Utilising IT in Education

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Agenda

- Overview
- Wireless
- IP Surveillance
- Broadband over Poweline (BPL)

SIMPLE

GREATER BANDWIDTH + SIMPLE NETWORKS + MOBILITY

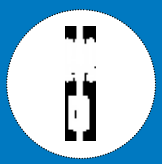
BANDWIDTH

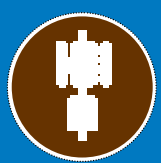
GREATER BANDWIDTH
SIMPLE NETWORKS
MOBILITY

Networking Enables "Me"

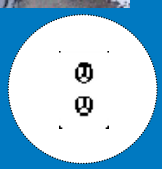
Wireless is on everyone's lips

Alternate Delivery Methods – the new coaxial cable

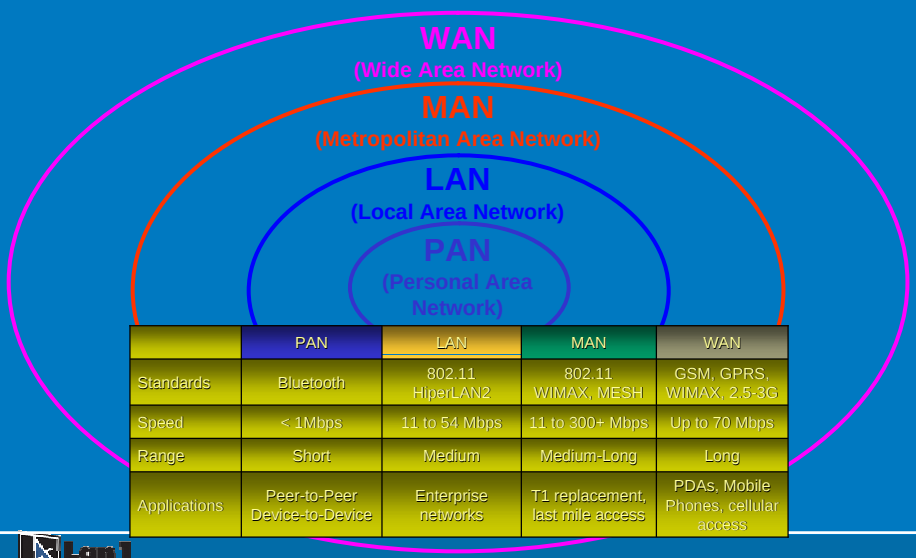




WiMAX



What Flavors of Wireless Are There?



	PAN	LAN	MAN	WAN
Standards	Bluetooth	802.11 HiperLAN2	802.11 WIMAX, MESH	GSM, GPRS, WIMAX, 2.5-3G
Speed	< 1Mbps	11 to 54 Mbps	11 to 300+ Mbps	Up to 70 Mbps
Range	Short	Medium	Medium-Long	Long
Applications	Peer-to-Peer Device-to-Device	Enterprise networks	T1 replacement, last mile access	PDAs, Mobile Phones, cellular access

Wireless Performance

Point-to-Point

Provides wireless backhaul, bridging, channelized T1/E1 for voice & data

Range: >100 Miles

Throughput: 300 Mpbs

Of course, actual speeds & distances may vary

Point-to-Multipoint

Enables delivery of broadband access to multiple locations from a single access point

Range: >20 Miles

Throughput: 14 Mbps

Real World Wireless Video

Over Water Applications
St. Thomas U.S.V.I Schools

VoIP, Video, Data Access for School System

43 miles at 28 Mbps

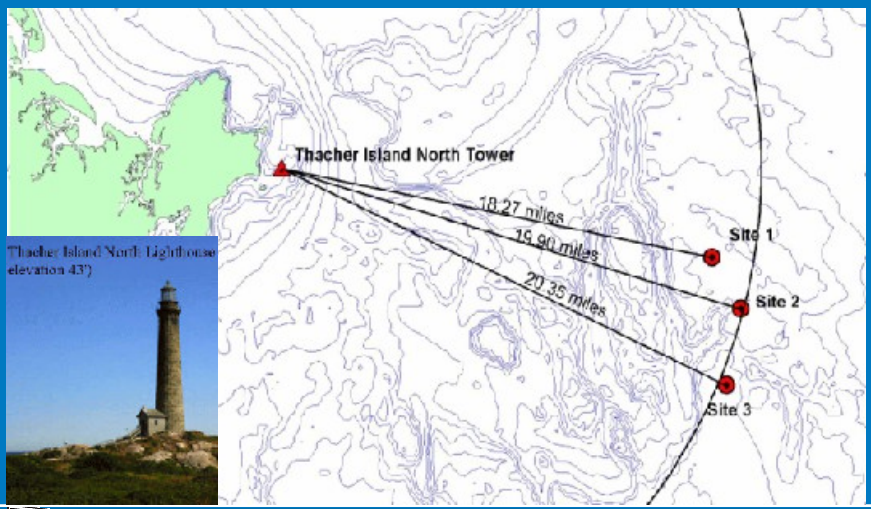
Overcame: Caribbean Sea

Over Water - NOAA - Key Largo Florida

Over-water buoy to shore application

- **From NURC at Key Largo to Buoy above Aquarius**
- **200+ Mbps at 11 miles (in 6' seas)**
- **99.999% link availability**
- **Real-time video/voice for internet broadcast**

