Meshed Technologies (WiFi-802.11)
- Other technologies
    - Wearable Computing Devices (Tacticomps)
    - Language Translation Devices.

Lastly, within this chapter briefly discusses the NPS sponsored research and field experimentation program entitled the Coalition and Operating Area Surveillance & Targeting System (COASTS). The COASTS program is focused on researching low-

cost, state-of-the-art, rapidly scaleable airborne and ground communications equipment suites that integrate with COTS wireless network technologies.[143]

Importance of Technology and the Royal Thai Air Force's (RTAF) "Vision"

In the book titled, *Secessionist Ethnic Conflict in South and Southeast Asia*, the author notes that the following is necessary for a secessionist movement to exist: "(a) a degree of in-group legitimation that endorses the aims and means of the conflict; (b) a credible military threat; and (c) some tangible or political support from external states."[144] In the case of Thailand, their external threat, in relation to internal security, comes from its "ethnic minority guerrilla forces"[145] who are allegedly receiving support from external actors via the porous Thai-Malay border.

Secessionist violence, which is one form of asymmetrical warfare, along with terrorism, illegal immigration, and arms and drugs trafficking are all recognized as major threats to security and stability. As a consequence, homeland-defense missions such as border defense, coastal surveillance, high-value object protection and force protection now receive a higher priority in the US and around the world.

Countering asymmetrical threats as they relate to internal security requires the ability to perform various roles with high speed, small size, and reliable technology. These asymmetrical threats potentially challenge traditional command and control (C^2) when applied to modern communication and sensor technology.[146] Therefore, emerging technologies, such as UAVs and ground sensing devices all linked via wireless networks, present increased capability for security forces deployed to remote areas of operation and also help to facilitate shared situational awareness (SSA) across the spectrum of combat.

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143 "COASTS After Action Report" dated 28 July 2005.

144 Rajat Ganguly and Ian Macduff, *Ethnic Conflict and Secessionism in South and Southeast Asia* (New Delhi: Sage Publications, 2003), 25.

145 Alan Collins, *Security and Southeast Asia* (Singapore: ISAS, 2003), 94.

146 James Ehlert, Edward Fisher, Collier Crouch, "COASTS Research Program and the Integration of Unmanned Aerial Vehicles," (forthcoming), 2.

This leads to a dynamic tactical battle rhythm (TBR) where execution collaboration and real-time feedback across the tactical information grid have the potential to synergize the commander's intent.[147]

For decades, the USG has understood that a technological advantage on the battlefield is a force multiplier for US troops. Organizations (military, security, or otherwise) that can adopt and promote new technologies clearly have a critical edge in "modern" warfare.[148] Therefore, understanding this, the USG created the Defense Advanced Research Projects Agency (DARPA) to ensure technological superiority for US military forces by "fostering innovation and pursuing high-payoff, frequently high-risk projects" and ensuring that these emerging technologies and concepts can be transitioned into capabilities the US military can employ.[149] Most of the technologies listed in this chapter either were, or still are part of DARPA's continuing research and development into emerging technologies.

In early 2005, the Commander-in-Chief (CINC), Royal Thai Air Force (RTAF), published two documents that indicated the RTAF's and RTG's vision for the future. Their desires are to develop a military that is more capable, leaner, and embraces technology. The first document, "RTAF's Operational Policy for Budget Year 2548,"[150] in the area of Operations Policy, CINC/RTAF calls for the RTAF to, "6.4.5 develop command and control capabilities by digitizing their system for command and control so that future requirements and developments can embrace technological advances which will move towards a Network Centric capability." CINC/RTAF proceeds to discuss in sub-items 6.4.8 and 6.4.10 how the RTAF should "work with allied nations on R&D" and how "R&D should match RTAF needs."

Another document that supports the RTAF's intent to embrace and leverage technology, with the aim of increasing their effectiveness, was the RTAF's "Ten Year

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147 Alex Bordetsky, "An Analysis of the Impact of Modern Collaborative Technology on Battle Rhythm at the Tactical Level," 26 September 2003.

148 National Defense University Publication, Hans Binnendijk, ed., "Transforming America's Military," (Washington DC, University Press, 2002), 32.

149 Defense Advanced Research Projects Agency (DARPA) "Technology Transition," 9.

150 RTAF Web Site translated by Albert Valentine http://www.rtaf.mi.th/news/n04/rtaf_working_policy_48.pdf (accessed 29 August 2005).

Vision (2003-2013)."[151] This document was delivered to PM Thaksin on 23 April 2003, and it is a detailed record of the various disciplines the RTAF wants to focus on in the next ten years taking into account their fiscal constraints. In the area of combat operations, the document outlines the RTAF's requirements to identify imaging capabilities that work day or night and in all weather conditions. Furthermore, it specifically addresses the RTAF's desire to find a capable UAV platform to satisfy their reconnaissance needs. Additionally, the paper talks about finding a low-cost, effective C^2 "sensor" and "situational awareness" capability.

Therefore, it can be summarized, due to budget constraints and the changing nature of warfare, the RTAF and RTG are seeking to modernize their forces. They are attempting to embrace technology by leveraging cost-effective solutions to R&D that will accomplish their goal of maintaining a secure nation.

The COASTS program is a prime candidate to fulfill the RTG/RTARF's requirements. COASTS is designed around technology, especially COTS, which focuses on low-cost solutions for border defense. A second benefit of COASTS and its enabling technologies is it reduces the manpower required to accomplish the same mission. This translates into a smaller personnel footprint and ultimately less exposure for police and military forces to be placed in harm's way.

A. OVERVIEW OF EMERGING TECHNOLOGIES

1. Unmanned Aerial Vehicles (UAVs)

One well known emerging technology is the UAV. The current military UAV market is divided into three general categories: medium-/high-altitude long-endurance (MALE/HALE) platforms, capable of staying aloft for approximately 24hrs and carrying payloads of 100kg to more than 500kg; tactical UAVs, with an endurance of 4 to 12hrs and payloads of 25 to 100kg; and a rapidly emerging requirement for small UAVs, including technology under development for micro-air vehicles.[152]

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151 RTAF's "Ten-Year Vision" translated by Albert Valentine http://www.admin.rtaf.mi.th/totalvision/cinc/rtaf1.htm (accessed January 2005).

152 Mark Hewish, *Jane's Intelligence Report*, "Pilotless Progress Report" Oct 2000.

Before discussing UAVs, a formal definition of the term UAV is presented from Joint Publication 1-02:[153]

> Unmanned Aerial Vehicle (UAV)-A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or non-lethal payload. Ballistic or semi-ballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles.

Brief History of UAV Development

The US military first dabbled in UAV technology during World War I.[154] These early UAVs flew very erratically; however, the military recognized their potential in combat. However, the war-ending armistice arrived before prototype UAVs could be deployed in combat and UAV technology was shelved until the late 1950s.

The first "modern" UAVs trace back to the Ryan Aeronautical Company's "Lightening Bug," a derivative of their sub-sonic target drone, the Firebee.[155] Lightening Bugs had a range of more than 2,400 miles, could fly above 65,000 feet, and had a top speed of 420 miles per hour.[156] Lightening Bug UAVs saw action in China and North Korea. During the Vietnam War, advancements were made, making the UAVs more maneuverable and equipping them with electronic countermeasures and jamming equipment to defend them from surface-to-air missiles and air interception.

Scout UAV

It would take two decades until UAV technology saw its next major advancement. This occurred in 1982 during the Arab-Israeli War when Israel employed a fleet of their indigenous "Scout" UAVs. The Scout UAV was developed primarily to act as a decoy.

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153 Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms, http://www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf (accessed 26 August 2005), 557.

154 Public Broadcasting Web Site, Nova Web Site, "Spies that Fly," http://www.pbs.org/wgbh/nova/spiesfly/uavs.html (accessed 26 August 2005).

155 Military Web, "Resources" Page, http://www.military.com/Resources/EQG/EQGmain?file=RQ4A&cat=a&lev=2 (accessed 31 August 2005).

156 Ibid.

Propeller-driven with no firepower, it flew slowly and had limited range; however, it emitted a radar aperture of a much larger plane, fitting the Israeli air force's needs perfectly.

The mission of the Scout was to find Syrian missile sites and entice the Syrians to activate their radars. This tactic allowed the Israeli air force to use manned bomber aircraft to destroy these sites. The result was 15 out of 17 Syrian missile sites being destroyed, allowing the Israelis to fly unabated in the skies throughout the duration of the war.[157] After seeing the operational capability of the Scout UAV, the USG worked collaboratively with the Israelis to develop the next generation UAV, "Pioneer."

Figure 3. Scout UAV[158]

Pioneer UAV

In the 1980s US Military operations in Grenada, Lebanon, and Libya identified a requirement for an on-call, inexpensive, unmanned, over-the-horizon targeting, reconnaissance and battle damage assessment capability for local commanders. In 1985, the Secretary of the Navy directed the acquisition of UAVs for fleet operations. The initial system delivery was made in July 1986 and later deployed on board the battleship USS Iowa in late 1986.[159] From there, Pioneer was added to the Marine Corps arsenal and eventually into the Army inventory by 1990. Pioneer saw action in Operations

157 Nova Web, "Spies that Fly."

158 Ibid.

159 Pioneer UAV Corporation Home Page http://www.puav.com/about_history.asp (accessed 26 August 2005).

Desert Shield and Desert Storm where it flew over 300 combat missions, supporting combat operations and providing battlefield commanders critical intelligence information, thereby cementing UAV utility and importance in a combat environment.[160] Pioneer is still in use today and is presently employed by the US Marine Corps in Iraq, along with a proto-type UAV, Dragon Eye.

Figure 4. Pioneer UAV[161]

Global Hawk UAV

The largest and most sophisticated US UAV is the Global Hawk. It was used in Afghanistan while still in the flight test stage during Operation Enduring Freedom. Global Hawk provided Air Force and joint warfighting commanders with more than 15,000 images, flew more than 50 missions, and acquired 1,000 combat hours.[162] Global Hawk is jet powered and has a cruising altitude of 65,000 feet. It is fully autonomous, once mission parameters are programmed. The UAV can taxi, take off, fly, loiter on station capturing imagery, return and land on its own.[163] It is a pure surveillance platform, carrying no weapons payload.

160 Pioneer UAV Corporation Home Page.

161 Ibid.

162 US Air Force Web Site, http://www.af.mil/factsheets/factsheet_print.asp?fsID=175&page=1 (accessed 28 August 2005).

163 Ibid.

Figure 5. Global Hawk UAV[164]

Predator UAV (RQ-1 / MQ-1 / MQ-9)

The RQ-1 Predator is a long endurance, medium altitude unmanned aircraft system for surveillance and reconnaissance missions. The MQ-1 is armed with AGM-114 Hellfire[165] missiles. It performs a multi-role mission of armed reconnaissance and interdiction. The Predator system first flew in 1994 and entered production in August 1997. Predator UAVs have been operational in Bosnia since 1995, where they have flown over 600 missions in support of NATO, UN and US operations.[166] Predators have also been deployed as part of Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom. The MQ-1 Predator achieved Initial Operating Capability (IOC) in February 2005.

Predator B (MQ-9 Hunter/Killer). In May 1998, the Predator's capabilities were expanded. System upgrades were made to improve the relief-on-station (ROS) system, which allows continuous coverage over areas of interest without any loss of time on station, secure air traffic control voice relay, Ku-band satellite tuning and implementation of an Air Force Mission Support System (AFMSS).[167] Additionally, its power-plant was upgraded and wing de-icing systems were added to enable year-round operations.

164 Desert Secrets Web Site, http://www.desertsecrets.com/i.ghawkuav.jpg (accessed 28 August 2005).

165 For information on the Hellfire missile and its usage with the Global Hawk UAV, see http://www.designation-systems.net/dusrm/m-114.html (accessed 26 August 2005).

166 US Air Force Technologies Web, http://www.airforce-technology.com/projects/predator/ (accessed 25 August 2005).

167 Ibid.

On 4 November 2002, six suspected al-Qaida members traveling in a vehicle in Yemen were killed by a Hellfire missile fired by a CIA controlled Predator.[168] Among those reportedly killed was Ali Qaed Senyan al-Harethi, a key suspect in the October 2000 attack in Yemen on the USS Cole.

Figure 6. Predator UAV[169]

For the purpose of defending or securing the Thai-Malay border, MALE/HALE platforms such as the ones just described are not feasible due to their high cost and inaccessibility. Therefore, understanding the vision of the RTG/RTARF, combining low-cost, state-of-the-art, and using COTS technologies, it is prudent to look at mini- and micro-UAVs.

Application at the Thai-Malay Border

a. Mini-UAVS

For environments like the Thai-Malay border, one solution is to deploy a system that can be launched within minutes, is easy to operate, and is fairly covert—all features of mini-UAVs. Mini-UAVs are generally classified as having a wing-span of less than four meters and a payload capacity less than 15kg.[170]

The first mini-UAV was developed by Paul MacCready in 1987 when he developed the "Pointer" UAV, the first hand-launched, backpack-carried UAV. Pointer

168 Global Security Web Site, http://www.globalsecurity.org/intell/systems/armed-predator.htm (accessed 25 August 2005).

169 Designation-Systems Web, http://www.designation-systems.net/dusrm/app2/q-1.html (accessed 28 August 2005).

170 Aerosonde Corp Web Page www.aerosonde.com/downloads/electronic_warfare_ledger.doc (accessed 29 August 2005).

combined the airframe technology of a high-performance model sailplane with an electric motor and propeller, a consumer video camera, and a radio datalink.[171]

As computer technology and components have reduced in size, so have UAVs. Mini-UAVs use technologies that are used in everyday electronic devices, such as laptops to cell phones and GPS receivers. Hand-launched mini-UAVs can now navigate autonomously and return automatically and its operator can track the UAV and control sensor pointing. Additionally, mini-UAVs can store imagery on-board and a portable ground station can store maps, terrain databases, and hours of video.

Figure 7. CyberDefense CyberBug™ UAV[172]
Figure 8. COASTS Team Member Employing CyberBug during COASTS Deployment 2005

b. Micro-UAVs or Micro Air Vehicles (MAVs)

Micro-UAV dimensions usually have a maximum length and width of 150mm, weight lower than 100g, airspeed ranges between 10 to 20 m/s, and have flight endurance times of 15 to 30 minutes.[173] The interest in micro flying machines had its origins with the notion that small, insect-like flying platforms could be devised for covert operations; the CIA was rumored to have attempted to build a remotely controlled

171 *Jane's International Defense Review*, "Mini-UAVs - The Next Small Thing" http://www4.janes.com (accessed 6 March 2005).

172 *CyberDefense* Home Page, CyberBug, http://www.proxygen.com/36 (accessed 30 August 2005).

173 G. La Rosa, G. Mirone, and A. Risitano, "Preliminary Design and Wind Tunnel Tests of a Micro Air Vehicle for Surveillance and Sensor-Bearing Applications," *Proceedings of the Institution of Mechanical Engineers*, (February 2005), 219:1, 1.

"dragonfly."[174] However, it was DARPA that became the main engine behind the advancement of MAV technology.

In 1997, DARPA's vision for MAVs was to deploy these platforms with individual soldiers for the purpose of reconnaissance and surveillance, battle damage assessment, targeting, or for other sensing purposes like detection of nuclear, biological, chemical agents.[175] Unfortunately, as of 2004, their goal had yet to be reached. DARPA concluded that MAVs were not suitable for outdoor environments.[176] In discussing what role MAVs do fill, DARPA states, "The mission space for which size really does matter is 'indoors and in confined spaces' where the environment is controlled or at least protected."

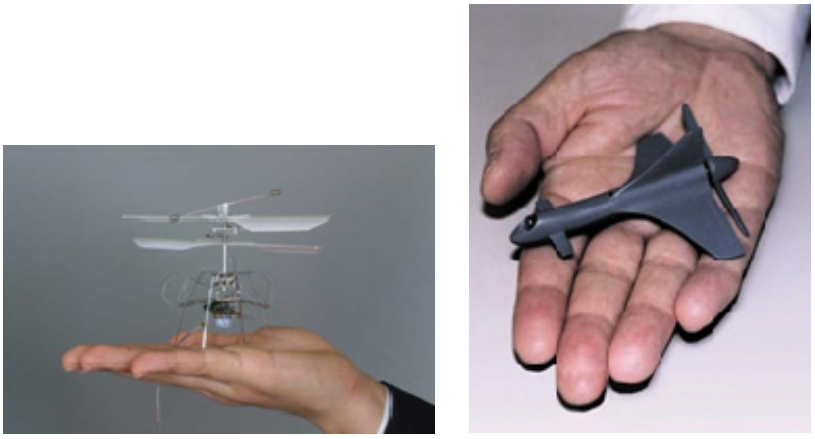

Figure 9. Examples of MAVs[177]

c. Role of the Mini-Tactical UAV and the Southern Thai Border

The exponential growth of data collection systems available to the decision maker has had a profound affect on intelligence, surveillance, and reconnaissance (ISR) collection, C^2, and shared situational awareness (SSA). The UAV, in particular the mini-UAV, plays a vital role in "filtering" information available to the

174 R. C. Michelson, "Novel Approaches to Miniature Flight Platforms," Proceedings of the Institution of Mechanical Engineers, (December 2004), 218:6, 363.

