

# INTRODUCTION

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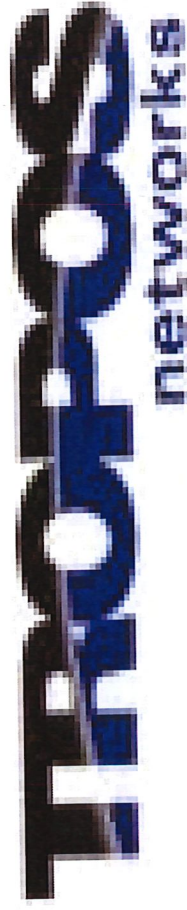
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# ACKNOWLEDGMENTS



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# ACKNOWLEDGMENTS



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# OVERVIEW

Wi-Fi

WiMAX

Wireless Broadband



# SCOPE

**Is WiMAX** what it is  
cracked up to be?



# SCOPE

**Will WiMAX be** what it is  
cracked up to be?



## DIGRESSION

Name an invention, or engineered device, or technology that delivered on its promise.

Name one that did not.

# DEFINITIONS

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**Wi-Fi**

Wireless Fidelity

IEEE 802.11

Wireless LAN



# Wi-Fi - TYPICAL

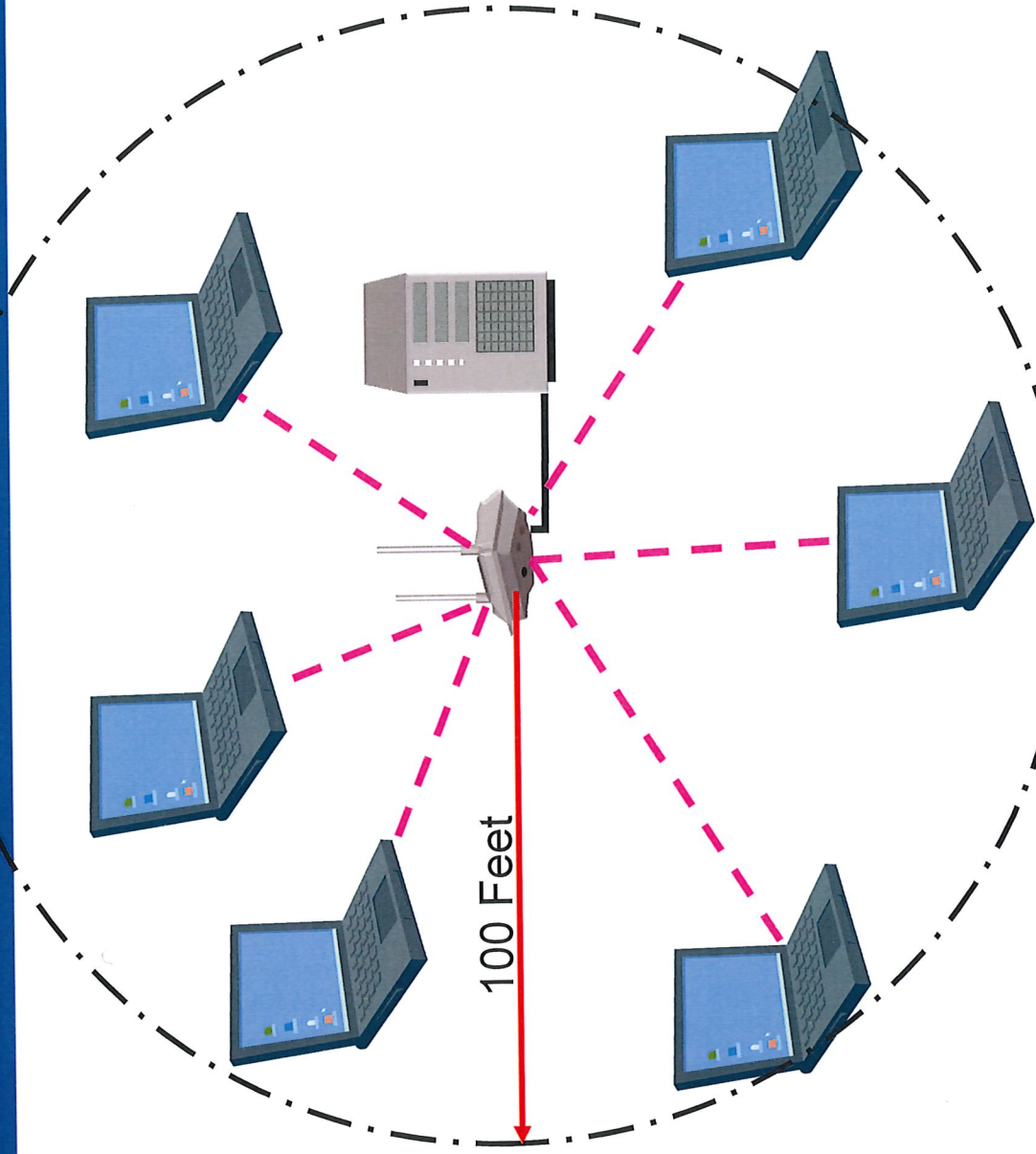


Illustration courtesy of **TROPPOS** networks



# Wi-Fi FLAVORS

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**802.11a**      **802.11b**

- **5 GHz**
- **54 Mbps**
- **2.4 GHz**
- **11 Mbps**

**802.11g**

- **2.4 GHz**
- **54 Mbps**



# DEFINITIONS

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## WiMAX

Worldwide Interoperability for  
Microwave Access

IEEE 802.16-2004

Wireless WAN

# WiMAX-(Wi-Fi)

- Longer Range – 30 Miles (100 Feet)
- Higher Bandwidth – 75 Mbps (11-54 Mbps)
- Multipath Resiliency
- ATM QoS (Ethernet packets)
- Mobile (Fixed)