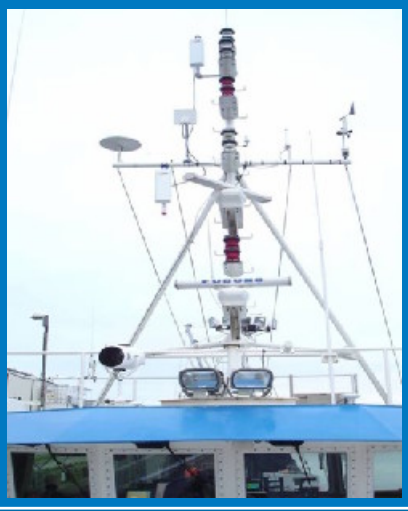
National Underwater Research Center (NURC) – University of Connecticut



National Underwater Research Center (NURC) – University of Connecticut

Ship-to-shore application

- Real-time video broadcasts
- 18 to 20 miles at 31Mbps
- Overcame reflective fade, pitch and yaw of 75' vessel



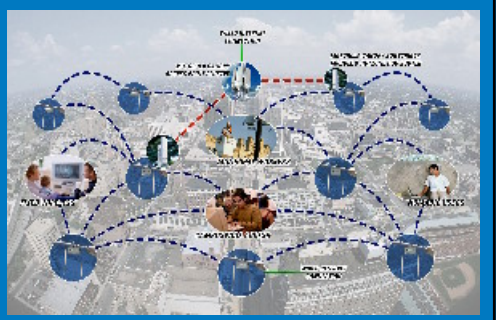
Security & Surveillance Support of 2005 Presidential Inauguration

- Multiple NLoS paths
- High Noise Floor
- High bandwidth demands

Mesh Networks

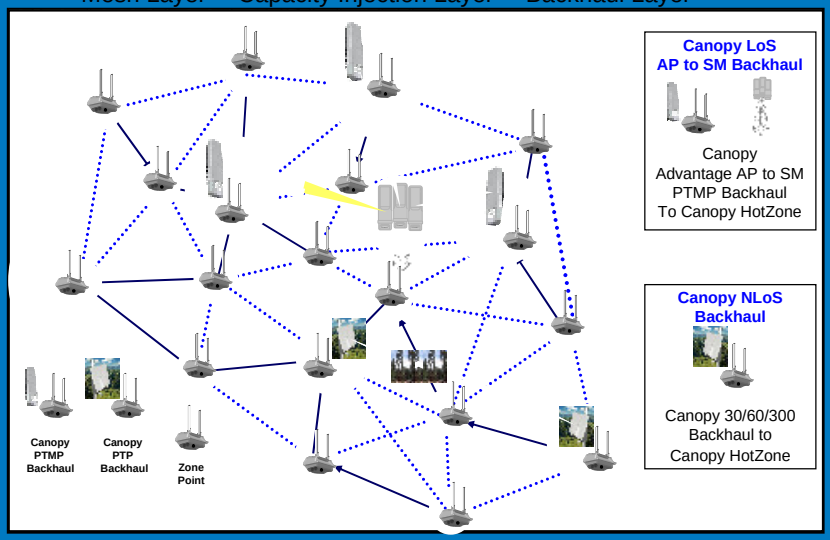
Dedicated, secure connections over public networks
Providing fixed and mobile IP-based wireless networks for area-wide coverage using WiFi bands. (*2.4 GHz, 5.8 GHz)*

- **Self-forming, self-healing, highly-available networks**
- **Proven technology developed for the military, highly resilient to interference**
- **Highly scalable solution for metro and campus**
- **Offering truly mobile broadband connectivity options**



The Canopy HotZone Network

Mesh Layer + Capacity Injection Layer + Backhaul Layer



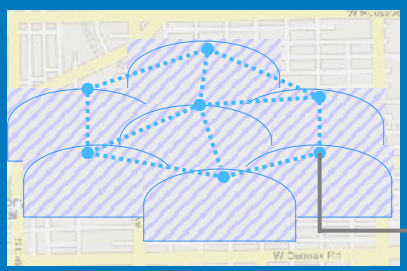
Canopy LoS AP to SM Backhaul

Canopy Advantage AP to SM PTMP Backhaul To Canopy HotZone

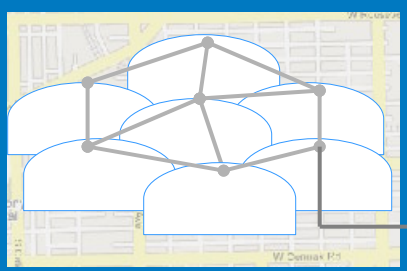
Canopy NLoS Backhaul

Canopy 30/60/300 Backhaul to Canopy HotZone

Dual/Quad Radio Expandability



The operator can deploy the network using 2.4 GHz radio. The capacity is split between client access traffic and backhaul traffic dynamically. Backhaul can be via Canopy, Fiber or other options.



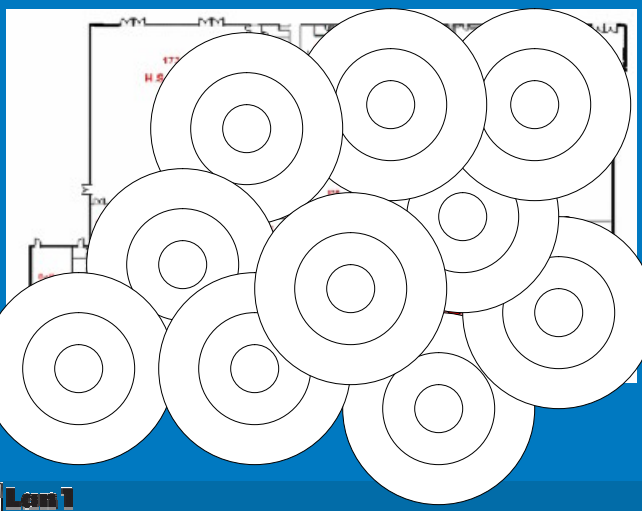
As capacity needs increase, the operator can enable the 5.8 GHz backhaul radio, providing simultaneous client access and backhaul in separate bands.