175 Ibid. 365.

176 Ibid.

177 Federation of American Scientists Web Site, http://www.fas.org/irp/agency/daro/uav97/images/42/hand.jpg (accessed 30 August 2005).

decision maker by providing and improving the decision maker's capability of collecting and disseminating battlefield information.[178]

Limitations do exist in ISR systems, as significant amounts of the data and intelligence collected rarely makes it to the tactical users in a timely manner, forcing them to make decisions based on incomplete information. Additionally, tactical users more often than not have trouble interacting with intelligence systems due to their high mobility and the lack of robust supporting systems.[179] "Local persistence" is one way of rectifying this shortfall and using UAVs can assist in this role.[180]

Local persistence allows continuous availability of intelligence data. This allows the on-site commander to access information obtained directly through organic Intelligence, Surveillance, Reconnaissance, and Targeting (ISRT) units and distribute this information through an organic wireless network. Integrated ISRT reduces the need for information to flow from the higher echelon down to the tactical unit by allowing them to collect, fuse, and disseminate their own information, and to better integrate and synchronize elements of the information operations effort.

By collecting ISRT data through organic means, tactical war-fighters can immediately develop potential actions to neutralize or mitigate adversary action(s). A local network supported by the integration of airborne sensor platforms such as mini-UAVs can be fielded quickly due to the vast array of WLAN, sensors, and man-portable UAV systems now available from the commercial world. Current COTS technology offers an affordable, mass-produced method for providing local persistence to the tactical military decision-maker and information operations planner.

To conclude, the most important element of information to the tactical decision-maker, or on-sight commander, is the availability, type, timeliness, quantity, and finally the quality of information provided to make critical decisions. By reviewing NASA's UAV continuum in Figure 8 and superimposing the mission needs of the RTARF/RTAF on to the continuum (the ability to work at close range in a tactical

178 Ehlert, et. al., 2.

179 Ibid., 3.

180 Ibid.

environment, done at low-cost), it can be concluded the tactical UAV (mini-UAV) is tailor-made for their mission requirements in southern Thailand.

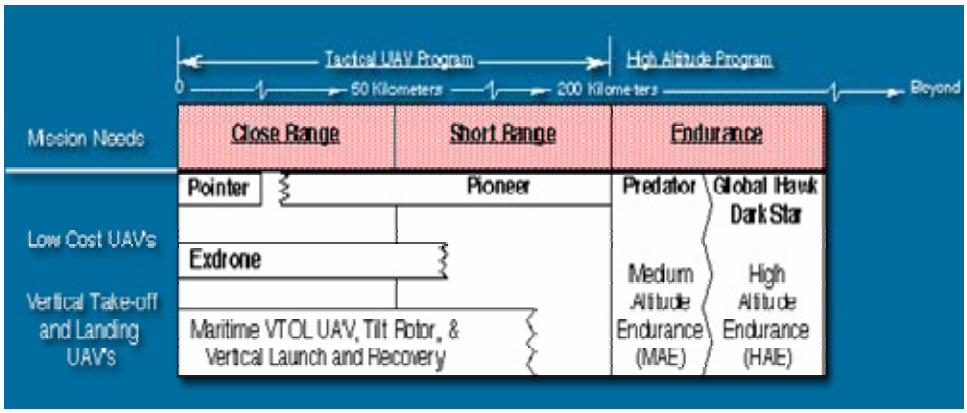

Figure 10. NASA's UAV Categorization[181]

2. Lighter Than Air (LTA) Platforms (Balloons/Aerostats)

Generally, there are two forms of lighter-than-air vehicles (LTAs), airships or blimps, and aerostats. Airships are traditionally manned, and use engines to maneuver. Aerostats are tethered, or moored to the ground[182] by a cable that can also provide power. Historically, airships and aerostats have been used for military surveillance and anti-submarine detection.[183]

181 NASA UAV Categorization http://uav.wff.nasa.gov/ (accessed on 28 August 2005).

182 U.S. Department of Transportation, Federal Aviation Administration, Flight Standards Service, Balloon Flying Handbook 2001 http://www.faa.gov/library/manuals/aircraft/media/faa-h-8083-11.pdf, 6-2.

183 CRS Report for Congress, "Potential Military Use of Airships and Aerostats" Order Code RS21886, 11 November 2004, 1.

Figure 11. Aerostat

Figure 12. COASTS Balloon

Airships were used extensively from the 1900s until about 1960. In World War I approximately 100 airships were used on both sides of the war. They ranged from the smaller (100,000 ft) non-rigid craft to larger (2.5 million ft) rigid craft. In 1933, the Goodyear Zeppelin Corporation completed construction on two rigid airships, Akron and Macon, for U.S. Navy use. These were the largest airships built during that era and two of the largest airships ever built.[184] Both rigid and non-rigid airships were used extensively as long endurance, long-range platforms to carry payloads that are essentially fixed (constant weight). But by the late 1930s, the popularity of the rigid airship declined due to several factors: their difficulty in managing excess buoyancy and applications with widely varying payload weights, the Hindenburg disaster, and the advent of commercial passenger airplanes.

184 Goodyear Corporation Web Site http://www.goodyearblimp.com/history/wingfoot.html (accessed 30 August 2005).

However, because of some unique advantages over airplanes LTAs have been given new life. For instance, they are superior for short distance hauling of very heavy or bulky cargo, they can be used in mineral detection and can also perform pollution watch. Undoubtedly, it is their surveillance role where LTA platforms perform optimally.

In missions that require long endurance ("persistence") in the air, such as certain types of border protection missions, as radar platforms, or as range extenders for WLAN (which will be discussed later), LTA craft, in particular aerostats, are critical to mission accomplishment. Additionally, due to their low vibration and low noise levels, they are extremely beneficial for ISR missions in which video feeds are essential.

In a 2004 report prepared for congress, it was noted that a number of developments have combined to draw increased attention toward LTA platforms:

> First, U.S. domination of airpower in military conflicts has been overwhelming since 1991. Threats to LTA platforms appear to be very low by historical standards. Second, the military's demand for "persistent surveillance," a function for which aerostats appear to be well suited, is growing. Network-centric warfare approaches, increased emphasis on homeland security, and growing force protection demands in urban environments all call for "dominant battle-space awareness." Third, growing airlift demands have spawned studies on using airships as heavy lift vehicles. Fourth, growing budget pressures have encouraged the study of potential solutions to military problems that may reduce both procurement and operations and maintenance (O&M) spending. LTA platforms may fit into this category. Finally, recent advances in unmanned aerial vehicle (UAV) command and control suggests that future airships may also be remotely piloted, or fly autonomously.[185]

The report also discusses the role and mission of aerostats and how the aerostat is the most mature of the LTAs. It is well documented in this report that the aerostats' best attribute is its capability for "persistent surveillance," coupled with a low life-cycle cost and long dwell time.[186]

As discussed in the COASTS section of this chapter, aerostats are vulnerable to weather and enemy ground fire. The CRS report illustrates this point by saying that

185 CRS Report for Congress, "Potential Military Use of Airships and Aerostats," 1.

186 Ibid., 4.

aerostats have been lost to severe weather, as have manned aircraft and UAVs.[187] But, aerostats tend not to fail in benign weather, whereas aircraft and UAVs, which are more complex and dynamic systems, suffer accidents caused by factors such as human error and mechanical failure.[188]

Lastly, during field experimentation in Thailand under the COASTS project, the balloon (aerostat) served as the most important communications node for the network (WLAN) topology. Employing a stationary, LTA vehicle equipped with a wireless access point extended the effective wireless network range and user connectivity. This node was invaluable and it enabled free-flow of information to and from the on-scene commander who was located several kilometers away.

Peacekeeping, law enforcement, and first-responder personnel are frequently called upon to enter physical environments that adversely affect, or limit, the capabilities of current communication tools. Combining an all-weather balloon, equipped with Wi-Fi technology, and multiple ground Wi-Fi units, offers almost instant situational awareness and communications over any land or water mass. This connectivity can reduce response times and tactical decisions and thereby create advantages for the on-scene commander.[189]

3. Unattended Air and Ground Sensors

Joint Vision 2020 (JV2020) is one document shaping US military warfighting capability well into the 21st century. When outlining Precision Engagement, JV2020 states, "Precision engagement is an effects-based engagement that is relevant to all types of operations. Its success depends on in-depth analysis to identify and to locate critical nodes and targets. The pivotal characteristic of precision engagement is the linking of sensors, delivery systems, and effects."[190]

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187 Ibid.

188 Ibid.

189 Ehlert, et. al.

190 Further defining Precision Engagement: It is the ability of joint forces to locate, surveil, discern, and track objectives or targets; select, organize, and use the correct systems; generate desired effects; assess results; and reengage with decisive speed and overwhelming operational tempo as required, throughout the full range of military operations, op cit, Department of Defense, "Joint Vision 2020, Volume II," http://www.dtic.mil/jointvision/jvpub2.htm (accessed 25 August 2005), 22.

As with many technologies, sensor technology has evolved from military research and development. It was during the Cold War that sensors proved their operational worthiness. One of the first sensor systems designed for military applications was the Sound Surveillance System (SOSUS).[191] It was a system of acoustic sensors (hydrophones) on the ocean bottom deployed at strategic locations to detect and track quiet Soviet submarines.

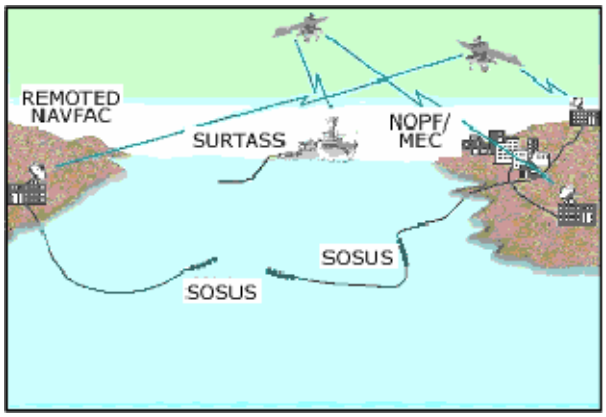

Figure 13. Sound Surveillance System (SOSUS)[192]

Modern research on sensor networks started around 1980 with DARPA's Distributed Sensor Networks (DSN).[193] Because microprocessor technology was still relatively immature in the early 1980s, the physical size of a sensor was a problem. However, this did not stop the military from foreseeing their application once their size could be reduced. In fact, military planners quickly realized that sensor technology was fast becoming a crucial component of network-centric warfare.[194] As the size and cost of embedded electronics systems reduced and their capabilities increased, new avenues opened for their application in areas such as defense, security, and law enforcement.[195]

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191 Pacific Marine Environmental Laboratory Web Site, http://www.pmel.noaa.gov/vents/acoustics/sosus.html (accessed 1 September 2005).

192 Pacific Marine Environmental Laboratory Web Site.

193 Chee-Yee Chong and Srikanta P. Kumar, "Sensor Networks: Evolution, Opportunities, and Challenges," Proceedings of the IEEE, (August 2003) 91:8, 1248.

194 D. S. Alberts, J. J. Garska, and F. P. Stein. (1999) Network Centric Warfare: Developing and Leveraging Information Superiority [Online] Available: http://www.dodccrp.org/publications/pdf/Alberts_NCW.pdf (accessed 1 September 2005).

195 William Merrill, et. al., "Open Standard Development Platforms for Distributed Sensor Networks," http://www.sensoria.com/pdf/OpenPlatform.pdf (accessed 3 September 2005), 1.

That modern ISRT systems employ sophisticated sensors is imperative. Sensor technology provides a wealth of data and can be deployed in a myriad of locations. They can be placed on the ground for unattended ground sensing, in the air, underwater, on bodies, in vehicles, and inside buildings. Establishing a system of networked sensors can detect and track threats (e.g., winged and wheeled vehicles, personnel, chemical and biological agents) and can be used for weapons targeting and area denial.[196] Small and inexpensive sensors based on wireless networking and inexpensive low-power processors also allow for the deployment of wireless ad hoc[197] networks, which can be used for various applications. The following table outlines the history of modern sensor technology:

Table 2. Three Generations of Sensor Nodes [198]

	Yesterday (1980's to 1990's)	Today (2000-2001)	Tomorrow (2010)
Manufacturer	Custom contractors, e.g. for TRSS	Commercial: Crossbow Technology, Inc, Sensoria Corp., Ember Corp.	Dust, Inc. and others to be formed
Size	Large shoe box and up	Pack of cards to small shoe box	Dust particles
Weight	Kilograms	Grams	Negligible
Node architecture	Separate sensing, processing, and communication	Integrated sensing, processing, and communication	Integrated sensing, processing, communication
Topology	Point-to-point, star	Client server, peer-to-peer	Peer-to-peer
Power supply lifetime	Large batteries; hours, days and longer	AA batteries; days to weeks	Solar; months to years
Deployment	Vehicle-placed or air-drop single sensors	Hand-emplaced	Embedded, "sprinkled" left-behind

196 Chong, 1247.

197 Ad hoc networking is where mobile nodes form a network in the absence of any fixed nodes; ad hoc networking will be discussed further later in this chapter, op cit, Kurose, J.F. and K.W. Ross. 2005. Computer Networking: A Top-Down Approach Featuring The Internet. 3rd ed., Pearson Education, Inc., page 507.

198 Chong, 1251.

Unattended, wireless air, ground, and maritime sensors hold the future for the modern battlefield. This integrated sensor network will be able to detect enemy movements, identify and locate targets, and feed that information back to the command center in real-time.[199] One critical link is the positioning of these unattended sensors. To fully exploit their capabilities, sensors must be tied into the network's maneuver layer, which is made of mobile vehicles, either ground- or air-based assets.[200] This also demonstrates the importance of UAVs and aerostats to C^2 and the WLAN network.

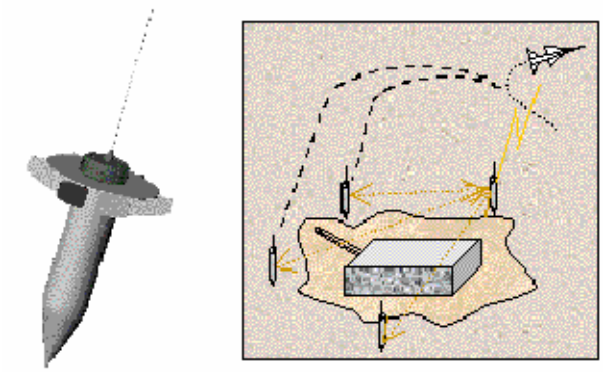

Figure 14. Deploying an Unattended Ground Sensor[201]

Networking a series of sensors allows them to share information on the grid. "Correlated Sensors," as Lawrence Livermore National Laboratory calls them, can help detect a nuclear terrorist attack, assist military operations in taking out a target, even to protect the president.[202] In the tactical environment, networked sensors provide the capability for soldiers or patrolmen to dismount, yet still be kept abreast of mission developments.[203] They can guide the soldier to the target area for recon or target acquisition. One challenge to deploying the sensor grid is properly positioning them, especially in rugged terrain or hostile environments. A potential solution is to use UAVs

199 Robert Ackerman, "Technologists Plan Tactical Future," *Signal*, (November 2001), 24.

200 Robert Ackerman, 25.

201 Scientific Applications and Research Associates Corporation Web Page, , http://www.sara.com/Graphics/remote/recon_surveil.gif (accessed 3 September 2005).

202 Bob Hills, Lawrence Livermore National Laboratory, "Sensing for Danger," *Science and Technology Review* (July/August 2001), 12.

203 Ibid. 16.

to drop the sensors in predetermined locations and then have the UAV serve as an airborne router.[204]

DARPA is developing a project, Quint Networking Technology (QNT), which allows for time-critical targeting information to be linked with weapon systems, tactical UAVs, and dismounted soldiers. QNT provides for the dismounted ground force to receive the air and ground situational awareness picture while also allowing deployed ground forces to communicate, machine-to-machine, with air vehicles.[205]

4. Wireless-LAN, Meshed Technologies (Wifi-802.11, 802.16)

As previously suggested, perhaps the most critical linkage of deploying and operating a tactical "network" is having the capability of doing it wirelessly while still integrating all of the aforementioned technologies for employment on the battlefield or, for the purpose of this thesis, along the Thai-Malay border. Therefore the backbone of this type of network should be based on wireless LAN (referred to as either WLAN or as WiFi) technology.

