Sensors, Security and Mesh Wireless Networks in the Public Safety Domain

W2i Conference Presentation

6/29/04

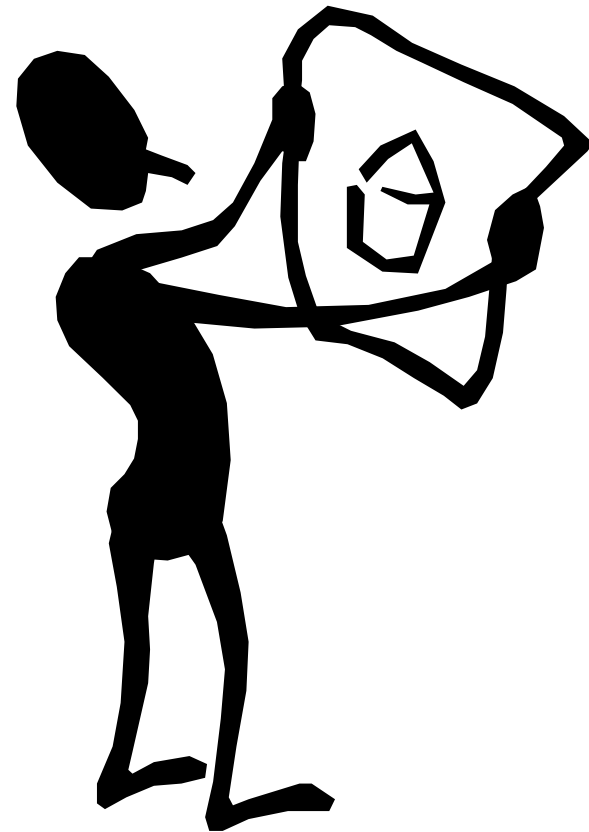**Ian McPherson**

President
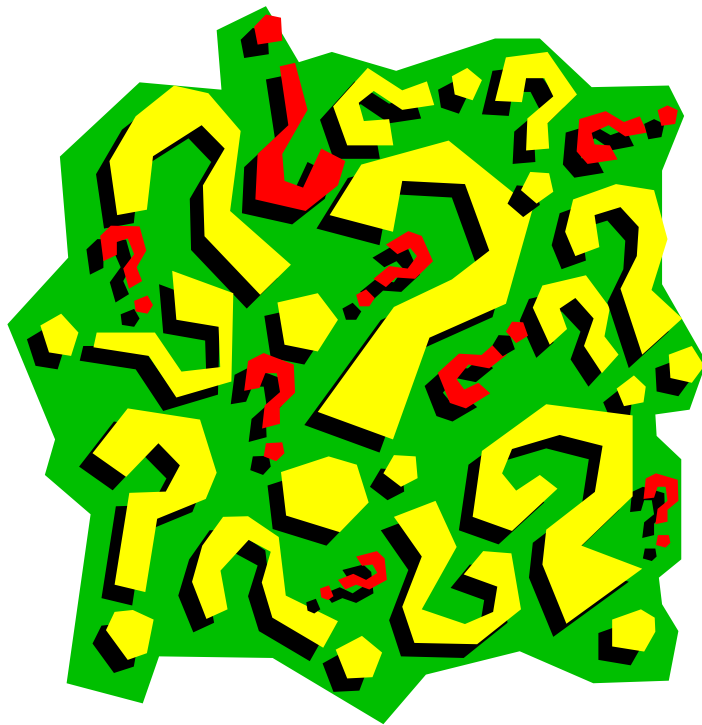
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Agenda

Examining the Wireless Landscape

- Where Are We Today?
- What Do We Mean by Wireless and Mesh?
- Why Are We So Bullish on New Wireless Technologies?
- Challenges
- An Integrated Future

Questions

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Where Are We Today?

- Wireless technologies and adoption remains fragmented; no single supplier or pervasive application

- New standards, industry alliances moving toward lower cost, higher functioning wireless systems

- Lessons can be learned from wireless sensing and the overall 'machine-to-machine' (M2M) paradigm which continues to deliver ROI to enterprises

- Application and environmental factors driving demand for new wireless networking capabilities

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What Do We Mean by "Wireless"?