Integrated Canopy and Mesh WiFi Solution

Canopy HotZone Provides DC Power & Data Connectivity Over Shielded Ethernet Cable

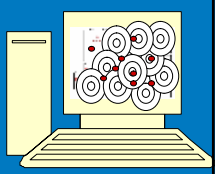
Motorola Canopy Subscriber Module (SM)

Geolocation-WHAT IS IT?



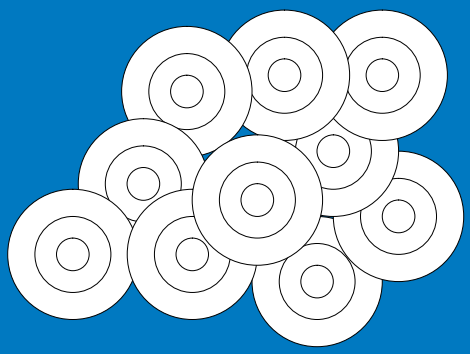
- Wireless Routers
- Users

Monitoring Station



Geolocation - How?

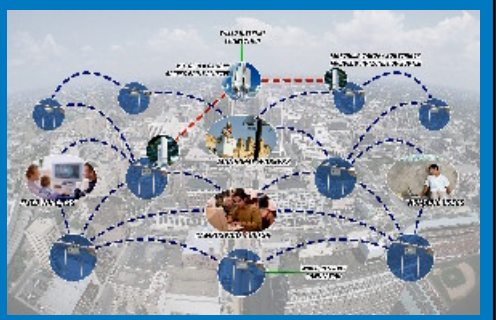
- Measure ranges between mobile users and some known fixed points (wireless routers).
- Triangulate (same as cellular systems).
- Since the “cells” are much smaller, much better precision is possible.



Mesh Networks Summary

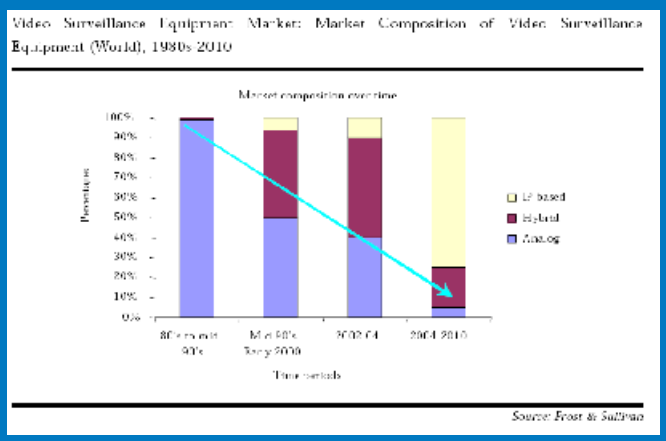
Dedicated, secure connections over public networks
Providing fixed and mobile IP-based wireless networks for area-wide coverage using WiFi bands. (*2.4 GHz, 5.8 GHz)*

- **Multi Radios offer high bandwidth for surveillance projects**
- **Plan for capacity – integrate Point to Multipoint and NLOS backhaul radios in network to maximise bandwidth**
- **Allow for other use when calculating ROI for example Campus Security and Geolocation!**



Business Case – The Results Are In

IP based Surveillance: The Foundation for the Future



IP based systems are the future, and IP building blocks provide a cost effective and efficient migration path.

IP based Surveillance: The Foundation for the Future

Analog / Hybrid Surveillance

- Coaxible Cable is expensive and bulky
- Disruptive digging and trenching
- Limited Coverage
- Feature sets are relatively fixed and simplistic
- Changing video cassettes is time consuming and may result in video going unrecorded
- Searching previously recorded video cassettes is manually intensive
- Video cassettes wear out over time, and are not 100% tamper-proof
- Archival of video cassettes takes up a lot or space
- Real-time video distribution to remote locations is difficult and expensive

IP-Based Surveillance

- No Single Use Wires
- Install in Hours
- Instant transmittal of images
- Provide Coverage in hard to reach areas
- Monitor multiple cameras from 1 location
- Incorporate data encryption to guard against tampering
- Play back and duplicate without quality degradation
- Randomly access recorded video
- Compress and store on and transport over a variety of media
- Adjustable frame rates

Wireless Video Surveillance
Myths vs. Reality

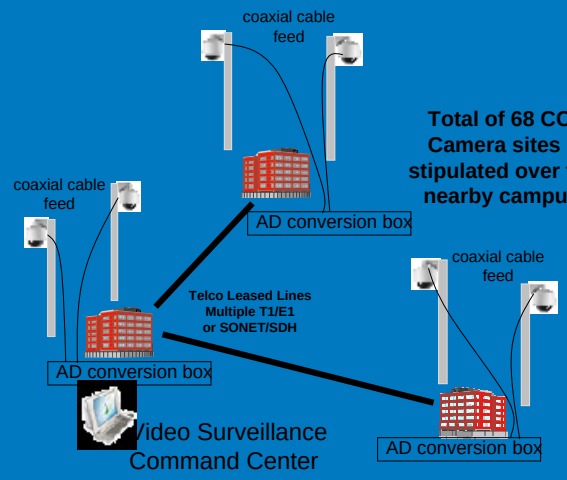
"Wireless Isn't Secure"
- Many systems offer multiple layers of Security
- AES Encryption and WEP/WPA can be used