# WiMAX -TYPICAL

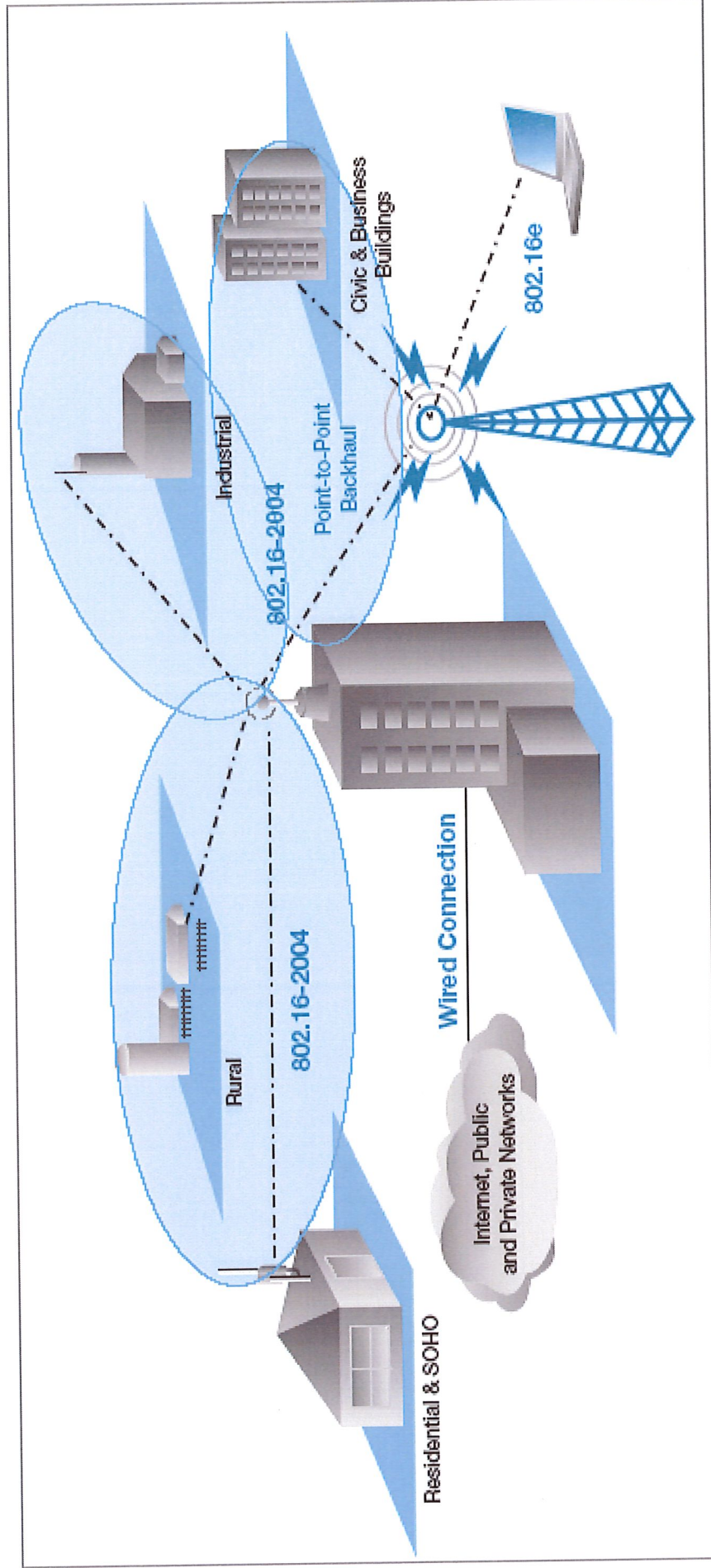


Illustration courtesy of 



# 802.16-2004 FREQUENCIES

## 2.5 GHz

- Licensed
- 75 Mbps (1.5 Mbps)
- 30 Mile Range
- Point to Multi-Point



# 802.16-2004 FREQUENCIES

## 5 GHz

- **Un-Licensed**
- 75 Mbps (1.5 Mbps)
- 30 Mile Range