Wireless Configurations

Wireless systems have various configurations, point-to-point, point-to-multipoint, or multipoint-to-multipoint. Point-to-point configuration is obviously not efficient for multicasting or where information must be shared, therefore, "networking" is not taking place.

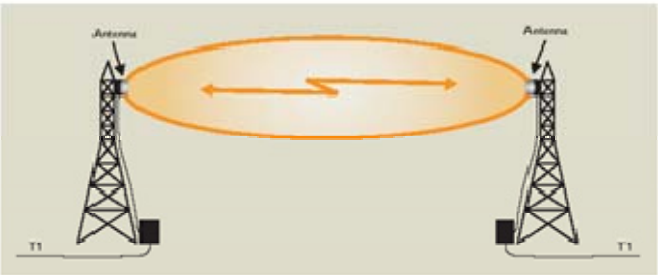

Figure 15. Point to Point Network[206]

204 Ibid..

205 *Jane's Defense Weekly*, "DARPA Eyes Sub-Networks to Speed Sensor-to-Shooter." 31 August 2005.

206 BelAir Networks White Paper, "Beyond the Hotspot: Wireless for Profit."

Point-to-multipoint wireless networks are limited because there is no interaction among the clients in the network. Information exchange only takes place between the sender and receiver, however, not among the network.

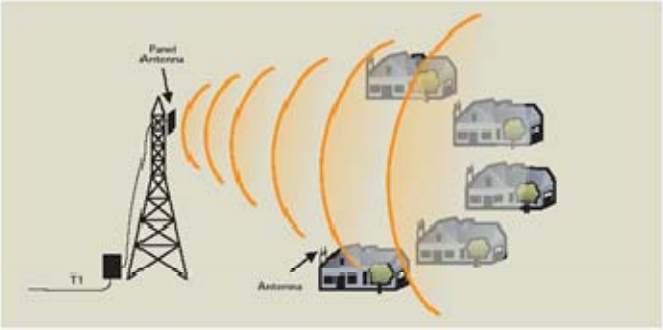

Figure 16. Point to Multi-Point Network[207]

Therefore, a preferred configuration for military applications is the multipoint-to-multipoint topology. In this configuration, every node becomes a router within the network, which enables a much wider coverage and this configuration allows for the formation of ad hoc networks.

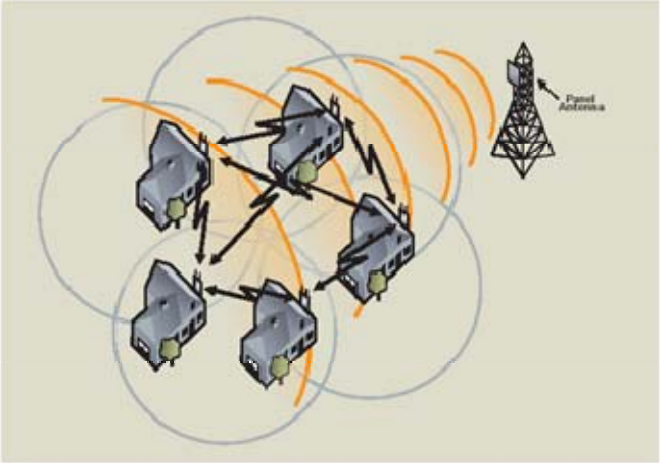

Figure 17. Multi-Point to Multi-Point Network[208]

Ad hoc, wireless mesh networks, are self-organizing, self-healing, self-balancing and, most importantly, self-aware. The basic idea behind self-organization is the network forms or bonds when separate networks come into contact with other. Conceptualizing it as an analogy may make this term more understandable. For example, if two clouds were

207 BelAir Networks White Paper, "Beyond the Hotspot: Wireless for Profit."

208 Ibid.

to combine, they have the capability to form one larger cloud. This same concept applies to network technology. As one wireless network, or "cloud," encounters another, they can mesh and thus an ad hoc network is borne.

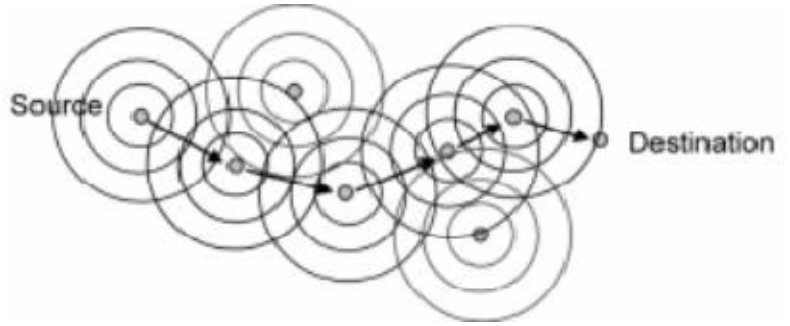

Figure 18. WiFi Mesh Networks[209]

Each network, or "cloud," is aware of its surroundings and can collectively decide the optimum path to best send data across the network to maximize throughput. If for some reason a path or route is weakened or lost, a better path will be selected, a process called "self-forming." As the number of clouds or nodes within a cloud increases, so does network strength. Examples of these are in Figures 16 and 17. As nodes are added into the network, they will self-organize and self-heal. If a particular node is weakened, the network will compensate by using another node within the network, and thus information will continue to be shared throughout the network.

209 Wi-Fi Technology Forum - WLAN Wireless and Mobile Technology News, Web Page, www.wi-fitechnology.com, (accessed 1 September 2005).

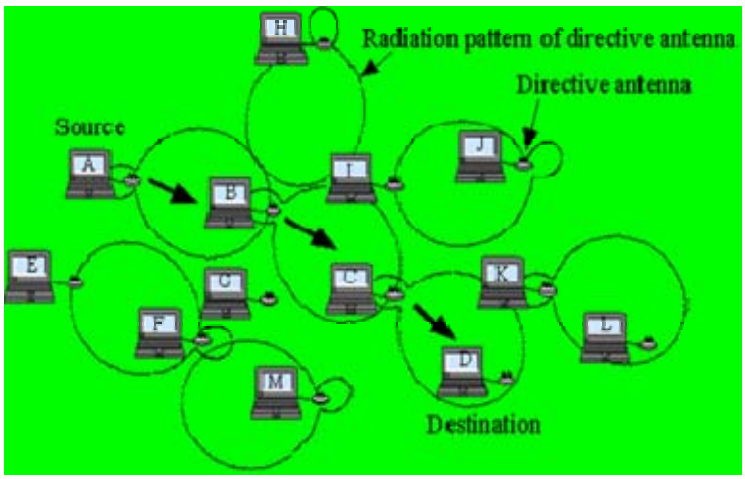

Figure 19. Ad Hoc Networking[210]

Once the network is formed, the capability exists to display this information world-wide in real-time under the USG's Global Information Grid (GIG).211 For example, if a fire-fight occurs at a border somewhere in the world, and, if local forces are connected to a system within the GIG, the information available to the on-scene commander can be simultaneously broadcast to higher echelon decision-makers, such as those at the Pentagon.

Mobile Ad Hoc Networks

As with sensors, mobility is critical to today's battlefield environment. Therefore, mobile ad hoc networks (MANET) are being designed to fill this gap. Generally, there are three forms of meshed, ad hoc network protocols. "Protocols" determine how data are sent or routed between the various network nodes. The first protocol to be discussed is termed "proactive," where each node attempts to maintain routes to all reachable destinations at all times, regardless of that individual node's requirement to send data to

210 Ibid.

211 The Global Information Grid (GIG) will be a net-centric system operating in a global context to provide processing, storage, management, and transport of information to support all Department of Defense (DoD), national security, and related intelligence community missions and functions-strategic, operational, tactical, and business-in war, in crisis, and in peace; GIG capabilities will be available from all operating locations: bases, posts, camps, stations, facilities, mobile platforms, and deployed sites; the GIG will interface with allied, coalition, and non-GIG systems, op cit National Security Agency Home Page, http://www.nsa.gov/ia/industry/gigscope.cfm?MenuID=10.3.2.2 (accessed 3 September 2005).

those other destinations.[212] Next is "reactive protocol," also known as on-demand, which differs sharply from the proactive approach because it actively seeks routes only when there are data to be sent and the routes are not known.[213] Lastly, there are the hybrid and combination protocols.[214] As the name suggests, a protocol was designed where a combination of proactive and reactive structures was formed. This protocol is very flexible and easily adaptable, given the diverse range of employment scenarios and the mixture of equipment that will be included in the network.

802.11 and 802.16 Technology

WiFi, or wireless fidelity, is the popular name for the wireless Ethernet 802.11b standard for WLANs.[215] Wireline local area networks emerged in the early 1980s as a way of allowing collections of PCs, terminals, and other computing devices to share resources and peripherals such as printers, access servers, or shared storage devices. The next evolution was wireless LAN (WLAN), which uses the 802.11x family of Ethernet standards for WLAN, operating in the 2.4GHz unlicensed frequency spectrum and having a range of approximately 100m.[216]

To overcome the 802.11b limitations of range (Line-of-Sight (LOS)) and bandwidth (11Mbs), another technology exists based on the 802.16 standard. This standard provides for large data transfers over a much longer distance. Specifically, the 802.16 standard was designed for local and metropolitan area network (MAN) fixed broadband wireless access.[217] The standard applies to frequencies between 10 and 66 GHz and is capable of performance comparable to cable, Digital Subscriber Line (DSL)

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212 R. Ogier and others, "Topology Dissemination Based on Reverse-Path Forwarding," RFC Internet Engineering Task Force, (February 2004), 4.

213 Wi-Fi Technology Forum - WLAN Wireless and Mobile Technology News, Web Page.

214 Ibid.

215 William Lehr and Lee W. McKnight, "Wireless Internet Access: 3G vs. WiFi?" Telecommunications Policy, http://pitpat.cs.utwente.nl/~draaijer/wifi/3G%20vs%20WiFi.pdf (accessed on 3 September 2005), 355.

216 David G. Leeper, "A Long-Term View of Short-Range Wireless," Computer, http://ieeexplore.ieee.org/iel5/2/20074/00928620.pdf (accessed 3 September 2005), 40.

217 Intel Corporation, White Paper, "IEEE 802.16 *WirelessMAN* Specification Accelerates Wireless Broadband Access," http://www.intel.com/technology/magazine/standards/st08031.pdf (accessed 5 September 2005).

or T1 systems, with data transfer rates of 120Mbps for line-of-site (LOS) transmission in the 10-66 GHz frequency range and 70Mbps non-LOS transmission in the 2-11 GHz frequency range.[218] It is also compatible with the 802.11 standard. Additionally, 802.16 systems are capable of providing:

- Long range operation: radius up to 30 miles (extremely important for backhaul capability for deployed forces)
- Non-Line of Sight (NLOS) performance
- Ability to operate in high multi-path environment
- Guaranteed service levels
- Superior scalability
- Quality of service capable of supporting voice and video applications
- High Spectral efficiency
- Routable networks within an Institute of Electrical and Electronics Engineers (IEEE) 802 framework
- Ability to support multicast traffic.[219]

The primary advantages of 802.16 systems over other wired systems include cost savings, a quick setup, and a more complete coverage of the geographical area of interest. These advantages were witnessed first-hand during the two COASTS deployments in 2005. Two 802.16 links, of six and nine kilometers respectively, were rapidly established (full operational capability achieved in under two hours) and due to the large bandwidth available, vast amounts of video (and other sensor data) and network information was delivered over the network with a high degree of speed and accuracy. The combined cost of the equipment (provided by Redline Communications) required to operate these two links was approximately $30,000 USD. This cost compares quite favorable when compared to the costs of laying fiber-optic cable (approximately $20,000 USD per mile in Thailand).

218 Intel Corporations, White Paper, "Understanding Wi-Fi and WiMAX as Metro-Access Solutions," http://www.intel.com/netcomms/technologies/wimax/304471.pdf (accessed 5 September 2005).

219 Intel Corporations, White Paper, "Understanding Wi-Fi and WiMAX as Metro-Access Solutions."

5. Other Technologies (Tacticomps, Language Translation Devices)

This thesis has briefly mentioned the role of the dismounted soldier. Therefore, it is prudent to discuss briefly some of the technologies currently being developed to assist them in accomplishing their mission. Two technologies will be discussed further, specifically, wearable computing devices and language translation devices.

a. Tacticomps

Wearable or hand-held computing devices,[220] sometimes referred to as tacticomps, are devices that can provide situational awareness and C^2 capabilities to commanders from the platoon through battalion levels. One example of this technology is Raytheon Corporation's Data Automated Communications Terminal (DACT) system.

DACT, one of many decision-making tools available to the modern warfighter, provides the capability to send and to receive digital messages, either in free or formatted texts, to view maps and overlays or freeform annotations on to maps, to perform route planning by plotting way-points on map overlays, to navigate with precision GPS; and is also updateable with situational awareness suites that display "blue" and "red" force tracking.[221]

Figure 20. Raytheon's DACT System[222]

220 These devices are designed using rugged personal digital assistant (PDAs) loaded with C2 software.

221 Raytheon Home Page, "DACT" http://www.raytheon.com/products/dact/ (accessed 4 September 2005).

222 Ibid.

Figure 21. Soldier Using DACT in the Field[223]

b. Language Translation Devices

Another technology that is essential for the dismounted soldier is language translation devices. The Joint Chiefs of Staff Advanced Concept and Technology Development office recently established the Language and Speech Exploitation Resources (LASER) program which states:

> Operational units typically deploy with insufficient numbers of qualified foreign language specialists and limited reachback support. Joint forces are increasingly becoming coalition forces. Multiple language requirements exist across all disciplines in the full range of military operations: medical assistance, noncombatant evacuation operation, force protection, humanitarian and peacekeeping operations, hostile action, and intelligence gathering and exploitation. Department of Defense (DoD) forces deploy to worldwide geographic locations with widely diverse languages and must operate with multinational forces and coordinate military operations with government agencies and international organizations. Often, these deployments occur with inadequate means to communicate in the languages of the multinational forces and organizations.[224]

Under development are three interesting language translation devices, which are as follows: the Multilingual Automatic Speech-to-Speech Translator (MASTOR), the Bilingual Phraselator, and the Voice Response Translator (VRT).

223 Ibid.

224 Language and Speech Exploitation Resources (LASER), Advanced Concept Technology Demonstration Community Assistance Response Exercise 2004 Limited Military Utility Assessment Report, (July 2004), 3.

(1) MASTOR: International Business Machines (IBM) Corporation developed MASTOR to facilitate communication via translation of natural spoken language. The system currently runs on Windows Experience or Windows 2000 laptop computers. MASTOR can translate in limited domains, including medical assistance, travel reservation, telephone banking, and force protection. Both the English speaker and the target language speaker must wear headsets containing earphones and microphones in order to communicate via the MASTOR (see Figure 20).[225]

Figure 22. MASTOR

The MASTOR relies on "speech-to-text" conversions, whereby spoken phrases are converted into text. The text is translated and then converted back into speech. The system also uses a pictorial display to illustrate the main concept embedded in the speech (see Figure 21). MASTOR produces contextual rather than literal translations (i.e., utterances that use different words but have the same meaning are translated the same way). For example, "I am injured" and "I need a doctor" would both be translated into an identical spoken sentence that would convey the need for medical assistance.

225 Ibid, 6.

Figure 23. Example of MASTOR Text

(2) PHRASELATOR: The Bilingual Phraselator is a software system that operates on PDAs and Windows-based PCs. It is designed for situations in which the information to be translated is fairly routine, predictable, and constrained. The system is designed chiefly for situations in which the English speaker controls the dialogue and the target language speaker provides one in a set of standard, expected responses. The device has approximately 600 questions and statements useful for medical and refugee camp interviews, as well as general questions and phrases, in its database. The phrases are grouped into mission domains and loaded via external modules. The Bilingual Phraselator also has the capability to identify words requiring urgent attention such as "doctor," "ambulance," "help," "bomb," "pain," and "danger." To use the Bilingual Phraselator, the English speaker must either state one of the predefined phrases or locate it on the display and select it with the stylus or navigation button. (If the phrase was spoken, the voice recognition software can display it in text format on screen for verification.) The target language speaker's response must match one of the pre-recorded Pashto phrases, or it will not be translated.[226]

226 LASER Advanced Concept Technology Demonstration Community Assistance Response Exercise 2004 Limited Military Utility Assessment Report.