"Interference Makes Wireless a Bad Option"
- Low Carrier to Interference Rate in systems minimizes data transmission errors
- Interference is not the end of the world - engineering workarounds are possible

"Wireless Doesn't Work"
- Canopy is a viable solution used in many industries worldwide

"Short Distances Only"
- Up to 100 miles Pt-Pt,
- 10+ miles PMP

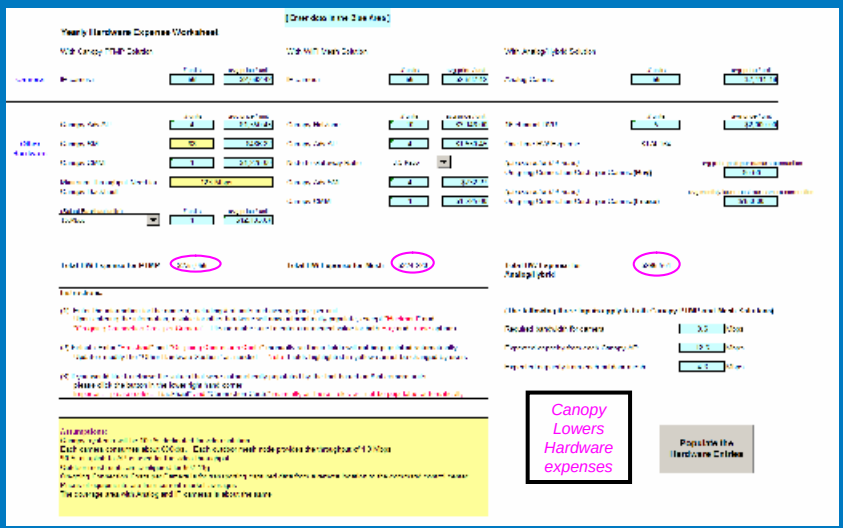
Consider This Existing Analog-Hybrid Video Surveillance Network



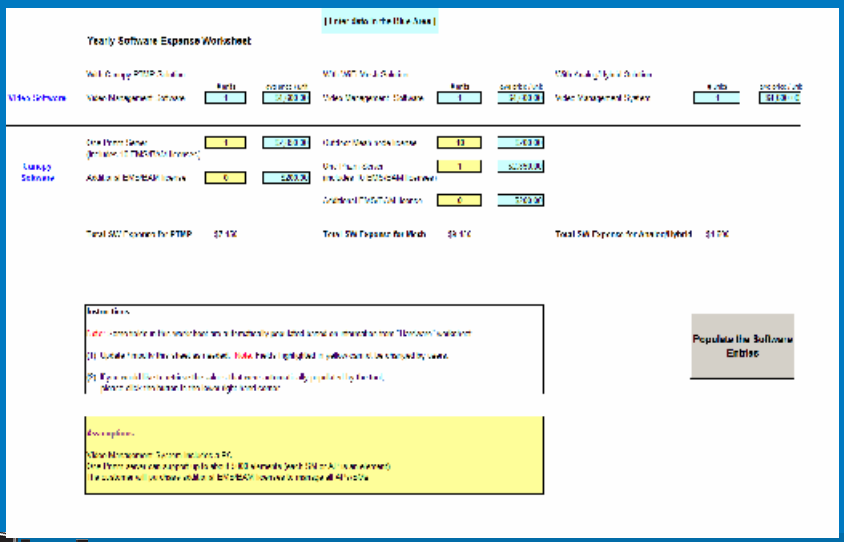
Total of 68 CCTV Camera sites are stipulated over three nearby campuses

A Canopy PTMP or WiFi Mesh Systems Delivers More Compelling Financial Benefits

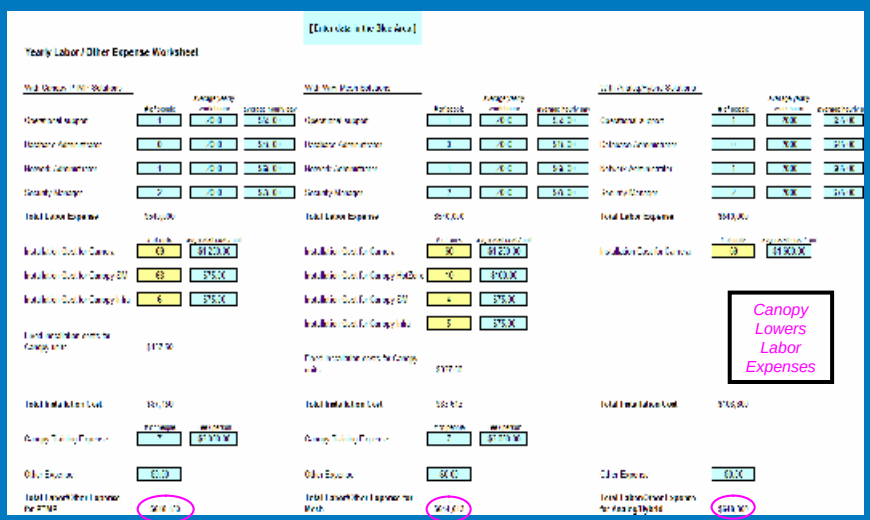
Canopy Video Surveillance ROI Calculator Comparison of Hardware Expenses