Many promising wireless standards and technologies…

- 3G Cellular (EvDO/UMTS/GPRS)
- IEEE 802.11 (WiFi)
- 802.15.1 (Bluetooth)
- 802.15.3a (UWB)
- 802.15.4/ZigBee
- 802.15.5 (WPAN mesh networking)
- 802.16/WiMAX
- IEEE 1451.5 (wireless sensors)
- Passive RFID
- Active RFID

…**no single wireless technology will carry the day**

The bottom line: *wireless technologies provide a set of tools for facilitating applications-use the best tool for the job!*

What is it Good For?

|	
• 3G Cellular	• Messaging; Mobility
• IEEE 802.11 (WiFi)	• Computing
• 802.15.1 (Bluetooth)	• Wire line replacement
• 802.15.3a (UWB)	• Wireless multimedia; harsh environs
• 802.15.4/ZigBee	• Sensing; remote management
• 802.15.5 (WPAN mesh networking)	• Building automation
• 802.16/WiMAX	• Backhaul; MAN communications
• IEEE 1451.5	• Sensor integration
• Passive RFID	• Micro-payments; security
• Active RFID	• Asset tracking

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So What is a Mesh Network?

Mesh Application Network
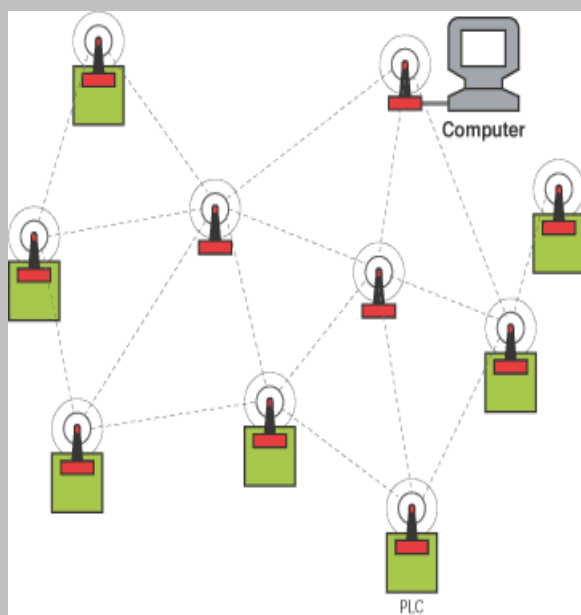
Source: Ember Corporation

Mesh Infrastructure Network
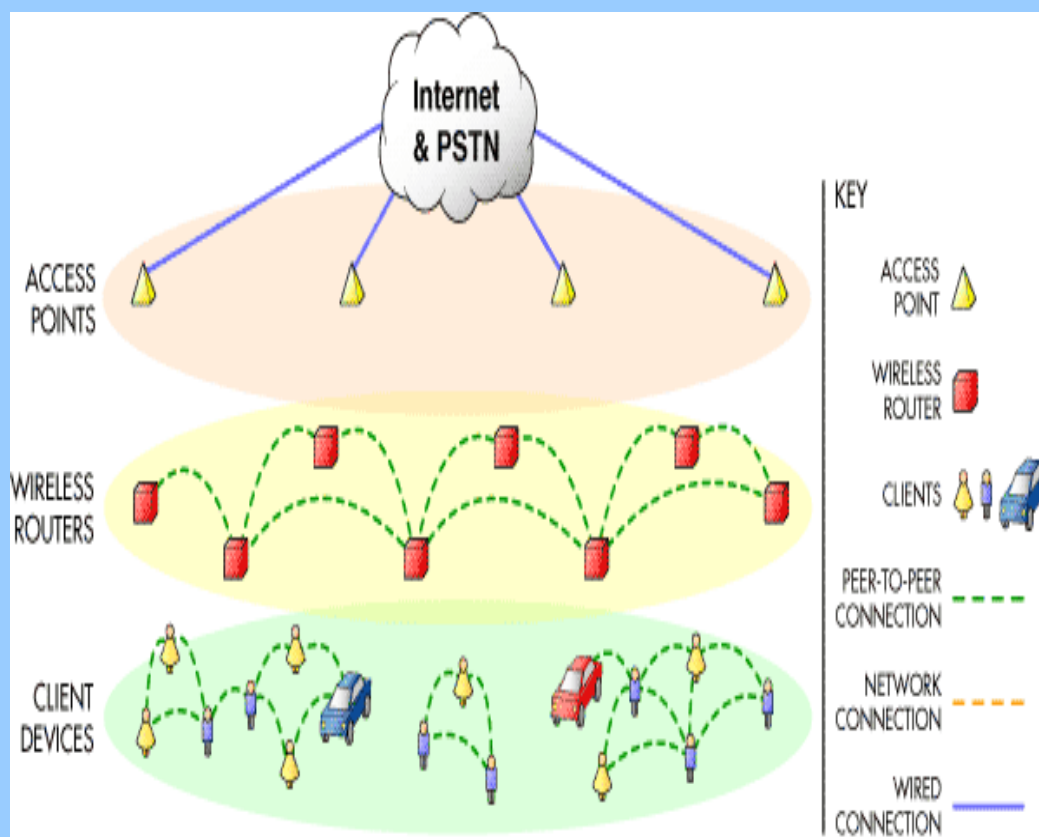
Source: MeshNetworks