Figure 24. Phraselator

(3) Voice Response Translator (VRT): The VRT is an automated language translation device that translates human language from a source language (the user's language) to a target language. Earlier generations of the VRT were initially fielded in 1997 in civilian police forces as a means of conducting routine traffic stops and crowd control. Later generations have been deployed in DOD since 2000. The VRT is a speech-to-speech, one-way translation, phrase-based tool. It is not a notional "universal translator" – meaning it is not a real time, two-way, free-flowing translator. The potential scope of use for the VRT is dictated by its capabilities. Since the VRT is a speech-to-speech, one-way, human language translation device that uses strictly pre-recorded phrases, it lends itself best to straightforward and repetitive situations where any expected replies can be visually expressed by body gestures or compliant behavior. Three environments where research has been conducted are coalition compound checkpoints, house searches, and maritime warning operation.[227]

227 LASER, Concept of Operations for Conduct of the Voice Response Translator (VRT), 4.

Figure 25. Voice Response Translator (VRT) System in Use

B. COALITION OPERATING AREA SURVEILLANCE AND TARGETING SYSTEM (COASTS)

COASTS is an individual and small unit network-capable communication and threat warning system that uses open, plug-and-play architecture, is user-configurable, employs LTA (balloons), UAVs, and portable and fixed air-, ground-, and maritime-based sensors, i.e. soldiers equipped with Tacticomp or similar PDAs, all of which communicate via wireless network technology.[228]

For years, NPS has been involved with research pertaining to low-cost, state-of-the-art, rapidly scaleable, real-time threat warning and tactical communications equipment. Existing NPS projects, such as the Tactical Network Topology (TNT) (formerly called Surveillance and Targeting Acquisition Network or STAN) involves hardware, software, and tools/tactics/procedures (TTP's) that are classified or operationally sensitive and thus not available to coalition partners. Therefore the COASTS program was specifically developed to address this shortfall. Simultaneously, the COASTS program complies with very important strategic missions:

- DOD's requirement to operate in coalition environments and strengthen relationships with foreign military partners;

228 COASTS Concept of Operations Document, 6 (See Appendix B).

- US Pacific Command's commitment to foster stronger multi-lateral relations in technology development and coalition warfare with key Pacific area of responsibility allies in WoT[229]

The purpose of COASTS is to leverage and integrate the technological expertise of the program's education and research partners with the operational requirements and challenges of using WLAN technologies in a tactical, coalition environment. It serves as a mobile field test-bed environment for R&D, integration, operational testing, and field validation of several emerging wireless technologies and equipment suites (such as 802.11 and 802.16) in a tactical coalition environment.

COASTS creates an international interaction mechanism for U.S. military forces, including NPS, to collaborate with coalition partners and allies to support WoT objectives and requirements using the latest wireless networking technologies, tools, tactics and techniques. In fact, NPS and Thailand have begun to integrate COASTS into a system to facilitate surveillance and monitoring the RTG deems as "areas of interest," especially along their 2,500km porous border with Burma.

The RTAF approached NPS requesting assistance integrating WLAN's and related surveillance and targeting technologies to augment their border patrolling resources. The RTAF, understanding the capability of UAV's, meshed sensor networks, and being aware of NPS's STAN field experiment program, endorsed COASTS as a suitable technology collaboration vehicle for investigating real-world information gathering and dissemination for issues such as narco-terrorism and human slave trafficking along the Thai-Burmese border.[230]

In 2005, NPS students and faculty deployed the COASTS project to Thailand twice. A network setup and rehearsal (see Figure 26) was conducted in March 2005 and a field research exercise and demonstration was conducted in May 2005.

Figure 26 displays the current COASTS' notional architecture, employing each of the emerging technologies discussed, ranging from UAVs to ground sensors. Future iterations of COASTS will incorporate other technologies expanding COASTS'

229 COASTS Concept of Operations Document, 6 (See Appendix A), 5.

230 Ibid., 11.

operational capabilities to include satellite communication links, unmanned underwater vehicles, and automated situational awareness software to name but a few.

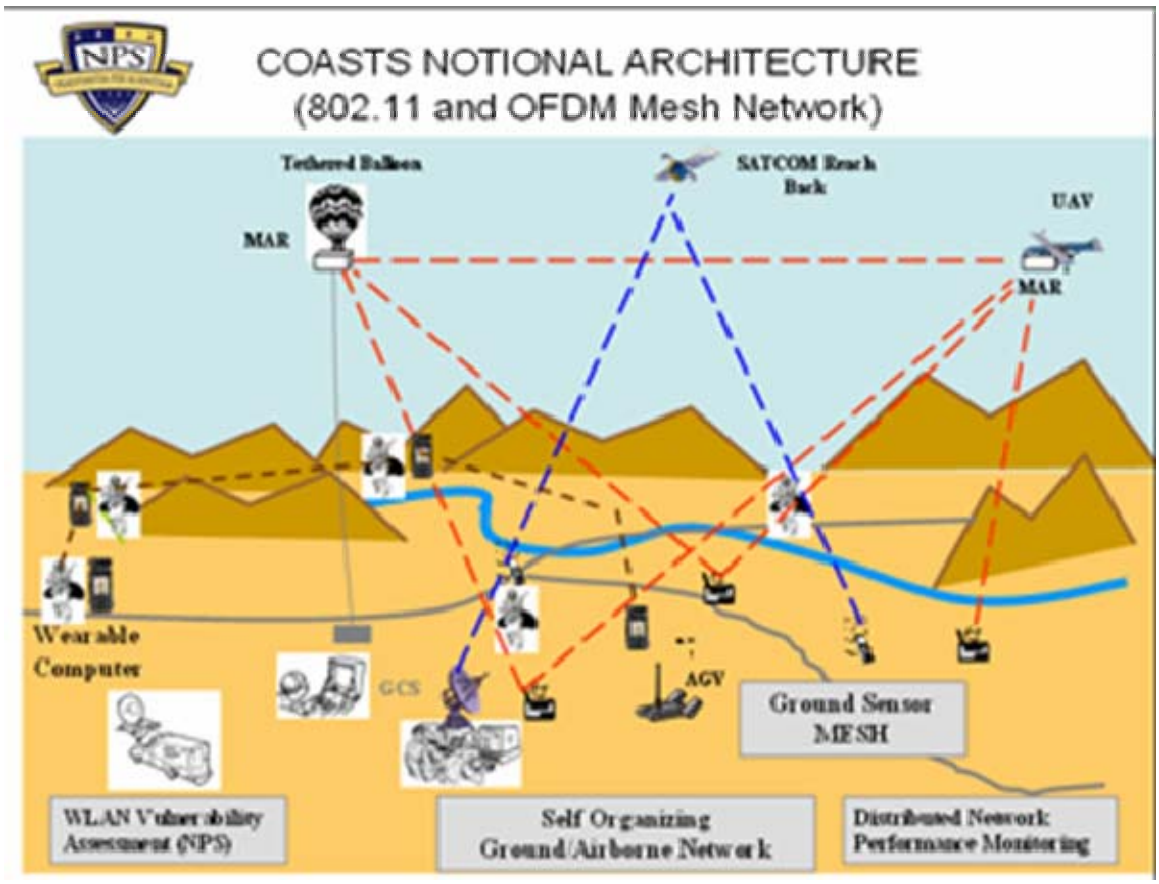

Figure 26. COASTS Notional Architecture

The Southern Border

As detailed in Chapters II and III, over the past 30 months, the RTG has been involved in a bloody insurgency in the Muslim-majority southern, specifically at the border in the provinces of Patani, Yala, and Naratiwat. Various ethnic Malay-Muslim separatist groups are fighting to establish an independent state. Since January 2004, more than 800 people have died in a slew of shootings and bombings in the provinces of Pattani, Yala and Narathiwat.[231]

231 Rueters On-Line, http://www.alertnet.org/thenews/newsdesk/BKK56496.htm (accessed 28 August 2005).

COASTS, even though initially intended for employment along the Thai-Burmese border, should be considered by the RTAF and RTG for implementation along their southern border as well. This project has the capability to provide the necessary intelligence to help secure their southern border. In fact, the COASTS program addresses many of the RTARF's requirements relating to border security by embracing and leveraging commercially available technology, increasing overall military effectiveness, highlighting the utility of a UAV as a reconnaissance platform, and providing an alternative, and low-cost solution, to indigenous R&D efforts. In addition, all of these factors are accomplished while reducing manpower or the "personnel footprint," a key point, especially when taking into consideration the history of the Thai-Malay border.

V. CONCLUSION

Research documents that the motivation to conduct or engage in armed conflict stems primarily from perceived differences in political and economic status and religious ideologies and beliefs. These perceived concepts and the resultant armed resistance that forms has existed for decades, if not centuries. Low-intensity conflict, insurgency operations, and asymmetrical warfare are all terms synonymous with the various struggles and resistance that have resurfaced after September 11th and the entry into the War on Terror; the conflict in southern Thailand is no exception. The labels attached to these struggles are used to identify the many ways in which fundamentalist organizations around the world operate to include groups such as Al Qaeda, Jemaah Islamiyah (JI), and the little known separatist groups in Thailand's southern border region, i.e. the Pattani United Liberation Organization (PULO), Barisan Revolusi Nasional – BRN, and Gerakan Mujahideen Islam Pattani (Pattani Islamic Mujahideen Movement) – GMIP just to name a few.

This thesis has described in some detail the resurgence of ethno-religious violence that has resurfaced in southern Thailand after a two decade absence and one possible solution to reduce or mitigate the violence now ravaging southern Thailand: the employment of technologies such as those used in NPS' COASTS field experiment program.

In this analysis, the plight of the Malay-Muslims in southern Thailand was outlined. The research started with a fairly detailed history of southern Thailand, describing how Islam came to the region and the emergence of Patani Raya or the Greater Patani State. Furthermore, it described how Patani Raya was considered, at one time in history, as one of the cradles of Islam in the region. In addition, the historical conflict between the central Thai state and the ethnic Malay-Muslims of southern Thailand was also explored. Highlights included the Muslim-Malay separatist ideology that developed in southern Thailand through "internal colonization," the perceived differences of the Malay-Muslims by the central Thai government, and the results of incomplete nation building. Evidence was provided to show that internal factors, such as the various Thai

government policies used against the Malay-Muslims, and external factors, such as the porous border region, dual-citizenship, and the Malaysian political party PAS, have combined to play a major role in shaping southern Thai separatist ideology.

However, the main intent of this thesis was to bridge the information gap that exists between the theoretical sphere and the operational sphere of how to provide a potential answer to reducing the violence that is currently plaguing one of the US' closest allies in Southeast Asia. This thesis has made an argument that one possible solution to reducing violence in southern Thailand is for the RTG to implement technologies such as those tested in the NPS COASTS field research program. These technologies certainly have applicability along the Thai-Malay border.

The COASTS program is beneficial to both the US and to the RTG for various reasons. It is beneficial to the RTG because it provides a possible solution to one of their national security problems, namely porous borders. The RTG understands their "open" borders are a detriment to their internal security as well as to regional stability. Whether in the context of illicit drug trafficking, the trafficking of people, or insurgency/militancy, the RTG recognizes that sealing their borders is a national priority. The Thai government also realizes how counter-insurgency campaigns require the ability to perform various missions with high speed, small size, and reliable technology. With this in mind, the RTG has asked the US for assistance in developing a reliable, fairly inexpensive border security system to support their border security requirements.. NPS responded by developing the COASTS program focused on low-cost solutions for border defense through integration of commercial-off-the-shelf technologies. Ultimately, the COASTS program provides the necessary shared situational awareness (SSA), command and control (C^2), and intelligence, surveillance, reconnaissance, and targeting (ISRT) capability to bolster Thailand's intelligence apparatus and to combat the asymmetrical threats which are occurring within southern Thailand.

The COASTS program also meets the spirit and intent U.S. Pacific Command's (USPACOM) science and technology research requirements, specifically relating to theater security and the War on Terror (WOT). Additionally COASTS demonstrates USPACOM's commitment to foster stronger multi-lateral relations in the area of

technology development and coalition warfare with key Pacific AOR allies in the WoT, of which the Kingdom of Thailand is a major partner.

During 2005, the COASTS program twice deployed teams to Lop Buri, Thailand. The first deployment was in March 2005; the objective for this deployment was to conduct a rehearsal of the various nodes and communications links in preparation for the deployment that would take place in May 2005. During the May 2005 field experiment, the COASTS team successfully integrated Unmanned Aerial Vehicles (UAVs), aerial balloons (LTA vehicles), portable and fixed ground-based sensors, Global Positioning System (GPS) and non-GPS enabled tracking systems, as well as other technologies to provide shared situational awareness to local and strategic users. This demonstration focused on integrating all of the sensor data at a Royal Thai Army command and control vehicle, called a Mobile Command Platform (MCP), and then linking it to higher headquarters, specifically the Royal Thai Air Force Headquarters (RTAF HQ) and the Royal Thai Supreme Command (RTSC), both located at different compounds in Bangkok, Thailand. While the program was very successful for its first deployment several lessons were learned, and actions to correct the findings are currently underway. Planning for COASTS 2006 is currently underway with all lessons learned from 2005 taken under advisement.

It can be concluded that NPS' COASTS field experiment provided insight to technologies, which may help fulfill the RTG's requirements for a low-cost, technology-based border defense system to assist RTARF intelligence units and RTG command authority in support of counter-insurgency operations aimed at reducing the violence associated with Malay-Muslim separatisms in southern Thailand.

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APPENDIX A. COASTS CONCEPT OF OPERATIONS

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1.0 Purpose.

This document describes the Concept of Operations (CONOPS) for the development and implementation of a Naval Postgraduate School (NPS) research project entitled Coalition Operating Area Surveillance & Targeting System (COASTS). COASTS support U.S. Pacific Command (USPACOM) science and technology research requirements relating to theater security and the War On Terror (WOT). This CONOPS is primarily intended for use by the Naval Postgraduate School and USPACOM management team and participating contractors and coalition partners. However, it may also be used by other Department Of Defense (DOD) organizations when applicable. The research and development of COASTS is described in this document as well as the proposed timetable for a series of limited objective experiments (LOE's).

1.1 Background.

The COASTS proposed coalition field experimentation concept is modeled after a very successful ongoing NPS-driven field experimentation program known as STAN. NPS, in cooperation with U.S. Special Operations Command (USSOCOM) and several contractors, has been engaged in a Research and Development (R&D) program entitled Surveillance and Target Acquisition Network (STAN) since FY2002. The program was initiated in support of a USSOCOM requirement for integrating emerging WLAN technologies with surveillance and targeting hardware/software systems to augment Special Operations Forces missions. STAN has grown significantly since inception to include 10-12 private sector companies demonstrating new hardware/software capabilities, several DoD organizations (led by NPS) introducing operational and tactical surveillance and targeting requirements, as well as other universities contributing solutions.

1.1.1 STAN Specifics.

STAN field experiments occur quarterly as a 1-2 week long complex experiment comprising 8-10 NPS faculty members, 20-30 NPS students, and representatives from multiple private companies, DoD and US government agencies. Major STAN objectives are as follows:

- Provide an opportunity for NPS students and faculty to experiment/evaluate with the latest technologies which have potential near-term application to the warfighter.
- Leverage operational experience of NPS students and faculty
- Provide military, national laboratories, contractors, and civilian universities an opportunity to test and evaluate new technologies in operational environments
- Utilize small, focused field experiments with well-defined measures of performance for both the technologies and the operator using the technologies
- Implement self-forming / self-healing, multi-path, ad-hoc network w/sensor cell, ground, air, SATCOM network components

Examples of STAN experiments:

- 802.11b/g / OFDM / 802.16 architecture
    - Network performance to include wireless traffic monitoring
    - Network vulnerability and intrusion detection capabilities
    - ARIES AUV – TERN UAV/balloon– TOC video transfer
    - Target geo-location from UAV video using live image differencing
    - Tasks and functions for TUAV in support of recognized maritime picture
- Red Team intent
    - INTER-4 Tacticomp (hand-held network enabled PDA)

1.1.2 STAN Limitations.

1.1.2.1 Sensitivities with Foreign Observers/Participants.

Certain hardware, software, and tools/tactics/procedures (TTP's) implemented at STAN field experiments are classified or operationally sensitive and as a result STAN sponsors have not agreed to foreign military partnerships. Despite DOD requirements to operate in coalition environments, to strengthen relationships with foreign military partners, and to execute operations globally, STAN field experiments remain primarily a US-only event.

