Evolution of a Transportable Emergency Communications System for First Responders

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Agenda

• Application Overview
• System Requirements
• Subsystem Overview
• Technical Details
• 1st Generation POC Design
• 2nd Generation Design
• Other Applications for System
• Lessons Learned
• Questions
Application Overview

• On 9-11-01, The Port Authority of NY/NJ experienced a catastrophic communications failure

• In late 2003, Unisys was commissioned to build a transportable, satellite-based communications platform

• Purpose:
  – Facilitate Command and Control by extending EOC intranet to emergency scene
  – Support First Responders with rapid communications recovery in crisis situations
System Requirements

– Transportable system with easy deployment for First Responders in hostile environments
– Highly resilient, with multiple WAN and LAN communications links
  • (2) Independent cellular data networks
  • (1) Satellite IP network
  • 802.11b WLAN
– Designed to support data, voice and video
– Standards-based modular platform for flexible configuration and support
Application Concept

- Emergency Operations Center
- Satellite Broadband Service
- Ground Station
- Emergency Scene

Additional Resources:
- Crime Databases
- HazMat (Chemtrec)
- CDC
Transportable?

- Vehicle mount
- Trailer hitch, or
- Portable
Subsystem Overview

• Two Major Subsystems
  – Satellite Transceiver Subsystem
  – Wireless Communications Hub

• Plus, a Satellite Service Provider that offers broadband data and ground station network access
Satellite Transceiver System Requirements

• Small and light enough to be quickly deployed by two people
• Tolerant of environmental extremes
• Completely automated communications acquisition with geosynchronous satellite transponder
• Sufficient bandwidth to support 2-way simultaneous data/voice/video
Wireless CommHub Requirements

• Easy to transport and deploy, and environmentally tolerant
• Multiple wireless LAN and WAN support
• Automated selection of best network path, with real-time connection recovery
• Sufficient bandwidth to support 2-way simultaneous data/voice/video
• Highly Secure Applications
1st Generation Design

- Satellite Transceiver Architecture Overview
- Wireless CommHub Architecture Overview
1st Gen Transceiver Design

- Satellite Transceiver Components
  - Based on a transportable Ku band VSAT terminal with servo-controlled .75m antenna dish integrated with:
    - Electronic Compass
    - GPS receiver
    - Motor Control Unit/User Interface
    - LNB (Low Noise Amp)
    - 1 watt BUC (RF Transmitter)
    - Satellite Modem with Ethernet interface
1st Gen Wireless Hub Design

Wireless CommHub Architecture Overview

- System core is based on Cisco Mobile Access Router (MAR) and Mobile IP (MoIP) routing protocol
  - MoIP developed to maintain single IP address as end user device travels from one network connection to another. Analogous to cell phones roaming from cell to cell
- Plus, several WAN and LAN wireless links
1st Gen Wireless Hub Design

Wireless CommHub Components:
- Cisco Mobile Access Router (MAR)
- CDMA cellular data modem
- GPRS cellular data modem
- WLAN (802.11b) Bridge
- WLAN (802.11b) Access Point
- UPS Power Conditioning
- Windows Server platform
1st Gen System POC Goals

Capabilities to be tested

- **Deployment** – rapid, easy setup and autosynch.
- **Voice** – support for IP telephony and conferencing over the satellite WAN
- **Data** – file transfer, Internet access
- **Video** – simulate IP video streaming from CommHub site to EOC
- **WLAN** – provide wireless access for multiple “first responders” in the area
- **Mobile IP** – auto-failover to backup WAN links without dropping sessions if satellite link is lost
1st Gen System POC Test

System Components:
- Satellite (SpaceNet)
- Ground Station
- Wireless Access Point (802.11B)
- Cisco 3250 Mobile Access Router
- Home Agent Router
- Windows Server
- Mobile IP
- Satellite Modem
- CDMA Modem
- GPRS Modem