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A Fragmented Mesh Vendor Landscape

Mesh Application Vendors

- Atalum
- Crossbow
- CSEM
- Dust Networks
- Eka Systems
- Ember
- Helicomm
- Machine Talker
- Millennial Net
- ZenSys
- ZMD

Mesh Infrastructure Vendors

- BelAir Networks
- Figure 8 Wireless
- Firetide
- MeshNetworks
- MeshDynamics
- PacketHop
- Roam AD
- Strix Systems
- Tropos Networks

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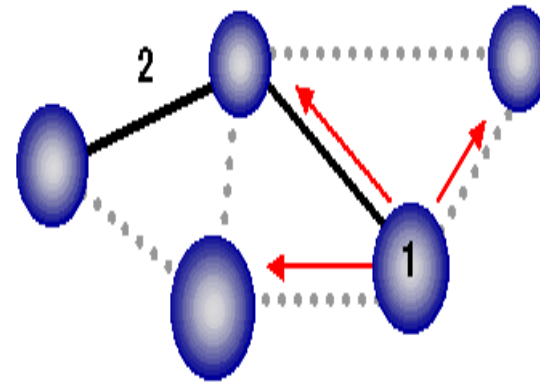
Standards Coming into View

Emerging Standards

- 802.15.4/ZigBee
- 802.11
- 802.16
- EPCGlobal Class 5 Active Tag

Issues Addressed

- Organization (Ad hoc vs. managed)
- Path and link discovery
- Routing
- Security
- Management
- Interoperability
- Application Profiles

Nodes Joining a Mesh Network

(1) A new node joins the mesh using a discovery protocol to broadcast its presence. Existing nodes reconfigure the network to incorporate it.

(2) Nodes select the best path based on the designer's route criteria. Nodes automatically reconfigure paths as network changes occur.

In a managed mesh, new nodes are authenticated before they can begin operation and transmissions are encrypted for secure communications.

Source: CMP Media

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Why Are We So Bullish on Mesh Wireless PAN/LAN/MAN?

Vertical Markets

- **Industrial Automation**
- **Consumer**
- **Backhaul/pub net infrastructure**
- **Government**
  - **DoD**
  - **DoE**
  - Municipalities
  - Public Works
  - Utilities
  - Condition Monitoring
  - First Responder Communications

- **Building/Facilities Management**
- **Security & Public Safety**

Value Proposition

- Lower TCO (predictable fixed costs vs. variable recurring costs)
- Resilient (may be self organizing/self healing)
- Compatibility with legacy systems (SCADA, TCP/IP, ERP, etc.)
- Extensible information network (sensing, tracking, operations, computing)

Applications

- Asset Tracking
- Security
- Telemetry (Asset and Patient)
- Mobile Computing
- Toll collection
- Micro-payments

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Although Mesh Topologies Have Some Serious Limits

Mesh Infrastructure (802.11)

- *Radio=shared medium; forces everyone to stay silent while channel is engaged. Wired networks, on the other hand, can and do hold multiple simultaneous conversations*