1.1.2.2 Meteorological, Hydrographic, & Geographic Considerations.

All STAN field experiments have been conducted at NPS's facilities in the Monterey California area. This vegetation and climate is not representative of the Pacific Area of Responsibility (AOR)—a likely deployment location for these tactical or operational WLAN and surveillance/targeting technologies. Higher temperatures and humidity, as well as denser vegetation in areas like Thailand and Singapore, will likely create WLAN and sensor performance problems.

1.1.3 COASTS.

1.1.3.1 Purpose.

COASTS will leverage and integrate the technological expertise of the program's education and research partners with the operational requirements and challenges of using WLAN technologies in a tactical, coalition environment. Additionally COASTS will demonstrate USPACOM commitment to foster stronger multi-lateral relations in the area of technology development and coalition warfare with key Pacific AOR allies in the WOT.

1.1.3.2 Strategy.

COASTS will serve as a mobile field test bed environment for R&D, integration, operational testing, and field validation of several emerging wireless technologies and equipment suites (such as 802.11, 802.16, orthogonal frequency division multiplexing (OFDM), free space optics (FSO), satellite communications (SATCOM), etc.) in a tactical coalition environment.

1.2 References.

- Joint Doctrine for Information Operations, Joint Pub 3-13, 9 October 1998

- Joint Doctrine for Command and Control Warfare (C2W), Joint Pub 3-13, 7 February 1996

- Joint Doctrine for Operations Security, Joint Pub 3-54, 24 January 1997

- Joint Doctrine for Command, Control, Communications, and Computer (C4) Systems Support to Joint Operations, Joint Pub 6-0, 30 May 1995

1.3 Scope.

This CONOPS applies to the employment of the COASTS project as part of the NPS R&D program. It will also serve as the base document for the CONOPS addressing the employment of COASTS, in part or in whole, in support of exercise COBRA GOLD 2005 or other similar exercises, events, or demonstrations. The CONOPS will provide a technical and tactical framework for operational scenarios used during FY05 and reflect the employment of the COASTS system as an integrated component to support emerging Regional Combatant Commander and DOD requirements for coalition operations. This CONOPS will cover the use of COASTS as a stand-alone or networked capability focused on Joint/coalition mission profiles that can be enhanced by the employment of COASTS technologies.

2.0 Overview.

2.1 Current Situation.

As reflected by the increasing number of requests to NPS from foreign partners, there is an operational requirement for low-cost, state-of-the-art, real-time threat warning and tactical communication equipment that is rapidly scaleable based on operational considerations. Unlike STAN most current tactical systems lack the capability to rapidly enable a common operating picture amongst air, surface, and sub-surface entities via a self-forming, self-authenticating, autonomous network. Although commercial-off-the-shelf (COTS) technologies exist that can satisfy some of these requirements, they typically do not meet all of the DOD and coalition partner requirements associated with WOT and other

security missions. The objective of COASTS is to demonstrate that NPS and coalition R&D, in concert with COTS capabilities currently available, can satisfy all of the technical and tactical requirements.

2.2 System Summary.

COASTS is an individual and small unit network-capable communication and threat warning system using an open, plug-and-play architecture, which is user-configurable, employing air balloons, UAVs, and portable and fixed ground-based sensors, i.e. soldiers equipped with Tacticomp or similar PDAs, all communicating via wireless network technology.

2.3 Capabilities.

COASTS provides a mobile field test bed environment for U.S. and coalition partners in support of R&D, integration, operational testing, and field validation of several emerging wireless technologies and equipment suites as follows:

- 802.11 a/b/g
- 802.16
- Orthogonal Frequency Division Multiplexing (OFDM)
- Free Space Optics (FSO)
- Satellite Communications (SATCOM)

2.4 Major Components.

While the final configuration of the COASTS system has not yet been determined, the following describes the core components of the basic ensemble:

- Networked Unmanned Aerial Vehicles (UAV's)
- Unmanned Underwater Vehicles (UUV's)
- Unmanned Ground Vehicles (UMV's)
- Tethered wireless network connected balloons
- Manned and unmanned sensors of many types
- Surveillance and targeting systems
    - Situational awareness common operating picture (SA COP) systems

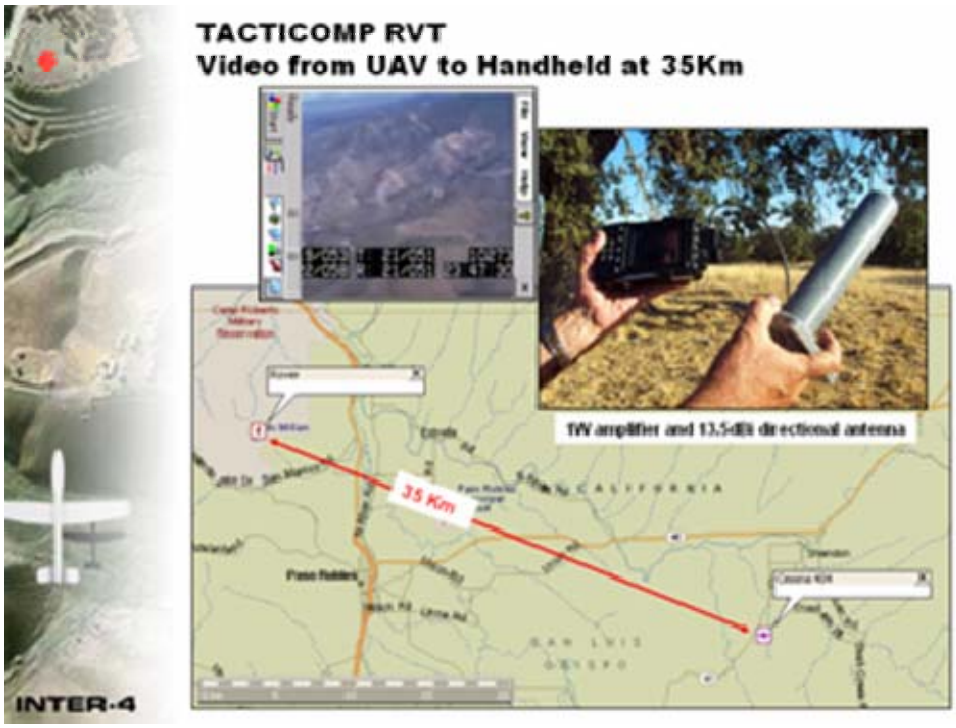

Figure 1.

INTER-4 Tacticomp Handheld GPS Enabled Networked Situational

Awareness Tools

2.5 Configurations.

COASTS will have three basic configurations: as a command, control, collection, and communication suite; a threat warning system; an intelligence collection system.

Figure 2.

STAN Tactical Operations Center (TOC)

Foreground – Network Monitoring Suite

Background – GPS Enabled Situational Awareness Suite

3.0 Concept of Operations.

3.1 Users.

COASTS will create an international interaction mechanism for U.S. military forces, to include NPS, to collaborate with coalition partners and allies to support War on Terror (WOT) objectives and requirements using the latest wireless networking technologies, tools, tactics and techniques. NPS, Thailand and Singapore are the proposed initial team that will integrate COASTS into a system to facilitate surveillance and monitoring of "areas of interest" for each country respectively.

3.2 COASTS Support for Principal Mission Areas.

As per Joint Doctrine, COASTS will directly support organizing training, and equipping U.S. military forces and the Thailand/Singapore Defense Forces in seven principal mission areas:

(1) Direct Action (DA): The primary function of COASTS during DA missions is to provide Force Protection. DA missions are typically short-duration, offensive, high-tempo operations that require real-time threat information presented with little or no operator interface. COASTS will augment other capabilities in direct support of the DA from an overwatch position. COASTS in support of the DA will target collection to support threat warnings relevant to that specific operation and provide automated reporting to the Tactical Operations Center (TOC) for potential threats relevant to a specific mission. COASTS may also be used as the primary source of threat information in the absence of other capabilities. Threat information presented by COASTS is intended to be relevant, real-time or near real-time, and within its area of operation.

(2) Tactical Reconnaissance (TR): The primary purpose of a TR mission is to collect information. COASTS will augment other capabilities to obtain or verify information concerning the capabilities, intentions, locations, and activities of an actual or potential enemy. COASTS will support the full range of information and communication functions. COASTS will support operators to collect, process, analyze, and disseminate information rapidly. COASTS performance in this mission will be affected by meteorological, hydrographic, or geographic considerations; in these scenarios, COASTS will primarily support Force Protection.

(3) Foreign Internal Defense (FID): COASTS will assist Host Nation (HN) military and paramilitary forces with the goal to enable these forces to maintain the HN's internal stability.

(4) Combating Terrorism (CT): COASTS will support CBT activities to include anti-terrorism (defensive measures taken to reduce vulnerability to terrorist acts) and counterterrorism (offensive measures taken to prevent, deter, and respond to terrorism), taken to oppose terrorism throughout the entire threat spectrum.

(5) Civil Affairs (CA): COASTS will assist CA activities in peacetime to preclude grievances from flaring into war and during hostilities to help ensure that civilians do not interfere with

operations and that they are protected and cared for if in a combat zone.

(6) Counter-proliferation of Weapons of Mass Destruction (WMD): COASTS will assist traditional capabilities to seize, destroy, render safe, capture, or recover WMD. COASTS can provide information to assist U.S. Military Forces and coalition partners to operate against threats posed by WMD and their delivery systems.

(7) Information Operations (IO): COASTS can augment actions taken to affect adversary information and information systems while defending one's own information and information systems. IO applies across all phases of an operation and the spectrum of military operations.

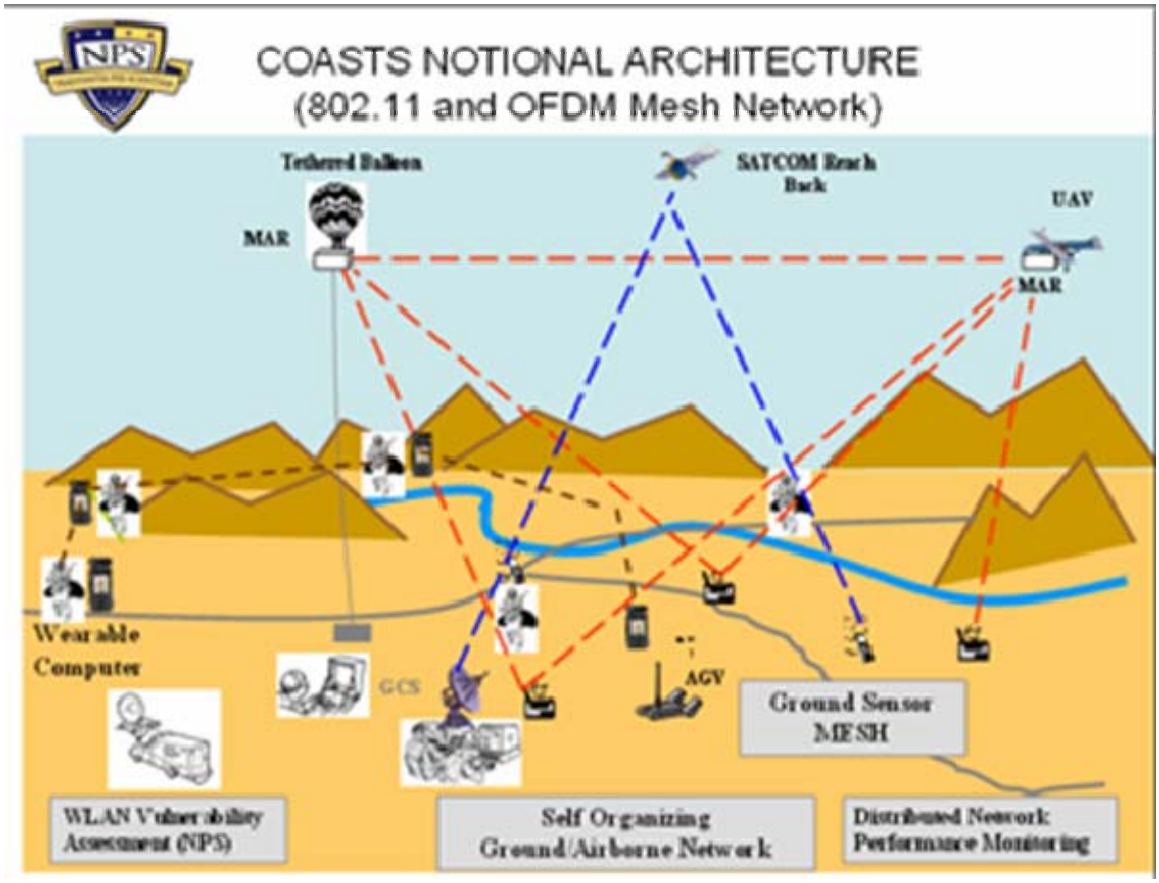

Figure 3.
Potential FY05-06 COASTS Architecture & Enabling Technologies

3.2.1 Thailand Requirements.

3.2.1.1 Thailand Requirement Overview.

Thailand has a 2500 kilometer border with Myanmar that requires its military assets to patrol, as well as to provide surveillance, monitoring and targeting to combat drugs from entering the country via Myanmar. This narco-terrorism problem is significant for both Thailand and the U.S. as much of the illicit drug trafficking supports the finances and operations of terrorist organizations. In addition, some of the drugs that do slip through Thailand's security infrastructure end up on the streets in the U.S. via container shipping in the Straits of Malacca and Singapore Straits. The Royal Thai Air Force (RTAF) has been assigned the responsibility of patrolling the Thailand/Myanmar border areas by the Thailand Ministry of Defense (MOD).

3.2.1.2 COASTS Support to Thai Requirements.

The RTAF has recently approached NPS for assistance using WLAN's and related surveillance/targeting technologies to augment their border patrolling resources. The RTAF has been considering using UAV's and sensor meshes to patrol this long border, and is aware of NPS's STAN field experiment program. COASTS appears to be suitable as a technology collaboration vehicle, but also as a demonstration and field test environment with Thailand to develop the capability for real-world information gathering and dissemination on their narco-terrorism and human slave trafficking problems.

3.2.2 Singapore Requirements.

3.2.2.1 Singapore Requirement Overview.

Singapore, as a small island city/state surrounded by water, has grave concerns about the alarming increase in the frequency of piracy near the country. Singapore is also in very close proximity to two key international shipping waterways, the Singapore

Straits and the Straits of Malacca that are attractive targets for terrorists to exploit the container shipping industry in those waterways. About 80 percent of the world's container shipping vessels pass through these two key Southeast Asian waterways. Singapore is currently able to identify and track a small portion of these container ships in their littoral waterways with current resources and technologies.

3.2.2.2 COASTS Support to Singapore Requirements.

Singapore has also recently contacted NPS about collaboration using WLAN and related surveillance/targeting technologies to patrol the Straits of Malacca and the Singapore Straits. The National University of Singapore (NUS) and a research/development lab on the NUS campus – the Temasek Labs have had a long-standing relationship with NPS. NUS/Temasek Labs have had a masters degree program for several years, with NPS faculty deploying to Singapore to teach part of a technical curriculum at the University. NPS also has had significant interaction with Singapore's Defense Science & Technology Agency (DSTA). DSTA has expressed interest in collaborative WLAN and surveillance/targeting research with NPS. We envision both Temasek Labs and DSTA as key coalition partners for the COASTS initiative. Temasek Labs and DSTA have been conducting research in the WLAN space for some time, and there are some technologies they are investigating that could be of great value to NPS and DOD.

3.3 LOE Implementation and Objectives.

3.3.1 Phased Approach.

A phased spiral development will be implemented culminating with two or three major demonstrations. Phase I – will consist of a technology search of existing off-the-shelf capabilities and a limited integration that can be quickly tailored / packaged to enhance the missions described in paragraph 3.3 above. Demonstration One would focus on the near term problem of setting up one COASTS node and

displaying a real-time, or near real-time, automated communication link between an aerial balloon and a ground sensor in support of exercise COBRA GOLD 2005. Phase I ends with the first demonstration in the 3rd Quarter of FY05. Phase II – will integrate and demonstrate additional capabilities into a more robust system. Operators will pick the capabilities after the conclusion of Phase I. Phase II will conclude with a second demonstration in the 4th Quarter of FY05 in the Singapore Straits of Malacca region.

3.3.2 Phase I - NPS.

NPS would invite foreign COASTS participants to NPS for the next Field Experiment (November 2004) as observers. NPS will desensitize the November 2004 Field Experiment such that COASTS foreign partners will be able to observe the overall experiment. This will enable the foreign partners to see first hand a WLAN-enabled surveillance and targeting operation. It is also possible to add new experiments to the NPS November 04 Field Experiment on the coast near Point Sur to test an 802.16 point-to-point network's performance over water (a study of WLAN performance in the littorals). This would correlate well with demonstrations outlined below in Thailand and Singapore (specific CONOPS are in development).