Network Connections:
- Internet
- Satellite (SpaceNet)
- Ground Station
- Mobile IP Priority 1
- Mobile IP Priority 2
- Mobile IP Priority 3

Equipment Details:
- Cisco Systems, Inc.
  San Jose, CA
1st Gen System Results

• Successful connectivity on all interfaces
• Satellite link throughput tests provided
  ~ 500kbps downlink and ~100kbps uplink
• CDMA throughput ~40kbps
• GPRS throughput ~20kbps
• WLAN distance limited to ~100 ft. at 1mbps
• Mobile IP works, but Internet backbone connection has significant variation in delay, jitter, and throughput. Works OK for data, but not optimal for voice/video
• Wireless CommHub Subsystem is too big and too heavy, and requires too much power! (small generator)
Back to the Drawing Board!
2nd Gen System Goals

• Move Home Agent Router to 1.5Mbps T-1 line instead of using Internet as backbone link
• Increase Satellite uplink/downlink performance
• Increase WLAN coverage area for responders
• Make CommHub smaller, lighter, and more rugged, and operate with less power!
2nd Gen System Goals

- Move Home Agent Router to 1.5Mbps T-1 line instead of using Internet as backbone link
- Increase Satellite uplink/downlink performance
- Increase WLAN coverage area for responders
- Make CommHub smaller, lighter, and more rugged, and operate with less power!
Increase Satellite uplink/downlink performance

- Increase dish size to .96 meters
- Replace 1watt BUC with 2 watt transmitter
- Use higher quality LNB receiver
Satellite footprint – 2 watt BUC

Customer: Connexstar, Hub McLean
Outbound: 360E 35Mbps - QPSK, 3/4 FEC, Concatenated R/S coding
Inbound: 480 kbps Turbo coding with 2.0W ODU
Transponder: 7 O/B, 9 I/B with 6 dB pad
Availability: 99.50%
TOPBO: 5.0 dB (inbound Tr.)
2nd Gen System Goals

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• Increase WLAN coverage area for responders
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Increase WLAN Coverage Area

- Add external high-gain (6dBi) omni-directional antenna to Access Point
- Add 1watt (30dBm) RF Amp between AP and antenna
- Add wireless “breadcrumb” devices to allow tactical WLAN extension
Wireless “Breadcrumbs”

- Self-contained 802.11b “repeater” in ruggedized enclosure with interfaces, battery and antenna.
- Built for military applications
- Small and lightweight
- Allows 802.11b LAN to be extended via wireless mesh technology
“Breadcrumb” deployment

CommHub

Node00
Command Post

Node01

Node02

Node03

Node04

Emergency Incident Area

Video Camera

Tablet PC

Tablet PC

300 ft.

250 ft.

350 ft.

250 ft.

250 ft.

250 ft.

250 ft.

UNiSYS

Imagine it ● Done ●
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2nd Gen Wireless CommHub

Biggest change of all!
CommHub Internal View
Wireless CommHub Contents

– Cisco Mobile Access Router (MAR)
– CDMA cellular data modem
– GPRS cellular data modem
– Encrypter & GPS cards
– WLAN (802.11b) Bridge
– WLAN (802.11b) Access Point
– 1 watt RF Amp
– 12vdc or 110vac Power Supply
Secret to New Wireless CommHub Design...

PC-104 Plus stackable form factor for Router, Switch, WLAN AP & Bridge, Encryptor, and GPS!
Other Applications

- Large Recreational venues
- Forest Service
- Insurance Companies
- Remote Medical diagnostics
Lessons Learned....

• Satellite Auto-synchronization is Cool!
• Smaller is Better!
• Mobile IP works!
• Bandwidth is key!
• Standards!
Next Steps...

– Continuous improvement - fine tune and refine solution as field experience is fed back to development team
– Monitor and assess market needs
– Customize solution for commercial applications such as backup and disaster recovery/resilient infrastructure
– Integrate new subsystem components that enhance specific applications
Questions???

Thank-you!

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