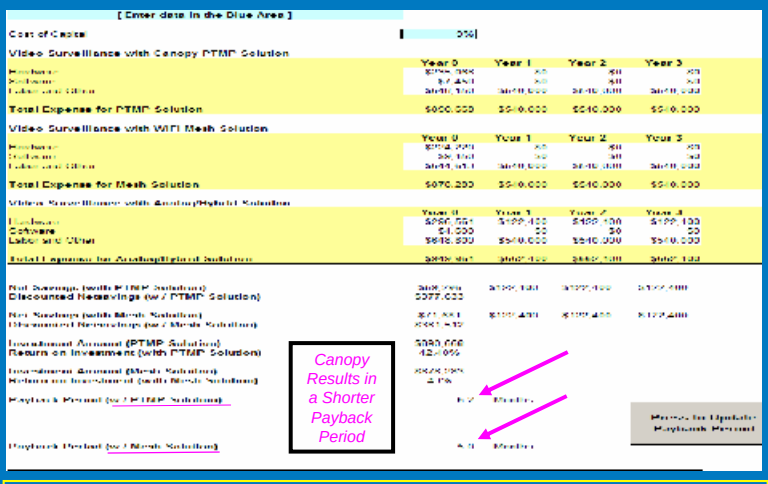
Canopy Video Surveillance ROI Calculator
Comparison of Software Expenses



Canopy Video Surveillance ROI Calculator
Comparison of Labor Expenses



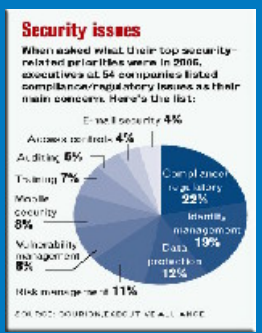
Canopy Video Surveillance ROI Calculator
ROI and Payback Results



A key competitive advantage of the Canopy system is the low entry price and short payback period

Multiple Layers of Security
Maintain Data Confidentiality, Integrity and Availability

Point to Multi Point	Point to Point	Mesh
•DES 56-bit encryption •FIPS 197 Certified AES 128-bit encryption •BRAID Encryption •Unique Synchronization •Authentication	•10, 20 Mbps - AES and DES Encryption •30, 60, 150, 300 Mbps - Proprietary Scrambling	•WEP •WPA (TKIP) •WPA2 (AES, 802.11i) •Hop-by-Hop Security •Authentication - 802.1x - MAC hardware



Decrease management concerns around loss of confidential or intellectual property and exposed sensitive information

Minimize exposure to fines, diminished reputation and loss of customers.

Success Stories

Case Study

Union Pacific, the Largest Railroad In the U.S. Uses Canopy Wireless Broadband To Increase Switching Yard Safety

Problem
Railroad classification yards function somewhat like air traffic control facilities, and may be many miles in length, and have hundreds of miles of track.
•When a Remote Control Locomotive crosses a road in the yards, there is now no one inside the cab to visually monitor the crossing for activity.
• To ensure efficiency and safety, Union Pacific needed effective, reliable and secure communications capabilities in classification yards.

Solution
Union Pacific placed cameras at each crossing.
• Using Canopy BackHaul modules, cameral video is sent to a yard control center where managers continually monitor each crossing for traffic.
• Managers are able to have constant communication with ground personnel.

Results
• The Canopy high bandwidth connection enables UP to backhaul data collected by the repeaters to the network, efficiently enabling a wide range of critical network diagnostic applications, including congestion management, statistics analysis and more.
• High-speed software upgrades for locomotives, which were previously carried out every few months are now done wirelessly.

Case Study

The Virginia Port Authority Enhances Security Monitoring Covering 15 miles

Problem
After 911, security needed to be enhanced at 3 ports.

Solution
Canopy was integrated with 91 cameras, servers & software to provide intelligent monitoring. Unauthorized objects and suspicious activity is detected over land & water for intrusions.

Results
The system was installed in less than 100 days at a significant cost savings. The system is accessible from all 3 port security offices and can be accessed directly by law enforcement & emergency response centers.

Case Study

Canopy broadband wireless helps increase traffic safety in Nevada

The Problem
The Nevada Department of Transportation (DOT) needed a cost-effective way to monitor road conditions of a highway the size of New Jersey

The Solution
A Canopy system supports a network of video cameras along a 200-mile stretch of I-80. Seven mountaintop installations of Canopy backhaul units, access points and subscriber modules support video cameras at remote weather stations.

The Result
The DOT Traffic Management Center now has a real-time view of road conditions, allowing quick dispatch of sand and salt vehicles for icy road conditions. Truck dispatches that used to take three to four hours now takes as little 30 minutes. The Canopy platform provides continuous video footage of traffic movement over 42 miles.

"We've finally found the solution with the bandwidth to go the distance"

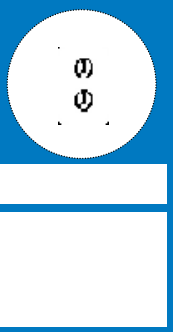
Wireless - Consider the alternative!