3.3.3 Phase II – Thailand.

Introduce a COASTS demonstration into Exercise Cobra Gold in April 2005 to prove a permanently deployed tactical WLAN's ability to monitor a border region (such as the Thailand/Myanmar border region). To keep the scope manageable NPS proposes implementing only a limited number of STAN-like technologies and experiments with very specific goals and objectives such as possibly using only a balloon (vice a UAV) to create an 802.11 (2.4 GhZ) local area tactical network footprint, having one 802.16 or OFDM (5.8 GhZ) backbone long haul link, setting up and operating a simple tactical operations center (TOC) that collects and displays data feeds, introducing a few unmanned sensors (such as seismic monitors, sound sensors, and streaming ground or balloon originating video feeds), deploying a few personnel using wearable networked computing devices, or INTER-4 Tacticomps, and integrate an existing GPS enabled Situational Awareness system.

3.3.3.1 Specifics:

An additional set of relatively simple tests, modeled after an experiment proposed for the November 04 Field Experiment, will be conducted as "littorals operations" setting up a point-to-point 802.16 access point enabled WLAN on the coast in Thailand with a ship positioned to access the network. A Test Plan would be developed with the ship moving further and further away from the access point while collecting network performance data (throughput measuring performance with different types of data such as voice, video, data – all at varying distances). This experiment could also focus on meteorological information as it effects network performance (throughput and sensor performance), as the much higher levels of moisture in the Gulf of Thailand will significantly impact performance of networks and sensors.

This notional integration with exercise Cobra Gold 2005 will allow partners an opportunity to test various technologies in different environments without the complexity and risk of flying UAV's.

3.3.4 Phase III - Singapore.

Tentatively conduct another demonstration in Singapore later in CY 2005 to demonstrate a permanently deployed tactical WLAN's utility for monitoring a key waterway (such as the Straits of Malacca), but add technologies that may include some of the following: sensors, UAVs, UUVs, surface vessels, SATCOM components, and experimentation over land and water. Singapore has also expressed interest in testing a manned ground vehicle in a WLAN environment (mobile WLAN nodes) similar to NPS's STAN program.

3.3.5 COASTS Critical Event Schedule.

Table 1 below depicts a high level of schedule of critical events projected for the COASTS project. Included are the critical development and demonstration milestones.

Task	Projected Date
Thailand RTAF Planning Visit (at NPS)	SEP 04
Singapore DSTA/NUS/Temasek Labs Planning Visit (at NPS)	NOV 04
Field Experiment (at NPS)	NOV 04
Cobra Gold 05 CDC (at USPACOM)	NOV 04
Cobra Gold 05 Planning Meeting I and II (in Thailand)	OCT 04 and JAN 05 respectively
Cobra Gold 05 Demo (in Thailand)	APR 05
Singapore Demo (in Singapore)	JUN 05
COASTS 05 Lessons Learned/06 Planning Meeting (Location TBD)	AUG 05
Field Experiments (at NPS)	NOV 05
Cobra Gold 06 Planning Meeting	TBD: OCT 05 – MAR 06
Cobra Gold 06 Demo (in Thailand)	TBD: APR 06

Table 1: Critical Events

3.4 Critical Operational Issues (COIS), Measures of Effectiveness (MOEs) and Measures of Performance (MOPs).

The COASTS project has three primary overarching COIs:

- Does COASTS provide threat warning information as part of a wireless LAN/WAN?

- Does COASTS meet performance requirements when deployed to Thailand (ground/jungle scenario)?

- Does COASTS meet performance requirements when deployed to Singapore (water scenario)?

The COASTS Oversight Group (see 4.1 below) will refine and finalize the supporting MOEs and MOPs, linked to specific operational tasks, standards and conditions, based on the evolving CONOPS for each specific demonstration. The assessment strategy and the final assessment criteria will be clearly delineated in the demonstration CONOPS.

4.0 Management Strategy.

4.1 Participating Organizations, Roles, and Responsibilities.

4.1.1 COASTS Oversight Group.

- Chair: NPS Dean of Research
    - Members: NPS Principal Investigator, NPS Operational Manager, and NPS Technical Manager

4.1.2 NPS Principal Investigator (PI).

Lead element of the COASTS project; responsible for project oversight, coordination between NPS, DOD, foreign partners, and commercial vendors; responsible for all fiduciary reports and contractual agreements.

- Co-PI: Mr. Brian Steckler and Mr. James Ehlert

4.1.3 NPS Operational Manager (OM).

The OM is responsible for developing all demonstrations, plans, collection and dissemination of data, site surveys, Measures of Effectiveness (MOE), Measures of Performance (MOP), NPS resource allocation, internal NPS coordination, and support to the PI.

The OM plans, coordinates and directs all user activities related to the COASTS project. The OM will develop and provide the CONOPS, TTPs, operational mission scenarios, and the overall utility assessment. Additionally, the OM will coordinate administrative tasks for user participants, equipment and facilities supporting demonstration events.

- OM: Captain Gary Thomason, USMC

4.1.4 NPS Technical Manager (TM).

The TM is responsible for technical management including program management, engineering, and acquisition of technologies to integrate and demonstrate. The TM will provide technical support to the OM and manage all funding and technology development efforts related to the COASTS project. The TM has the overall responsibility for establishing criteria for technical performance evaluations.

- TM: Assignment TBD

4.1.5 Participating Test Organizations.

The primary organization for assessment for the COASTS project is the Naval Postgraduate School. Other participating organizations are as follows:

- U.S. National Tactical Integration Office (NTIO)
- U.S. Pacific Command (USPACOM)
- U.S. Joint Information Operations Command (JIOC)
- Royal Thai Air Force (RTAF)
- National University of Singapore (NUS)
- NUS's Temasek Labs
- Singapore's Defense Science & Technology Agency (DSTA)

4.2 Risk Assessment, Management and Mitigation.

Overall risk is estimated to be low to medium for the COASTS initiative. Risks can be mitigated by either reducing or adding additional experiments as appropriate. Table 2 depicts the NPS developed risk matrix:

Risk Area	Rating	**Mitigation Approaches**
Technology	Low Medium	- leverage STAN technology - early/continuous coordination with partners - early prototyping - multiple data collection events - modeling and simulation - in-process reviews

Schedule - Technical	Low Medium	- schedule estimates based on technology provider agreements - schedule estimates incorporate STAN lessons learned
Schedule - Demos	Low Medium	- incremental demonstrations - identify/leverage existing events
Assessment	Low	- develop MOEs and MOPs
Funding	Low	- significant funding confirmed ($500k), additional sponsors contacted

Table 2: Risk Matrix

4.3 Development Strategy.

The success of COASTS is dependent on the establishment of an open architecture that will facilitate the standardization and COTS interfaces that are critical to the system's ability to keep pace with technology and to be available to coalition partners.

A major element of the COASTS project will be to develop concepts of operation and Joint/Coalition tactics, techniques, and procedures for all the technologies integrated into the system.

4.4 Acquisition and Contracting Approach.

Development and integration efforts will consist of contractor and in-house government activities using a variety of contract vehicles. Contractors and vendors that are currently providing some of the technologies for Field Experiments will be approached and offered an opportunity to participate on a no-cost to the COASTS program basis (they will have an opportunity to demonstrate their technologies to US and foreign partners in a marketing and testbed environment that is extremely difficult to replicate on their own). Most contracts will be based on modifications of existing contractual arrangements.

5.0 Training, Logistic and Safety.

5.1 Training.

A primary goal of the COASTS project is to execute operational demonstrations with U.S. and coalition warfighters. Accordingly, appropriate training materials will be developed for each demonstration and operator training will be conducted prior to each demonstration. Training will be performed by a combination of contractor and government personnel. There are also significant hands-on educational opportunities for NPS students, and it is expected that multiple NPS masters theses will be generated by participating US and foreign NPS students.

5.2 Logistics.

Maintenance and logistics support will be conducted using a combination of contractor support and in-house NPS expertise and facilities. This includes the development and distribution of maintenance, training, and operating manuals, instructions, or materials. During the demonstrations, reliability, availability, and maintainability information will be collected for later analysis and review.

5.3 Safety.

There could be safety or potential environmental hazards associated with technologies being considered. As needed a safety analysis will be performed to identify potential safety hazards and risks and determine appropriate controls to preclude mishaps and reduce risks. The OM will coordinate all safety efforts associated with demonstrations.

6.0 Modifications.

This CONOP is intended to be a living document. It will be updated as required to reflect changes to the COASTS project. Most modifications will be at the discretion of the COASTS Oversight Group who will approve any substantive alterations to include changes in objectives, funding, schedule, and scope. Any changes, which materially affect commitments made by coalition partners, will be approved by the affected organizations.

7.0 Points of Contact.

- Mr. Brian Steckler, Information Sciences Department Faculty, (831) 656-3837, steckler@nps.edu

- Mr. James Ehlert, NSA Cryptologic Research Chair for NPS and NPS Faculty, (831) 656-3200, jfehlert@nps.edu

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APPENDIX B. COASTS AFTER ACTION REPORT

28 July 2005

From: James Ehlert, Naval Postgraduate School
To: Information Sciences Department, Naval Postgraduate School (NPS)

Subj: AFTER ACTION REPORT FOR COASTS 2005, MAY 06-21

Ref:
(a) Concept of Operations (dated 15 March 2005)
(b) Operations Order 02-05 (Thailand Rehearsal)
(c) Operations Order 04-05 (Thailand Demonstration)
(d) COASTS 2005 March After-Action Report (dated 21 April 2005)

Encl: (1) Personnel Roster
(2) After Action Report 802.11/802.16
(3) After Action Report Balloon
(4) After Action Report UAV
(5) COASTS 2006 Initial Concept Timeline and Recommendations

1. Background. The COASTS program is a joint project between the NPS and the Royal Thai Armed Forces. The COASTS program is interested in researching low-cost, state-of-the-art, rapidly scaleable airborne and ground communications equipment suites including various wireless network technologies. Along with the organizations mentioned above, numerous commercial vendors participated in the program to include Mercury Data Systems, Cisco Systems, CyberDefense UAV, Inter-4, Rajant Corporation, and Redline Communications.

(a). COASTS Field Experimentation

During a field experiment conducted in Lop Buri, Thailand during May 2005, the COASTS team successfully integrated Unmanned Aerial Vehicles (UAVs), aerial balloons, portable and fixed ground-based sensors, Global Positioning System (GPS) and non-GPS enabled tracking systems, as well as other technologies to provide shared situational awareness to local and strategic users. This demonstration focused on integrating all of the sensor data at a Royal Thai Army command and control vehicle, called a Mobile Command Platform (MCP), and then linking it to higher headquarters, specifically the Royal Thai Air Force Headquarters (RTAF HQ) and the Royal Thai Supreme Command (RTSC), both located at different compounds in Bangkok, Thailand.

2. Mission. In conjunction with the Royal Thai Armed Forces (RTARF), the COASTS team conducted an operational rehearsal of the COASTS network topology in the Wing 2 (Lop Buri) training area of Thailand from 06-21 MAY 2005. Further details pertaining to

operational issues can be found in the Operations Orders 02-05 and 04-05 (references b and c respectively).

3. Personnel. The COASTS team consisted of four faculty and eleven students from the NPS. In most case, students were either conducting thesis research or deciding on a thesis research topic. Several civilians representing private companies were also present to assist in implementing the technologies that COASTS employs. See Encl (1) for a detailed roster of the team.

4. Operations.

a. Scheme of Maneuver.

Per the previous deployment to Thailand in March 2005, a field research exercise and demonstration was conducted in an iterative manner. Building on the detailed field rehearsals which were conducted at Ft. Ord, California in February 2005 and the March 2005ndeployment to Thailand, the network was re-established in Wing 2 (Lop Buri). This evolution was completed in four phases as follows:

- Preparation
- Network set-up
- Network integration
- Recovery.

For this deployment, the preparation phase also included the evaluation period from the March lessons learned.

(1) Preparation Phase.

The team was initially formed in January of 2005; several organizational, planning, and equipment purchasing issues were resolved during this phase. As some equipment did not arrive until after the February rehearsal, there was no opportunity to properly test and integrate those technologies into the network during the initial experimentation phase. The NPS acquisition staff did an outstanding job in responding very rapidly to purchase order requests; however, due to the cutting edge nature of this project, and the team's unfamiliarity with many of the technologies and equipment requirements, many items were not identified until very late in the preparation phase. There was a steep learning curve, but all parties persevered and ultimately acquired all necessary equipment for the deployment.

Detailed coordination with our Thai counterparts was difficult. This was primarily due to the fact that assignments within the RTARF were not clear until the team's arrival in country. The team deployed to Thailand with several important technical questions, relating the topology, unanswered.

The redeployment to Thailand in May 2005 involved many of the same difficulties from the March 2005 deployment, as well as some new ones. Most significant of the new

problems were the loss of key personnel, and the sudden addition of certain new team members. Both the student team leader and the network lead left COASTS immediately after the return from the March 2005 rehearsal. The addition of four new personnel to the COASTS May 2005 deployment team also increased the difficulty level of integrating a functional team for demonstration.

(2) Network Set-up Phase.

This phase was difficult yet successful. The ambitious goal was to arrive in Thailand with all coordination and knowledge needed to integrate with RTARF and successfully build the network in short order; in reality, the advanced party's detailed site coordination visit was being completed even as the main team members arrived in country.

Many important technical questions were not answered until the COASTS team members physically arrived at their operating locations around Thailand. The team was able to rapidly assess the situation on the ground and react accordingly to construct the network. The COASTS team was undermanned and strained; especially when operations required team members to be spread across multiple sites. The civilian vendor representatives played a critical role in filling gaps in the need for additional personnel.

The majority of the problems identified during and after the March 2005 rehearsal were handled by the advanced party for the May demonstration, which was deployed to Thailand one week before the departure of the main body. With a combined two-person team, many of the identified problems were able to be completed prior to main body arrival. Considerable network set-up, logistical management, and site survey re-verifications were accomplished during this lead time.

(a) Airborne Wireless Access Points

Employing a stationary, lighter-than-air vehicle equipped with a wireless access point is perhaps well suited to extend the effective wireless network range and user connectivity. For example, a helium filled, tethered balloon offers the advantage of a line of sight (LOS), over the horizon (OTH), Wi-Fi relay platform. This same balloon can be outfitted with various antennas and amplifiers enabling the free-flow of viable information to and from the on-scene commander who may be positioned to support other assets miles away. In fact, helium balloons offer an inexpensive solution to maintaining the visual, audio, and sensory information required to conduct operations. These balloons can be deployed within minutes and maneuvered into a position (altitude) several thousand feet in the air with a minimum radar cross section (RCS) and at an altitude safe from light arms fire. Equipped with an antenna, and the appropriate RF hardware, ground-based users can access the local tactical network through the balloon and receive real-time information while performing their mission. The variety of information transferred is limited to the 802.11 bandwidth and the software capabilities of the individual units.

Peacekeeping, law enforcement, and first-responder personnel are frequently called upon to enter physical environments that adversely affect, or limit, the capabilities of current communication tools. Combining an all-weather balloon, equipped with Wi-Fi technology, and multiple ground Wi-Fi units, offers almost instant situational awareness

and communications over any land or water mass. This connectivity can reduce response times and tactical decisions and thereby create advantages for the on-scene commander.

(3) Network Integration Phase.

The biggest challenge during this phase was establishing the links between Wing 2 and the RTAF headquarters. The COASTS team brought several Cisco routers to Thailand in order to make this happen. The team worked side by side with the Thai communications staff at their network facilities to install and configure the routers. Much troubleshooting and network experience was required to make the links work, but all links were up and tested by Monday of the second week.

Another challenge, during network integration, was implementing various bandwidth enhancements. These enhancements were devised after learning the network's limitations during the March 2005 evolution. One of these enhancements, implementing multicast, proved to be easy to configure. Multicasting was difficult to operate smoothly and the quality of multicast streaming video was very low. This caused the team to revert to less efficient unicast video streaming.

The other attempted measure was to combine the bandwidth of the two main links between Lop Buri and Bangkok. One link was a T1 (Bangkok) and the other was an E1 (Lop Buri). Overcoming the bandwidth limitations between the two data pipes turned out to be too difficult. This problem was put aside in the pursuit of other goals.

Network integration was more difficult during the May 2005 deployment. Given the close timing of the two COASTS 2005 evolutions, a number of desired trouble-shooting efforts were not able to progress sufficiently in time for the May 2005 demonstration. The foremost issue, seen during the March 2005 deployment, was significant 802.11b connection problems.