- *In a single radio ad hoc mesh network, bandwidth is divided $(1/2)^{\wedge\wedge}n$ at each hop. So in a multi hop mesh network, the max available bandwidth available to you degrades at the rate of 1/2, 1/4, 1/8. By the time you are 4 hops away the max you can get is 1/16 of the total available bandwidth* (others argue that radio silencing may limit this to $1/8^{th}$)

- Latency and QoS much tougher to manage in mesh networks

Source: Francis diCosta CTO and Founder
Mesh Dynamics (dailywireless.com)

Mesh Applications (802.15.4)

- **Scalability (what happens at 100 nodes? At 1000?)**

- **Throughput (see above)**

- **Latency (as little as 5 milliseconds for mission critical SCADA applications)**

- **Interoperability**

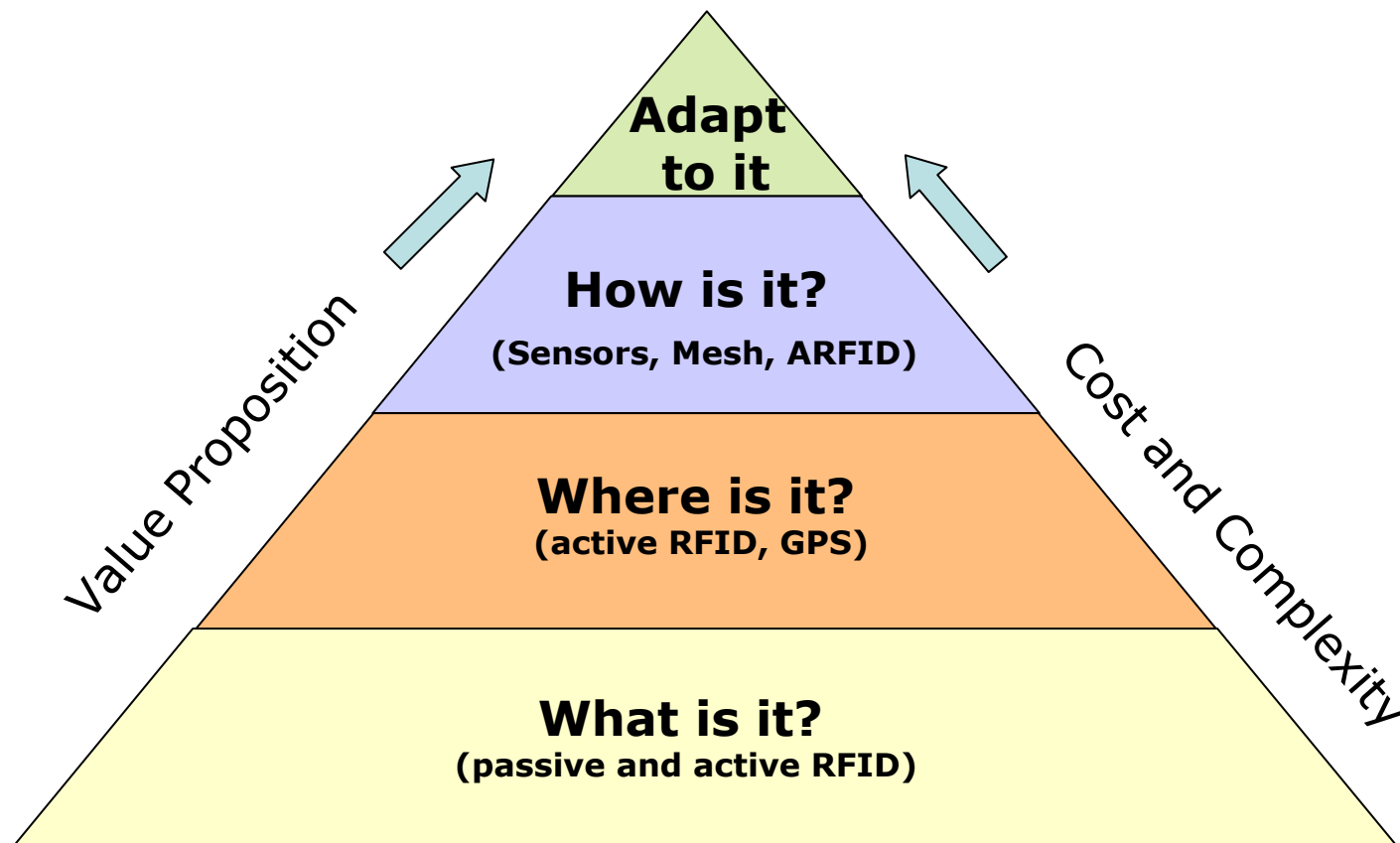- **Global Frequency**

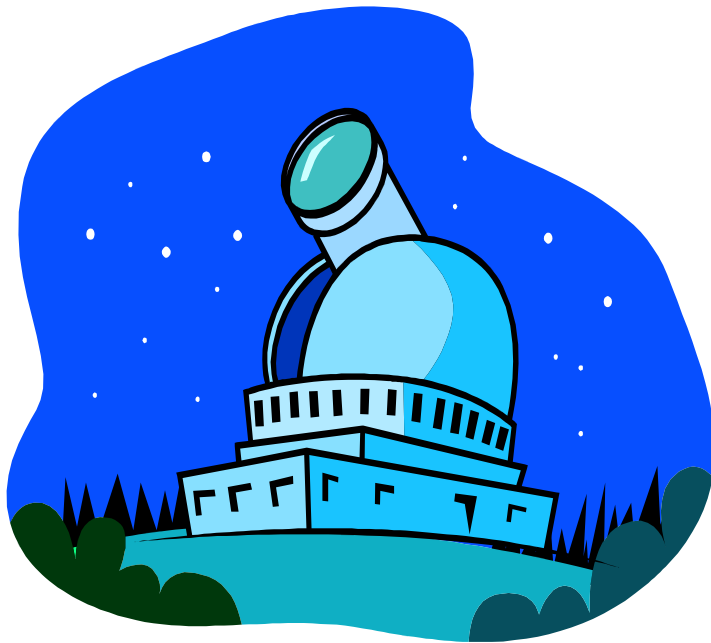- **Power consumption**

- **Security**

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An Integrated Future for Wireless Identification and Sensing

*Goal: Adaptive environmental neurology
in the global supply chain*

Value Proposition

Cost and Complexity

**Adapt
to it**

How is it?
(Sensors, Mesh, ARFID)

Where is it?
(active RFID, GPS)