- *Wireless technology avoids disruptive digging and trenching on campuses and corporate sites*

- *Most systems operate in unlicensed frequencies, eliminating wait time, expenses and right of way issues*

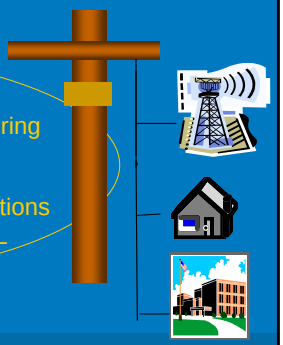
Powerline MU

Broadband over Powerline (BPL) Technology for high density dwellings

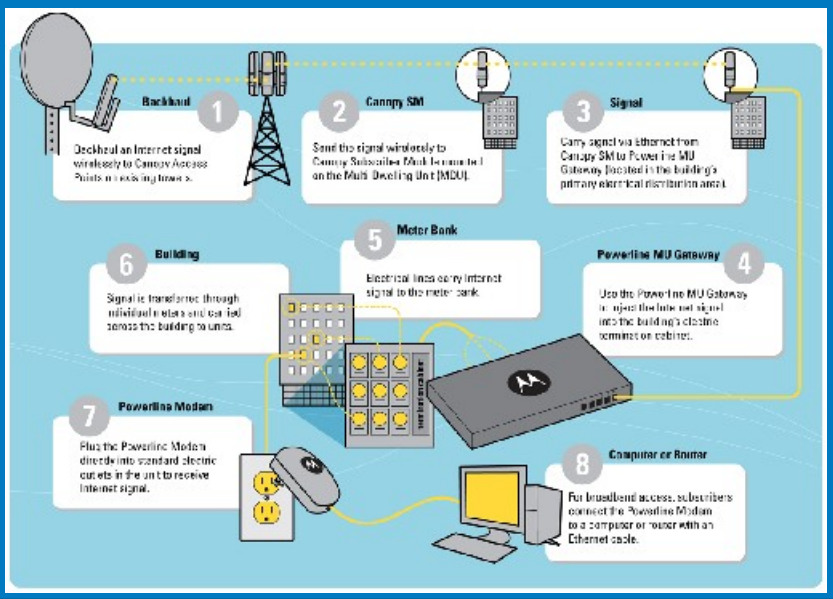


What is Broadband over Power Line (BPL) ?

- **BPL is the transmission of radio signals through an electric power line at broadband speeds**
- **Utilities have used narrowband power line carrier (PLC) for over 50 years both to transmit control signals and to collect simple data about their electric grid**
- Roadmap**: Data rates up to 200 Mbps (phy rate) / ~50 – 70 Mbps (user throughput) are achievable with new chipsets in test now**
- Applications:
  - Multi-Dwelling Unit / Multi-Tenant Unit Market
    - Broadband Access using building's electrical wiring
  - Utility Market:
    - Smart Grid - using powerlines for utility applications
    - "Last Mile" Broadband Access ➡ Access BPL
  - In-Home Networking



Powerline MU - Solution Deployment



Powerline MU Solution Components

- Powerline MU Modem – CPE and Powerline-to-Ethernet adapter. NAT and Firewall protection.

- Powerline MU Gateway – Head-end and controller/router for Powerline network

- Powerline MU Hybrid Adapter – Powerline– Twisted Pair adapter for utilizing unused phone lines to connect the Canopy SM to the Powerline MU Gateway (optional)

- Powerline MU Panel Extender – Accessory to provide coupling among 4 separate 3-phase power distribution panels (optional)

Powerline MU: Key Benefits vs other Technologies

Lower cost – **Wireless backbone means a better ROI and faster payback**

Easier and less costly to Deploy – **uses the building's existing wires, electric panels and meters**

Completes the WISP's wireless portfolio – **opening new markets for revenue**

More profit potential -- **More efficient method to deliver internet signal to multiple users with the same Canopy backbone**

"Plug and Play" -- **CPE (Modem) is self-install – no appointments needed**

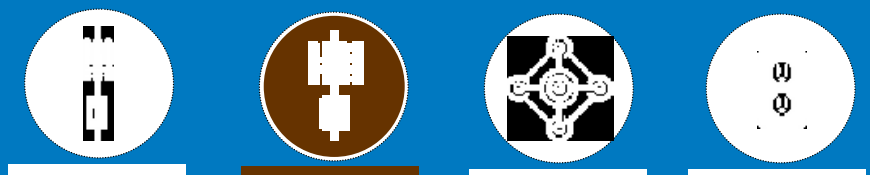
Scalable architecture -- **Pay as you go approach allows you to start small**

Wireless offers you flexibility outside the building

Broadband over Power gives you Flexibility inside the building

IP Networks enable information anywhere at anytime in a secure environment.

THANK YOU



WiMAX

THANK YOU

Back-Up

Markets and Applications

Government – Municipalities

- Provide law enforcement the evidence needed to investigate and prosecute incidents
- Deter vandalism and other crime in isolated / hard to reach areas.
- Survey railroad crossings and busy traffic intersections.
- Monitor weather conditions for improved public safety.
- Protect monuments, museums and other attractions
- Respond quicker to public safety emergencies

Government – Federal / National

- Secure the homeland and monitor and ports, bridges, and military bases
- Enhance domestic security as part of a comprehensive homeland security program
- Adhere to customs laws and abide by maritime security treaties

Markets and Applications

Transportation

- Monitor parking lots, bus terminals, airports, train stations and shipyards for
- signs of suspicious behavior.
- Monitor road conditions to prevent traffic fatalities
- Alert the public of inclement weather conditions
- Reduce Insurance Premiums
- Monitor unmanned locations in rail yards, railroad junctions and public roads
- Secure expansive airport perimeters, with numerous points of access

Markets and Applications

Oil & Gas

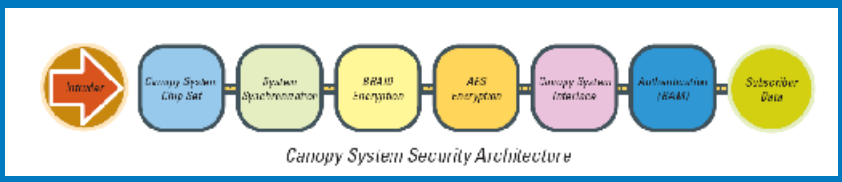
- Monitor wells, pumps and compressors located in remote areas.
- Provide security at refineries, offshore oil rigs and ports that accept incoming oil from tankers
- Decrease lost revenue resulting from production interruptions.
- Avoid costly fines resulting from oil spills and other hazardous material exposures.
- Easily move Canopy equipment from one drilling tower to another to rapidly determine optimum locations for drilling.