- Point to Multi-Point



## 802.16-2004 FREQUENCIES

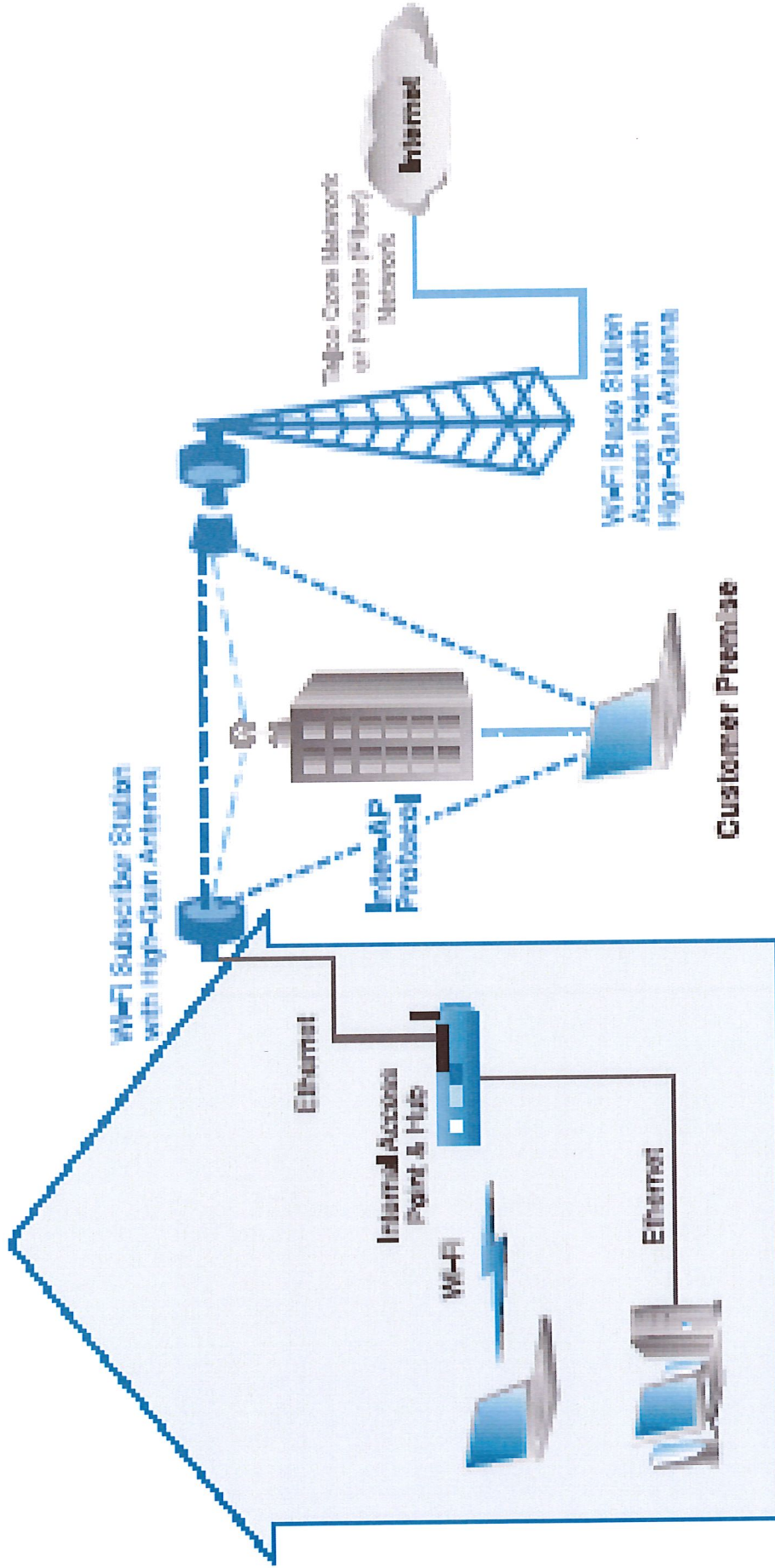
# 10-66 GHz

- **Licensed**
- **120 Mbps**
- **30 Mile Range**
- **Point to Multi-Point**





# Wi-Fi MESH



Customer Premise  
(Home, Business or HOTSPOT)

Illustration courtesy of **intel**.