This issue necessitated the use of spectrum analyzers in the field to narrow the trouble-shooting process. The suspected conflict was signal interference between the air field assets and the COASTS 802.11b equipment. There was not enough time to obtain the necessary equipment and train operators to perform a usable RF spectrum evaluation. This particular need, as well as a host of other needs expressed in reports attached below and within the team's corporate knowledge, will be considered in planning the site survey and coordination trips prior to the first COASTS 2006 rehearsal trip.

Ultimately, the team performed a successful demonstration, even given the setbacks in network setup and loss of aerial assets.

(4) Recovery Phase.

A coalition debrief was conducted after the operation. Good feedback and lessons learned were exchanged from both sides. In addition, a draft timeline and schedule were discussed for COASTS 2006. This dialogue will prove to aid in the planning and preparation for the next deployment.

The recovery phase of the May evolution had smooth elements, which were based on experiences from the March 2005 deployment. Once again, the importance of Equipment Density Lists (EDLs) for each node was realized as a key component of the 2006 deployment. Inventorying equipment in the recovery phase was time-consuming, but with the focus of packing based on accuracy, time was not factored into the paperwork.
While the gathering and inventorying of equipment was handled properly, the packing and embarkation lacked proper attention to detail. Further care should have been taken to ensure an even weight distribution across all shipping containers, considering the high cost of transporting overweight luggage on commercial carriers. The return trip from Thailand cost over $1300 (US) in oversized baggage fees.

b. Safety.

A safety officer was appointed and an operational risk assessment was conducted. There were no major safety incidents during the trip. However, there was some unsafe activity in installing 802.16 antennas on the radio tower at Lop Buri. The surrounding environment required the antenna to be placed on the tower over 60 feet. The COASTS team did not have the proper safety equipment and had to improvise. Some safety equipment and harnesses were procured on the spot. Overall, this climbing requirement was not identified early and was a potential hazard.
The safety hazards to the climbing team at the 802.16 node were addressed through the addition of safety gear, and the focus on the usage of professional Thai climbers. No new safety hazards were experienced during the May 2005 exercise.
One safety oversight did occur since emergency cards were not distributed to the May team. Although no injury resulted, it is an important oversight to note to prevent future omissions.

5. Logistics.

a. Embarkation.

The basic embarkation plan was to shuttle the equipment in standard size Pelican cases. These cases were checked as luggage aboard commercial air. Several oversized items were shipped via FedEx to JUSMAGTHAI via our US Embassy point of contact. All items shipped FedEx were shipped prior to the team's departure, and arrived in country within days. However, it still took up to three weeks for the items to clear Thai customs. Overall, the embarkation plan worked and there were no issues.
New shipments for the May 2005 demonstration all arrived on time and none were held by customs. More equipment was brought to Thailand by the main body.

b. Equipment.

Much of the equipment for COASTS was either provided from civilian companies through Limited Purpose Collaborative Research and Development Agreements (LP CRADAs), or was procured by the team. Purchase orders (POs) were the vehicle to buy

equipment. While students are generally the individuals who identify requirements and draft POs, tight control must be kept on the process. Students that have a need to call vendors directly in planning a purchase order must be briefed on applicable rules and procedures before doing so. The staff at NPS dealing with POs was very supportive of the COASTS project and understood the reason for late requirements and the need for quick action.

c. Transportation.

A majority of the ground transportation in Thailand was provided by the RTAF. A 45 passenger bus was put in direct support of the team for a majority of the trip. This oversized bus was needed due to the amount of equipment. In addition, several civilians were accommodated in the interests of mission support. At Lop Buri, several vans were contracted for the team. These proved critical in making numerous logistical runs around the Lop Buri area. Organic transportation was necessary for the success of the mission. In both deployments, only one incidence of miss-management occurred. At the end of the March 2005 deployment, the return bus to the airport did not arrive prior to the team departure. This incident was minor and easily addressed by the use of the local taxi service.

d. Gear Storage.

The RTAF provided short term storage for much of our equipment that will be used during the May 2005 deployment. The equipment was stored at the Search and Rescue Squadron Facility in Wing Two. Long-term storage was also managed by the RTAF at Wing Two in Lop Buri. All equipment was accounted for with no losses.

6. Communications.

a. Communications Links.

(1) 802.11.

802.11b was the backbone of the wireless mesh at Wing Two. In the March 2005 rehearsal, the team did not have a dedicated individual managing these links to ensure success. As a result, some antennas were not located properly and optimum performance of the 802.11 network was not accomplished at Wing Two. Time constraints limited detailed troubleshooting. One possible reason for poor 802.11 performance, could have been other antennas and interfering RF energy around the tower facility.
The May 2005 team attempted to compensate for the lack of a dedicated 802.11 manager by assigning the duty to one node leader. The use of the 802.11 across many different nodes is too big for one person to control the trouble-shooting process in the field. COASTS 2006 will assign at least 3 individuals knowledgeable of 802.11 and antenna deployment to broaden trouble-shooting efforts.

The Rajant Breadcrumbs were strongly affected by weather and distance and were not able to be deployed as advertised by contractor specifications. The lack of fans, a heat sink, and a vent in plastic cases caused the equipment to seemingly overheat on a regular basis. The network placement of these Breadcrumbs had to be adjusted considerably from our original intention of a long-distance surveillance network.

Different 802.11 equipment needs to be integrated into future COASTS 2006 deployments in order to extend the desired range of the wireless network cloud. The environmental factors were too much of an effect on the Rajant Breadcrumb for it to be utilized by design. A more resilient model will be required before this technology can be considered tactically effective. See enclosures 4 -7 for more technical descriptions of the 802.11 network deployment and future recommendations for deployment.

(2) 802.16.

The 802.16 links worked very well. Once established, these links supplied data rates up to 54MBps. The main issues were found in set-up, particularly when creating the shot between Lop Buri and Wing 2.

Upon the return to Thailand in May 2005, the advance party inventoried the 802.16 equipment, and surveyed the downtown communications facility, and the placement of that antenna. During the first day of operations, one of the AN-50s experienced a power surge, making the unit inoperable. Re-setting the fuses did not correct the problem, highlighting the seriousness of the damage form the surge.

The 802.16 links were re-established in little time. See enclosures 4 -7 for more technical descriptions of the 802.16 OFDM link deployments.

(3) T-1 Landline from Wing Two to RTAF HQ.

This link was difficult to establish because several routers had to be installed. This requirement was identified on the fly and the RTAF had to locate the appropriate personnel to execute the appropriate changes.

Considerable time was used by the advance party and the May 2005 main deployment body to achieve the establishment of the T-1 link. The T-1 became the primary demonstration link, but multicast and load-balancing was never achieved during the tests.

(4) E-1 from Lop Buri.

No significant problems with this link were observed.

(5) E-1 from RTAF to RTSC.

This link was tough to establish. The primary reason for this was the fact that the link at the Royal Thai Supreme Command (RTSC) was routed to a conference room, not an established command center. Again, the network engineering experience on the team made the link successful.

(6) Satellite Communication Link.

This link was made by a civilian company called SweDish. It was not operational until late on the last day of operations. For this reason, we were unable to integrate it and pass traffic across the link.
Various planning was put into place to establish the Satellite network for the demonstration. Unfortunately, the cost of the usage of the satellite network made it impossible to afford the satellite connection for more than one day. The day of the demonstration was not enough time to properly integrate the satellite into the network properly. Further expansion of this satellite technology is planned for the COASTS 2006 deployment.

b. Network

(1) TrakPoint.

The software integration worked as advertised and met the stated requirements for the exercise. Using the software, members from the Royal Thai Armed Forces were able to monitor the situation at Wing Two and control cameras from their command post in Bangkok.
TrakPoint was functional for the May 2005 demonstration but significant set-up obstacles were necessary to overcome in accomplishing its implementation. The major contributing factors hindering a smooth and successful integration was the lack of a stable 802.11 network, changes in Areas of Operations, and key personnel tasked with maintaining network connectivity and troubleshooting. The sensor inputs and network performance functionality of TrakPoint are dependant on a stable network for integration, management, and event population. With the difficulties in establishing a functional mesh, troubleshooting and optimization schedules were shortened creating a significant lag in effective implementation. From these lessons learned, a major developmental change has taken place to correct the architecture to a Publish/Suscribe system. This will negate the issues resulting in a lack of performance of the TrakPoint application in COASTS 2005. Increased training by all 2006 team members, as well as the addition of a student software liaison between NPS and Mercury Data Systems (MDS), will be initiated to compensate for user end problems. Greater coordination will provide for greater success for TrakPoint.

(2) Router Configuration.

All network requirements and router configurations were eventually identified and installed. The success in these links made the topology possible. Several key individuals

had extensive networking knowledge that was critical. Detailed experience in these skill sets is a must for future missions.

c. Sensors

(1) CAMERAS.

The Sony camera worked well and as designed. However, it did not work well on the balloon platform. The balloon, even in light wind conditions, experienced too much jitter and did not provide a stable enough platform for the camera. It must be noted that the primary purpose for the balloon is to act as a breadcrumb 802.11 node, not a camera platform.

In May 2005, more cameras were implemented into the network to fulfill various sensor requirements. The number of cameras used necessitated a camera node manager to be created in-country. This task fell on the 802.11 node manager, who was already over-worked concerning breadcrumb issues. All cameras operated well, although with the increase in cameras, the importance of compression software for the network became apparent.

In COASTS 2006, cameras will be included in the planned cross-training between all deploying COASTS team members, and will become the overall responsibility of the Sensor node leader.

(2) Crossbow Sensor.

This device was not able to be implemented. The problem was diagnosed as software related. With insufficient manpower and resources, a decision was made not to continue troubleshooting, but rather make a site visit to the vendor upon return to the United States. The Crossbow Company is located within 60 miles of the NPS.

Before the return to May 2005 , LT Cone and Mr. Mike Clement traveled to Crossbow in order to improve their training concerning the implementation of the sensors into the network correctly. Further training enabled a successful set-up for the demonstration in May 2005. The Crossbow suite will be augmented by the MDS deployable sensor suite in the next COASTS 2006 deployment.

(3) Unmanned Aerial Vehicle (UAV).

The UAV (provided by CyberDefense UAV) performance in the May 2005 demonstration was limited due to the extreme wind conditions. Although the network camera was able to integrate into the network, the UAV itself was unable to maintain sustained long flights as the swirling Lop Buri winds were too strong for the UAV operator to compensate for, resulting in a very early mission-ending crash. The CyberDefense UAV system was light weight, highly portable and had the potential to significantly add to the demonstration.

7. Host Nation Support. Other than pre-deployment planning at the action officer level, host nation support was excellent. All requests for equipment and support were met. In addition, ad hoc and unanticipated support requests were also handled very quickly and

efficiently. The professionalism and hospitality of the Thai military was noteworthy and a positive experience for all involved.

8. Aviation Operations. The team appointed an Air Marshall to conduct all aviation planning and coordination. This proved invaluable as there were many aviation issues to be addressed. Prior to arrival in Thailand, several aviation information items were unknown. Many of these issues were sorted out during a confirmation brief upon arrival. Planned daily air meetings were rolled into a group meeting for the day.

The aviation meeting should be a separate meeting in future efforts. Several air assets were not able to support the operation due to real world requirements. This turned out to be good as network set-up took longer than expected. Several important flights were made with the AU-23 Peacemaker but connectivity to the 802.11b network during was marginal.

In the May 2005 demonstration, the Air Marshal was unable to join the team until exercises were underway for almost four days. This placed training of a deputy Air Marshal at the forefront of deployment training. LT Lee, as the balloon operator, was the most logical to fulfill this role, and accomplished all required tasks with no incidents.

9. Future Operations. Planning for COASTS 2006 is underway; the POC is Mr. James Ehlert who can be reached at 831-656-3002 or jfehlert@nps.edu.

// signed //
MR. JAMES EHLERT
COASTS Thailand Project Manager

NPS
MONTEREY, CALIFORNIA
19 Apr 2005

APPENDIX 1 TO ANNEX A TO OPERATIONS ORDER 04-05 (THAILAND REHEARSAL)
PERSONNEL ASSIGNMENT MATRIX (Revised for 28JUL 2005 AAR to reflect actual deployment manning)

1. Individual Assignments.

Name	Functional Team Pri.	Functional Team Alt.	OPORD Requirement	Thailand Node	Vendor POC	Thesis
COASTS Team Leader						
Mr. James Ehlert COASTS Technical Manager	Program Manager					
COASTS Faculty						
Mr. Mike Clement	Software Integration	COC		COC		
J.P. Pierson	Network	COC				
COASTS Students						
LT Robert Hochstedler	Student Lead /	802.16				
Capt. Gary Thomason	802.11	VOIP	SSO, Orders, Hotel/Air Resv., Annex W	MCP, AU-23		Y
LT Jonathon Powers	802.16	Tacticomp	Annex K, Node Input	Mtn Node, PDA	Redline / Tacticomp	Y
LT Damian Ngo	802.11	Tacticomp	Node Input	Comm Facil Downtown		Y
LT Scott Cone	Sensors		Annex B, FP Plan, Node Input	Comm Fac. Lop Buri	Crossbow	Y
Capt Al Valentine	Liaison, Balloon	UAV / HNS Linguist	Language, HNS, Thai Liaison, Node Input	RTAF UAV		Y
LT Chris Lee	Balloon		Balloon Node Input	Balloon		Y
ENS Collier Crouch	UAV		Embarkation Plan, CD UAV Input	CD UAV	Cyber Defense	Y
Capt. Steve Urrea	Software Integration					
LT Bruce Iverson	Data Analysis					Y
LTjg Josh O' Sullivan	802.11 Lead	Camera sensors				

COASTS Vendor Support						
Flt.Lt. Sunyaruk Prasert	Liaison					
Red Line	802.16					
Inter-4 - N/A	PDA					
Cyber Defense - N/A	UAV					
Mercury Data Systems - Mr. Ryan Hale - Rich Guarino	Software Integration					
Crossbow - N/A	Sensor					
Cpt. Chayutra Pailom	Software Integration					
Flt.Lt. Sunyaruk Prasert	Liaison					
Rajant Corporation - N/A	802.11					

After Action Report
COASTS 2005
802.16/802.11 Network

Review of Networking Goals:

- Create 802.11b network to process and distribute digital data including:
  - video streaming
  - text
  - sensory information
  - audio

- Establish Long-haul 802.16 links between Wing Two Air Tower, the Lop Buri Downtown Communications Building and the Mountain Communications Facility.
- Obtain 11 Mbps connectivity with all nodes within the 802.11b mesh network
- Obtain 54 Mbps connectivity through 802.16 links
- Provide real-time data to client links (Tacticomps and laptops) through mesh network
- Provide real-time response tools implementing TrakPoint Software.
- Integrate 802.11, 802.16, 802.3 protocols to establish continuous real-time data to forward deployed units and remote Command and Control centers. (RTAF and RTSC)

Goals Attained:

- 802.11b network established
- 802.16 links established
- Real-time data reached every node in the network
- Trak Point software implemented
- Integration of various protocols achieved
- Obtaining a 802.16 link connectivity of 54 Mbps.

Lessons Learned:

- The two days spent at Wing 6 at the Air Field allowed for consolidation of all the equipment shipped in early February and shipped out in advance through Federal Express. All the equipment was accounted for, packed for operational use, and staged for operations. This set-up allowed for laying out the gear in a centralized area facilitating personal interaction and rapid coordination for troubleshooting and systems configuration.

- Automated network management tools that are SNMP enabled might allow for greater network awareness, yet limit the impact on node operators. Recommend looking into software that will pull some of this information from system devices. If manning constraints can support a recommend one person be designated Network Operations Chief as a sole assignment.

- The installation of this 802.16 link represented a significant investment in personnel, time, and resources. The resources required during this installation set us back in terms of set-up, and operations conducted at Wing 2 and at RTAF/RTSC. Key personnel (Mr. Ryan Hale, Mr. John Pierson, LT Rob Hochstedler, Mr. Andy Eu, and Mr. Brian Steckler) were tied up for two days at this site. Prior site survey would have discovered that the antenna mast would need to be scaled, to a height of at least 150 feet, requiring, safety harness, rope and pulley system, gloves and a ladder just to access the structure. Aspects that could have been mitigated through a site survey stole away personnel for a significant amount of time because answers we sought were not provided and because the site was not previously reconnoitered.

- Ensure teams of two (at a minimum are deployed to set-up 802.16 links in the future. Apply lessons learned from this installation to better prepare for future 802.16 installations in the future. Had this team had access to the laptop running Redline Communications RF Monitor application and access to the AN-50 Graphical User Interface (GUI) the full 54Mbps would have been attained.

- The purchase of these antenna masts will make it possible to set up 802.16 antennas in any location independent of an existing antenna mast or man-made structure. Research and procure two 28 foot collapsible antenna masts to raise 802.16 antennas.