What's Interference?

Interference Occurs When One Radio Signal Disrupts The Transmission Of Another Signal

- C/I Ratio:
  - Carrier To Interference Ratio
  - Describes How Strong The Desired Signal (The Carrier) Is Relative To Unwanted Signals (Interference)
- Sources Of Interference:
  - Self Interference (Emanates From A Network Under Your Control)
  - External Interference (Opposing Signal Coming From A Network, Device Or Other Source Not Under Your Control)

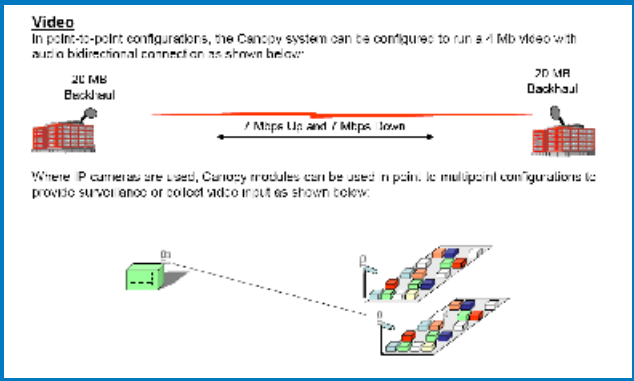
Stringent Security to Protect Proprietary Data



Canopy System Security Architecture

- *Exclusive Chip Set - A Motorola design and are not commonly available, reducing access to experience with embedded algorithms.*
- *System Synchronization - Unique synchronization provides higher security than 802.11 alternatives by requiring precise synchronization from all modules in the network.*
- *BRAID Encryption - The AES key is encrypted by Motorola's 128-bit Telecommunications Industry Association (TIA) standard BRAID algorithm making it more secure than others in the market.*
- *AES Encryption - There are approximately: 3.4 x 1038 possible unique 128-bit keys protecting communication.*
- *Canopy System Interface - The Canopy system has a unique interface which is not published.*
- *Authentication - Canopy modules are authenticated when they are registered by the system.*

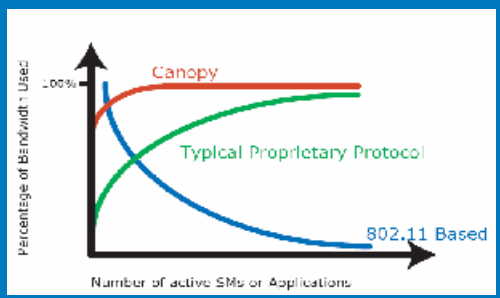
Canopy Bandwidth Management



Throughput is fully configurable to offer balanced up/down service, or at a ratio tailored to meet customer requirements.

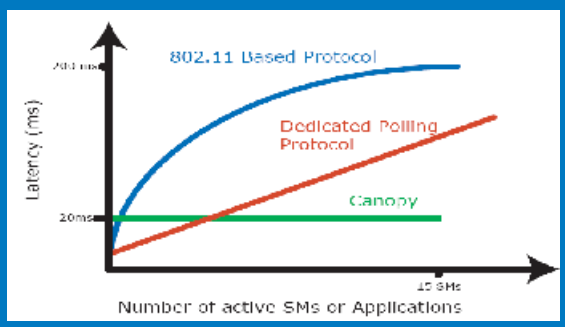
Performance Parameters

The Canopy system has been designed to provide maximum throughput and to ramp up and maintain fairness as load increases.



Performance Parameters

The Canopy system delivers consistent, predictable low latency over a range of Subscriber Modules



Canopy Technical Specifications

	Canopy Advantage
C/I	< 3 dB
Coverage Performance	Low C/I ratio, GPS Sync, ARQ
Signal rate Max	20 Mbps
Peak Throughput	14 Mbps
Operating Temperature	- 40 C to +55 C
Scalability	High
Packets per second	6400
Latency	5-4 Milliseconds (5.7 Ghz)
Network Management System	Prizm Element Management System
Failure Rate	40 year MTBF. < 1% failure