# WiMAX --PHASE 1

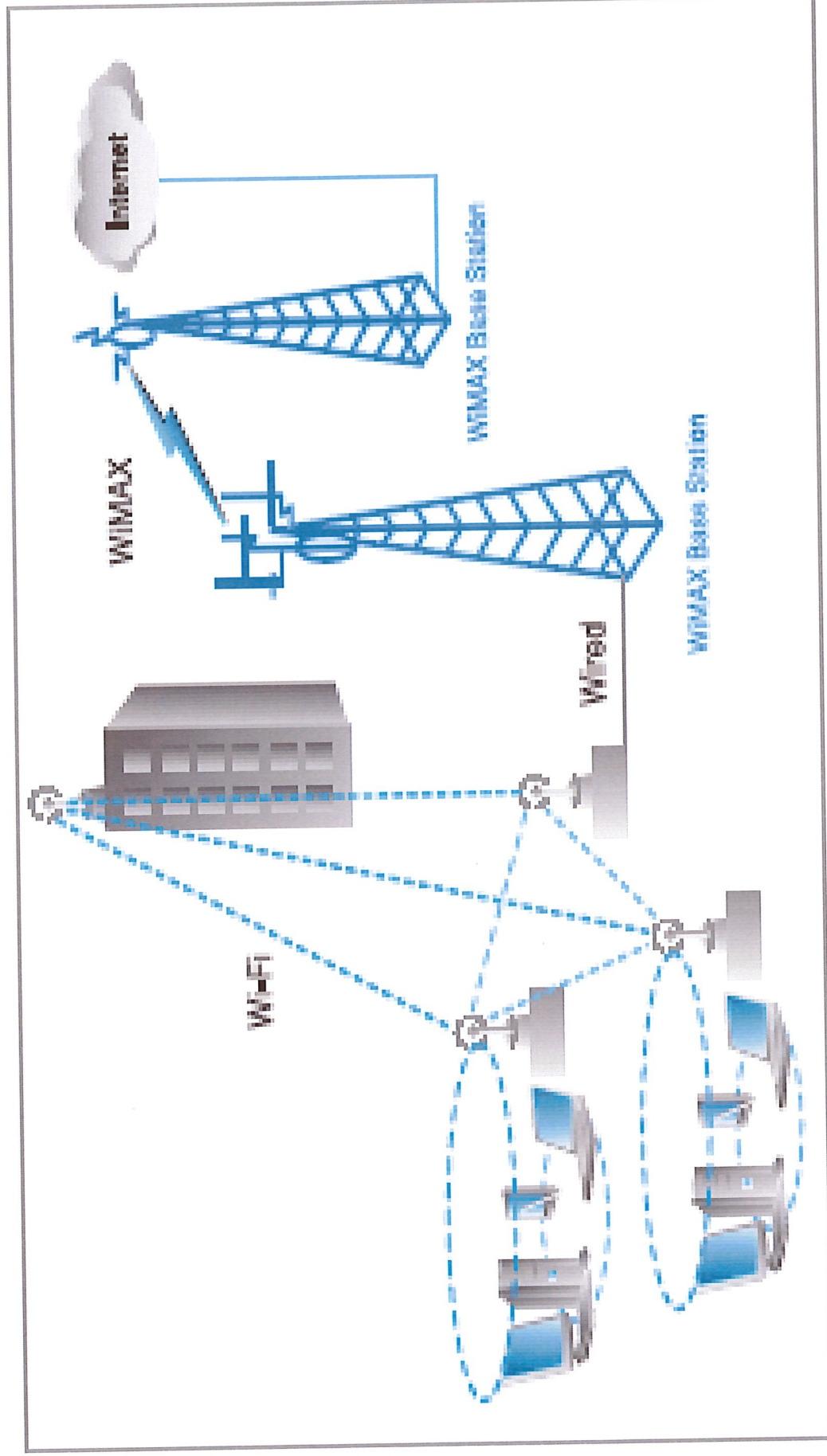