What is it?
(passive and active RFID)

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Observations

- Wireless is a technology not an application

- If designed properly a wireless mesh network can create a common information infrastructure on which other wireless applications can be layered

- Best practices from enterprise automation efficiency can be applied to municipalities and public agencies

- Inevitable increase in wireless network applications argues for infrastructure investment (fixed vs. variable cost models)

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How We Can Help
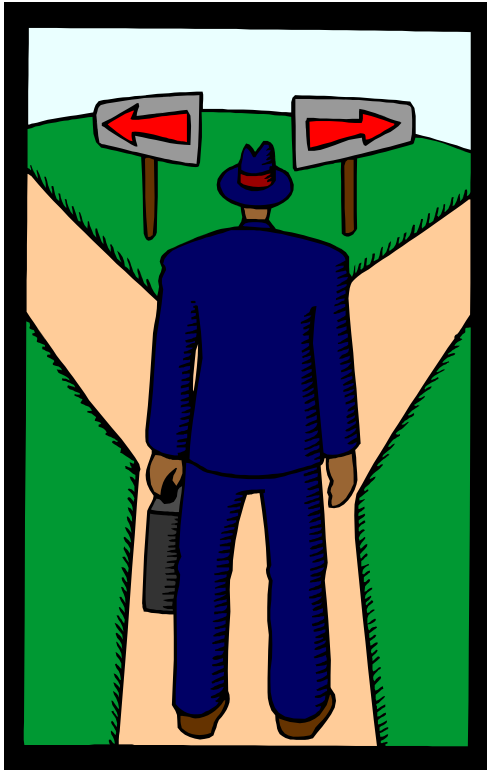
WDR helps our clients make informed decisions on technology and strategic direction through:

- Objective market studies
- Technology analysis and recommendation
- RFI/RFP development and management
- Technology development forecasting (phased adoption development)
- Competitive position consultation
- Funding sourcing; investor due diligence
- Comparative technology assessment
- Ongoing advisory retainer

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Thank You

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