Throughout: Canopy Point-to-Multipoint Configurations

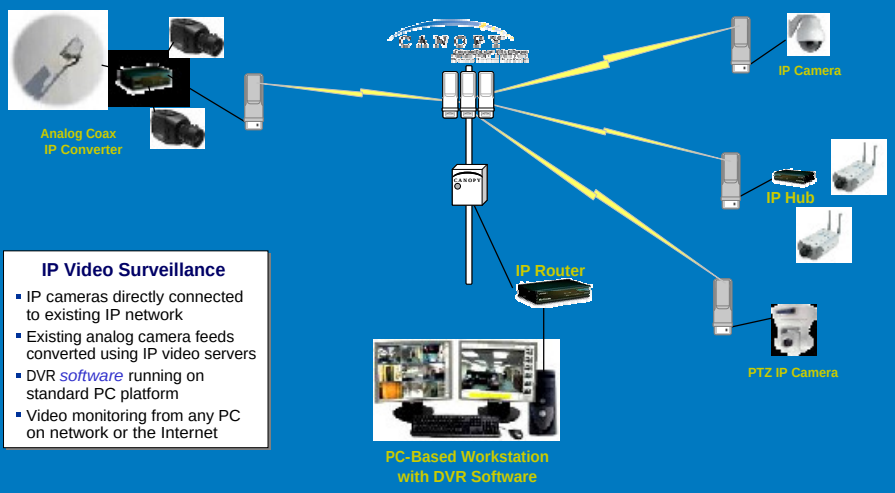
Frequency	**Aggregate Throughput Advantage AP / SM**
900 MHz (Line of Sight	4 Mbps / 2 Mbps
2.4 GHz	14 Mbps / 7 Mbps
5.1 GHz	14 Mbps / 7 Mbps
5.2 GHz	14 Mbps / 7 Mbps
5.4 GHz	14 Mbps / 7 Mbps
5.7 GHz	14 Mbps / 7 Mbps

Throughout: Canopy Point-to-Point Configurations

Frequency	**Aggregate Throughput 10 Mbps / 20 Mbps**
2.4 GHz	7.5 Mbps / 14 Mbps
5.1 GHz	7.5 Mbps / 14 Mbps
5.2 GHz	7.5 Mbps / 14 Mbps
5.4 GHz	7.5 Mbps / 14 Mbps
5.7 GHz	7.5 Mbps / 14 Mbps
5.7 GHz	14 Mbps / 7 Mbps / 33.6 Mbps (45 Mbps Modulation Rate)

Migrate to IP while Protecting Investments in Legacy CCTV

Easily Integrate Analog and IP Based Cameras

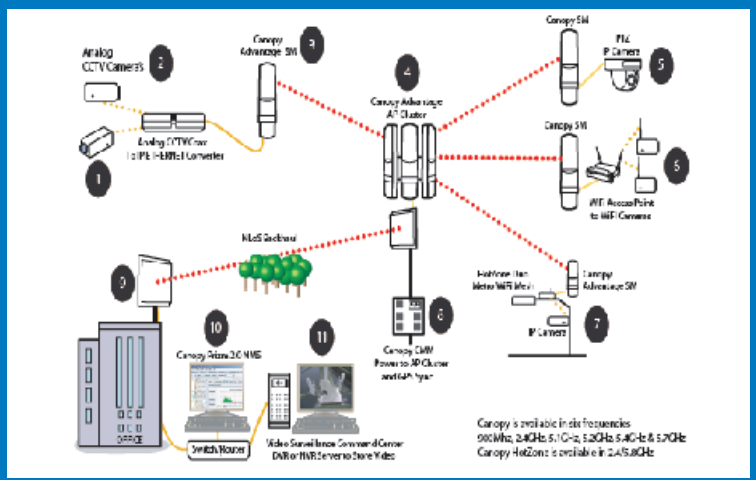


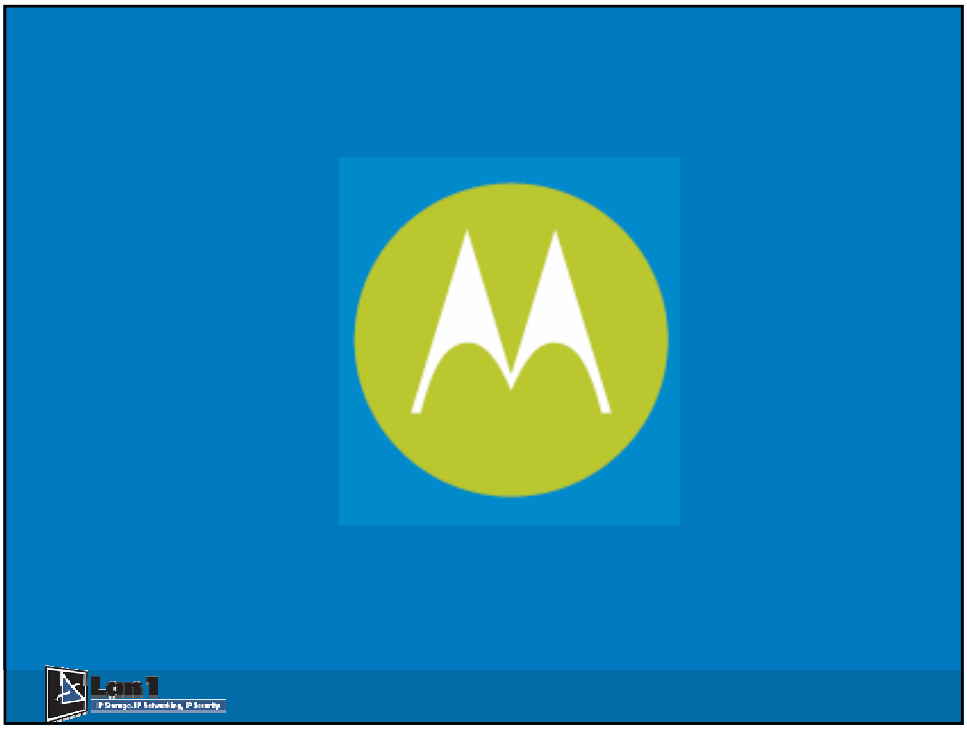
IP Video Surveillance

- IP cameras directly connected to existing IP network
- Existing analog camera feeds converted using IP video servers
- DVR *software* running on standard PC platform
- Video monitoring from any PC on network or the Internet

Canopy Wireless Video Surveillance

PTMP, PTP and Backhaul to Canopy HotZone Duo




Lan 1