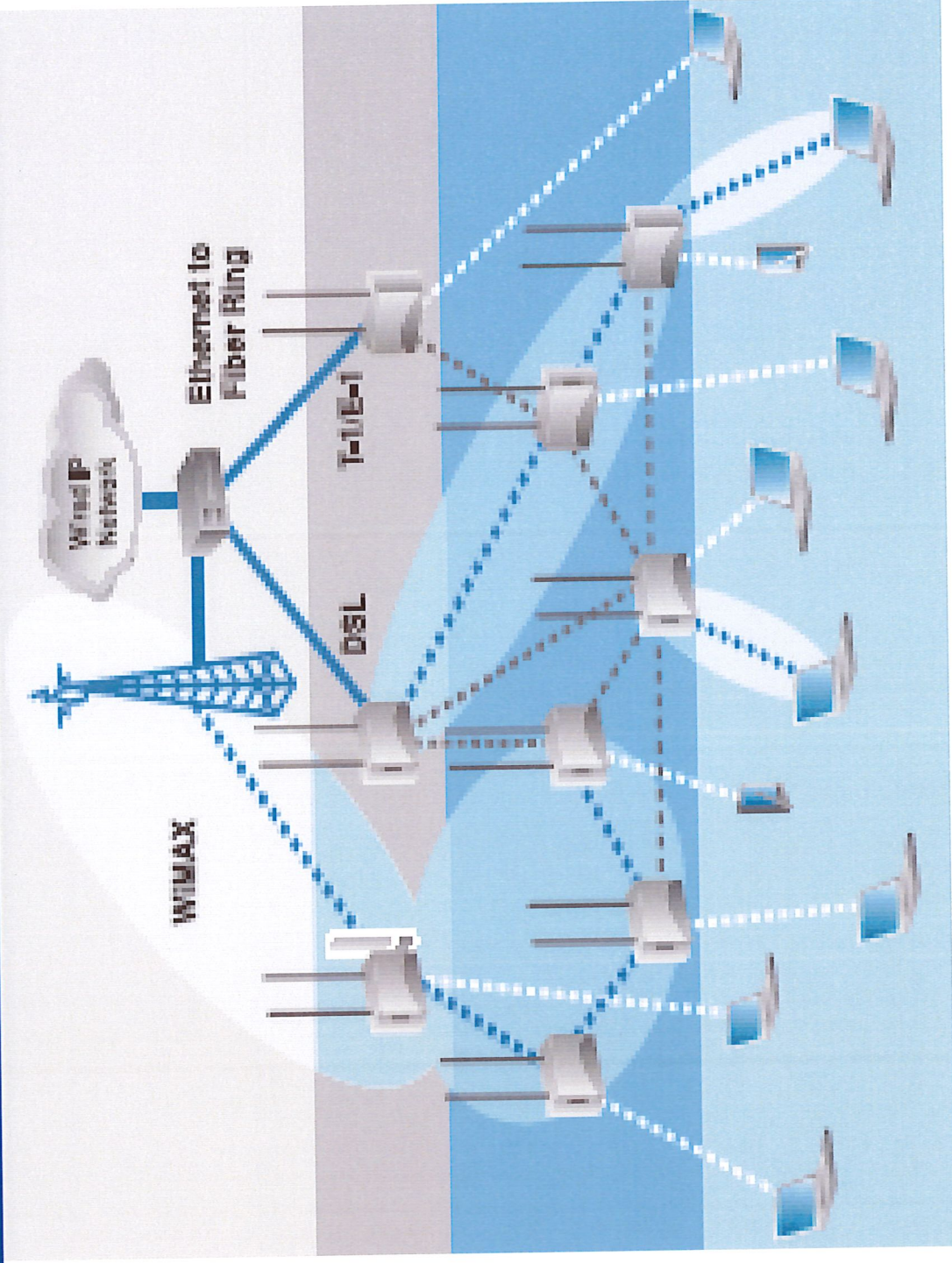


Illustration courtesy of  intel.