- Throughout the planning phase COASTS 2005 was designed to incorporate the use of the Mobile Command Post (MCP). Days prior to our deployment NPS learned that it would lose the MCP due to real world requirements, but at the last minute earned that the MCP would be made available for COASTS ’05 Phase II. The MCP did not play a role in the May 2005 demonstration. The integration of high profile assets such as the MCP, need to be planned very early in the process.

- COASTS members and Thai counter parts must be involved in a site survey. Inputs from the RTARF concerning terrain, landmarks and placement of network assets are vital.

- Ensure sufficient time is allotted for gear accountability and configuration before any type of operation is planned. Conduct localized and full scale operations with all equipment similar to our efforts at Wing 6 flight line to ensure all essential equipment is accounted for, properly configured and ready for operations.

- Training on utilizing the Rajant Breadcrumb must be given to all personnel involved in the operation. The 802.11b lead needs to be responsible for the procurement,

inventory, and coordinating the deployment and retrieval of breadcrumbs, antennas, and other mesh network related equipment.

- The 802.11 lead should have a thorough knowledge in operating Breadcrumb Admin (BCAdmin) and the deployment concerns of the breadcrumbs. This person also needs to be familiar with radio wave propagation and antennae patterns.

- Distance for SE, ME with 8 dBi omni-direction external antenna was limited to 300 meters with partial to full line of sight for 11 Mbps. The SE internal/ ME external 1 dBi antennas were limited to roughly 100 meters for a full 11 Mbps.

- The ideal configuration for the command center was to hardwire through an Ethernet cable to an XL with an external 8 dBi omni-directional external antenna. Co-located with an SE connected to an 18 dBi flat-panel external antenna, directed in the direction of a balloon or other large distance Breadcrumbs.

- The battery life for all the Breadcrumbs was limited to an operational optimal time of 6 hrs. Ideally in an operational environment, each Breadcrumb that will be running on batteries should have two batteries.

- All RJ45 connections failed internally on ME breadcrumbs.

Recommendations:

- Points of contact and support personnel from the Thai military need to be identified and assigned to the project much earlier in the process and through official tasking.

- For future deployment, recommend using SE for all Ethernet required connections, such as cameras, due to their reliable RJ45 interface and using ME for linking and redundant nodes, due to their dual external antennas.

- Ensure a site survey of all locations that will support network operations are inspected during site survey and planning conference meetings. Ensure proper personnel with technical expertise execute site surveys in order to properly assess the situation. Additionally, see item #2 above for assignment of Thai personnel to the COASTS mission.

- All antennas need to be 6ft off the deck to get best signal propagation. The SE have internal antennas and also need to be located 6ft off the deck. The use of 7ft PVC pipes, procured locally, worked well.

- BCAdmin uses about 2 Mbps of network traffic per operating client. The number of clients running should be limited to provide more bandwidth.

- The Rajant Breadcrumbs are not a reliable solution in this hostile environment. It is recommended that Rajant research improving reliability in this kind of environment or COASTS needs to research replacing with a better breadcrumb.
    - Change the color of the boxes (black is not a good color for heat)
    - Increase internal air flow - add internal fan(s)
    - Install heat sinks on some of the internal components
    - Upgrade standard to 802.11g or 802.11n for better distance and speed

- DLINK AP2100 Wireless Access Points were linked with 14.5 dBi Yagi Antennas with a nearly perfect point-to-point bridge for providing constant and consistent T1 connectivity between the Wing 2 Comm Center and the Command Operations Center (COC). In the future, utilizing more of these WAPs for wireless links should be investigated. For example a point-to-point or point-to-multipoint bridge would have been a better choice than a breadcrumb for linking the firehouse to the network. The unreliability of a single bread crumb for a presentation link resulted in a number of connection problems during our local demonstration. The use of a DLINK WAP may have been a better alternative in connecting the COC to the mesh network as a more reliable connection.

- The payload (a modified XL) on the balloon and the COC XL needs to be tested operating together. The XL would consistently reset itself when trying to form a link with the balloon's payload. This may have been a configuration issue with the way the two breadcrumbs establish their IP addresses, however, this was unable to be tested during this demonstration due to the unavailability of the balloon payload at the end of the deployment.

- Overall, the team did not have enough breadcrumbs to accomplish the intended mission. To properly employ the Rajant breadcrumbs in this hostile environment, it is very important to employ an overlapping, redundant mesh. Single breadcrumbs would work less reliable than two co-located breadcrumbs. In fact the team would have been unable to meet our network requirements if it had not been for the 4 breadcrumbs and cable connectors returned from the Phuket Tsunami Relief Area.

- The team deployed with a shortage in the number of connecting wires for external antennas to Breadcrumbs, resulting in less than optimal network configurations. There were no ready repair connectors in case a cable was damaged and the inability to utilize all antennas due to a lack of connectors particularly N-type to N-type. Varying lengths of cable were limited and reduced the options for ideal antenna placement.

- Tracking names of the breadcrumbs was an issue. In the future the 802.11b lead should recommend changing the names of the breadcrumbs from numbers to words.

For instance, change ME 03-245 to ME Yorktown and then mark the name on the Breadcrumb. A number of personnel had issues remembering the numbers on the Breadcrumbs.

- Writing the deployment location and configuration on the Breadcrumb prior to the operation helped in integrating network assets.

- If balloons are utilized in the future, they should contain two separate bread crumbs and more than one balloon should be used in a given footprint.

- To reduce the bandwidth constraints of cameras, the use of MPEG4 and multicast through a UDP protocol needs to be further tested and researched. This will eliminate the constraints of Motion JPG. For a future configuration, use MPEG4 for real-time monitoring and streaming to long distances and locally store Motion JPG to a server through the camera software for after action analysis.

- Before using cameras on the network, ensure all computers have been properly upgraded. To run MPEG4 streaming, the connecting computers require an upgrade to DirectX 9. Due to the undocumented requirement and lack of Internet access, multicasting was not fully tested.

- The Rajant Breadcrumbs, although advertised as a one-switch network solution, proved to be somewhat more difficult when forced to interoperate with an existing network topology. The primary difficulty introduced was the use of a 10.x.y.z/24 IP address space that was not DHCP-controlled by the Breadcrumbs. Though it can be strongly argued that the addressing scheme was not a significant issue in most cases, there were certain elements that had to be adjusted to accommodate the Breadcrumb design. Unfortunately, the Breadcrumb design elements that were affected by this scenario were undocumented for the end user (e.g. that the Breadcrumbs used 10.x.y.1/8 addresses, so external gateways cannot also use those addresses when the Breadcrumbs operate in Bridge mode), so without having Rajant representatives on-site, this difficulty would have been a much worse issue. This lack of documentation needs to be corrected before the next evolution, to avoid future problems.

- Could not fully integrate Crossbow sensors due to network stability issues, and due to lack of time/support for integration with TrakPoint

- Dedicate a Chief Engineer or Lead Systems Integrator, whose job it is to oversee all technical developments, with the primary concern of ensuring that all the pieces of the system that are developed will integrate together into a coherent system. This position should not be tied down with significant in-the-weeds technical tasks, though the technical capacity to do these tasks is necessary.

- Initiate a System Design Process, with a top-down method of specifying the system. This begins with defining high-level requirements for the system (e.g. What targets does this system need to detect), specify and delegate meaningful components of this

system (e.g. Wireless backbone that provides a gateway to local networks, aerial view of the ground that can visually detect targets), and allowing research groups of students and faculty to design the component and choose products that meet all the needs (e.g. choosing a camera that matches the power constraints of the balloon). This also requires oversight, possibly provided by the Chief Engineer, but possibly with help from a Systems Engineer, which is a separate but related discipline.

- Clearly define the roles of each individual and each vendor, and making a clear and well-known chain of command both for NPS internally and for interaction with vendors and with coalition partners.

- Lacked some needed backup software, including backup Operating System install media

- TrakPoint operated successfully with some last-minute changes/fixes in the field; contained (undemonstrated?) support for Sony Cameras; did not accomplish integration with Crossbow sensors.

- TrakPoint GPS tracking was successfully demonstrated by time of demonstration

After Action Report
COASTS 2005
Balloon Node

Review of Balloon Node Goals:

- Use the balloon to create a center node for a mesh network
- Create a suitable video image from the balloon in order to support a tactical picture of the environment.
- Test the propagation paths of various antenna configurations to test 802.11 signal strengths.
- Establish power requirements for the balloon payload.
- Determine environment limitations to equipment attach to payload
- Determine limitations of the balloon during operations in designated areas.

Goals Achieved:

- The balloon was successfully established as a center piece for the Breadcrumb mesh network. The maximum altitude was not achieved due to physical constraints and the lack of wind conditions or lack of signal strength from the host network to achieve the desired 2000 ft.

- Maximum continuous throughput achieved was ~ 2Mbps. The most optimal antenna configuration seen during the demonstration was a horizontal and vertical dipole staged 90 degrees apart.

- Video image was established from the balloon and the camera could be controlled via wireless interface. Camera control was established in Bangkok via 802.16 structure. Video imagery was not the primary mission of the balloon, however this imagery did give first hand analysis of the strength of the network.

- Power requirements for the particular payload was determined. The batteries can last well over 8 hours with full operation of the camera from multiple sources over the network.

Lessons Learned:

- Without wind, the Sky-Doc balloon only lifts 16.8 lbs

- SkyDoc Balloons did not send a detailed operational guide for the balloon. Specifics on the operation of the balloon will be included in the Operational Guide for the balloon node.

- The winch is only capable of holding 2000 ft of the 1000# line. Smaller line might be used to extend operational characteristics of the balloon.

- The winch depletes a 12 VDC / 60 AH battery in ~4 hours of use.

- Continuous operations of the winch for more than 30 minutes will cause extreme heat conditions. These temperatures can be minimized with adequate air flow across the winch housing. Keep winch out of the high temperature and rain as much as possible.

- The Sony camera proved to be very durable. It demonstrated survivability in extreme environmental conditions.

- The toolbox is not the most desirable platform to send in the air due to its broad faces and terrible aero-dynamic features.

- The balloon should be launched in an area clear of mountains or conditions that create swirling winds.

- The maximum throughput achieved was 11 Mbps for <3 minutes. Found that the Breadcrumbs are susceptible to high temperature conditions and humidity. These devices need some sort of internal fan or environmental control when used in environments such as Thailand.

- Need at least 3 people staged at the balloon for operations (changing the payload, filling the balloon, etc.)

- Winch can be adjusted to increase amount of line it can hold.

- Maintaining a stable image from the balloon is very difficult at low altitudes. Need stability lines from the payload to the balloon tether. Simple adjustment creates significant stabilization. Storing the balloon in an uncontrolled environment (warehouse) causes the material of the balloon to become weak and brittle.

- The extreme heat (100+ F) and intense sunlight of Lop Buri also caused some deterioration of balloon material. The valve connection lost its adhesiveness during operations which caused air to leak out of the balloon. Due to the location of the valve and unfamiliarity of proper position during operations, uncontrolled leakage of air occurred during balloon operations.

- Inadequate air pressure coupled with high wind conditions (12 knots +) resulted in uncontrollable balloon flight characteristics (intense spirals and rapid side movements). These flight patterns resulted in significant occurrences of the balloon making contact with the ground and the local foliage that created numerous pin holes in the balloon material which intensified the loss of helium during balloon operations.

- The balloon was left over a two day period without supervision. This resulted in an unobserved casualty to the balloon. The balloon was not repairable. A 6 to 7 foot gash was created in the balloon material along one of the seams. This failure was unforeseen and could have been due to extreme weather conditions or by human tampering. Cause remains unknown.

- The balloon payload consisted of a RAJANT Super Crumb powered by a UBI 2590 15 Volt battery. The unit was cooled by an internal fan and a Pan-Zoom-Tilt (PZT) Camera was attached to the unit through an Ethernet connection. All loads were powered by the same source.

- Battery operation was observed to last well over 6 hours with all loads operational. Due to the limited flight operations (loss of air), proper operation from the balloon payload was observed for a consistent period of time on the first and second day of operations. The balloon payload provided connectivity within the local mesh, with limited wireless pipes (1 to 6 Mbps) to the remote network (Wing Two Control Tower).

- Extreme winds and improper air pressure within the balloon caused irregular flight patterns. These extreme turns and twists caused the battery source in the payload to come in contact with the sensitive computer parts which resulted in a failure to the motherboard housing and radio cards. After this day of experimentation, the super crumb failed to operate correctly and connectivity to the local mesh did not exist.

- Decision was made to attach an SE breadcrumb to the payload for future operations. Data was only collected with an 8dbi dipole antenna attached to the balloon. Further experimentation with various antennas could not be performed due to the failure of the radio card housing.

- The balloon is ideally operated during moderate winds below 10 knots. This is not an all weather balloon. Extreme heat and solar conditions causes some deterioration of balloon material. Winds greater than 10 knots must be in a consistent direction. With swirling winds, the kite flap causes the balloon to twist with the changing winds and if the winds exceed 10 knots violent swirls have been observed.

- The balloon winch operated successfully. During extreme flight variations, the winch and line successfully maintained retrieval and deployment capability. The winch is slow at best during operation. Manual operation of the winch is suitable during modest winds, but is ill advised during winds that exceed 10 knots.

- Carabiners were more than adequate to connect the balloon to tether.

- For future use, a housing should be equipped for the winch to protect it from rain and dust. The only requirement for the maintenance of the winch is to grease the internals after operation. Proper documentation on the type of grease was not provided by the manufacturer. This will be resolved once INCONUS, and proper maintenance of the winch will occur for future operations.

Recommendations:

- For future balloon operations, it is recommended to use a simple 10 ft ball balloon. This balloon is rated with a 25 pound lift during any wind condition. The only flight pattern that should be observed is a side to side motion. With the smaller balloon, less helium is required and the cross section is much smaller. The price of the balloon is significantly less than the Sky Doc balloons ($500.00 vice $2000.00)

- A super crumb should be tested again as the payload on the balloon. A multi-polar antenna should be used for radio signals. The existing battery power is sufficient for greater than 8 hours of operation.

- The balloon should always be filled with air when conducting subsequent operations to ensure that the balloon is free of holes or other material damage that will cause leaks.

- Camera operation is still a luxury for the balloon operation. The intent of the balloon payload is extend network connectivity over the horizon. Camera on the balloon should be used as a safety parameter to monitor areas directly under the balloon.

- The following items must be on hand for proper maintenance and handling of the balloon:
    - Patch kit (sealant and adhesives)
    - Work Gloves
    - Electricians Kit
    - Various Antennas with adapters (SMA male, N male connections)
    - 3 to 4 bottles of 290 cu ft helium
    - 12 VDC car battery
    - 500 to 1000lb tether (Spectra)
    - 3-4 Carabiners
    - Crescent wrench
    - Assorted Screwdrivers
    - Hex Wrench set
    - 2 UBI 2590 military batteries with chargers.
    - 18 to 22 gauge wire
    - Electrical connectors (pin type)
    - Small fans (12VDC) for payload housing

After Action Report
COASTS 2005
UAV Node

Goal:

- Demonstrate the capability of a man-portable mini-UAV as an integrated tactical collection platform for real-time intelligence, surveillance, and reconnaissance (ISR) at the squad level.

Goals achieved:

- UAV video-feed was integrated into the COASTS wireless network.
- Tests the metrological effects upon the operation of the Cyber Defense Cyberbug UAV.

Goals unattained:

- UAV was unable to maintain consistent flight at Wing Two due to the combined density altitude.
- Daytime operations prevented the test of the IR camera on the UAV.
- The Integration of the UAV camera was not established via a direct link to the COASTS network. It was linked through a CyberDefense UAV proprietary laptop and fed through a video application to the COASTS network for display.

Lessons Learned:

- When deploying the UAV, the combined environmental effects on the density altitude at the launch location need to be reviewed prior to deployment. The Cyberbug operated optimally during tests in the United States. The temperature, pressure, and air density in Monterey, California was not substantial enough to affect the location's air density. In Thailand, these factors combined to create the effects of an elevation at Lop Buri of 8500 feet of elevation. This created an air density to thick for the UAV to maintain flight.

- The temperature effects upon the UAV itself need to be considered. Heat strongly effects the electrical components inside the UAV itself, degrading network connectivity, GPS, and computers during the pre-flight stage.

- A more powerful UAV engine is recommended to overcome climatic considerations and to maintain flight in Thailand.

- More than one UAV should be carried in order to ensure redundancy.

- The Cyberbug UAV is a very stealthy platform when deployed. The gray-white color combination, small engine, and small overall sail area make the UAV very hard to detect in flight.

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