# WiMAX –PHASE 2



WiMAX Backhaul

Wi-Fi Gateways

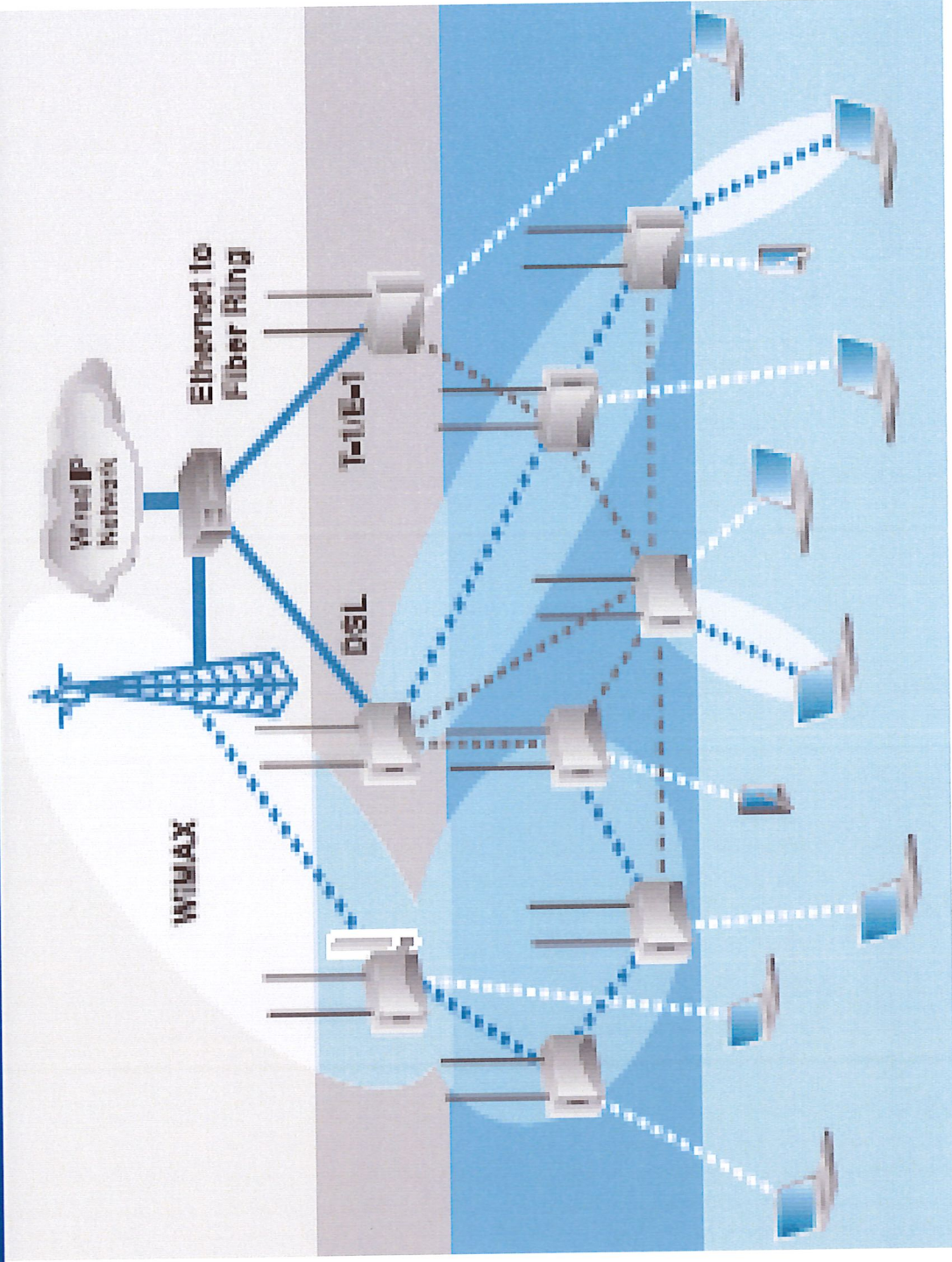
Wi-Fi Access Points

Wi-Fi Access Clients

Illustration courtesy of 



# WiMAX --PHASE 3



WiMAX Backhaul

Wi-Fi & WiMAX Gateways

Wi-Fi & WiMAX Access Points

Wi-Fi & WiMAX Access Clients

Illustration courtesy of 



## QUESTIONS

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Is WiMAX THE Answer?

It Depends

Is WiMAX Mobile?  
Standard due in '07

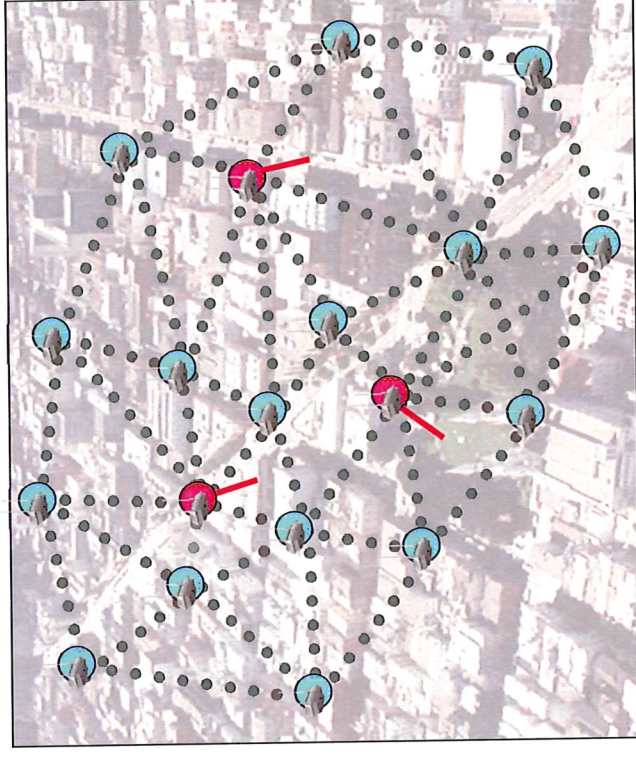
Is WiMAX Ready?  
Equipment '05

Pre-WiMAX



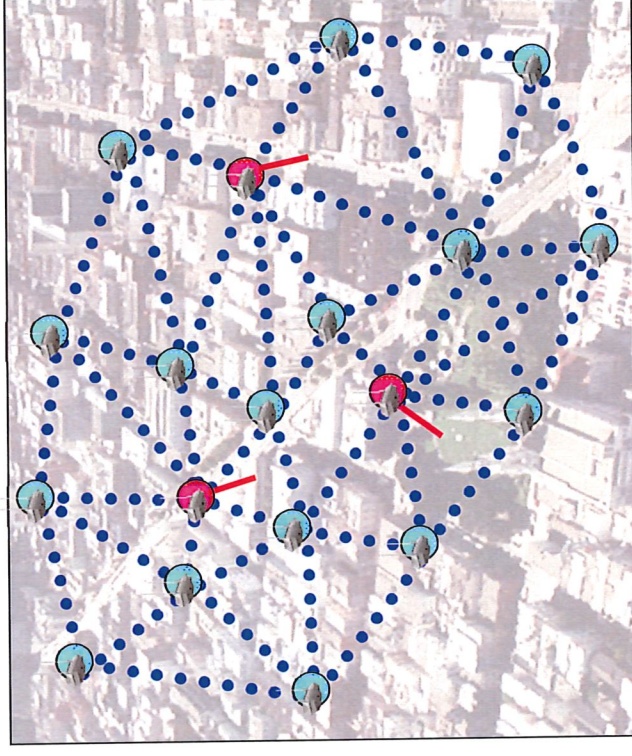
# Anatomy of a Wireless Mesh

- Mesh units talk to each other wirelessly
  - Most are totally wireless (**nodes**) and only need a power connection
  - They use Internet Protocol (IP) to share the spectrum bandwidth
    - The same way 100 users can share a 1.5 Mbps T-1 line
- Typically, only 10-20% of mesh units are **gateways** to the wired network
  - Their precise location in the mesh can be determined by backhaul availability
  - Nodes can be reconfigured as gateways as subscriber capacity needs increase



# Anatomy of a Wireless Mesh

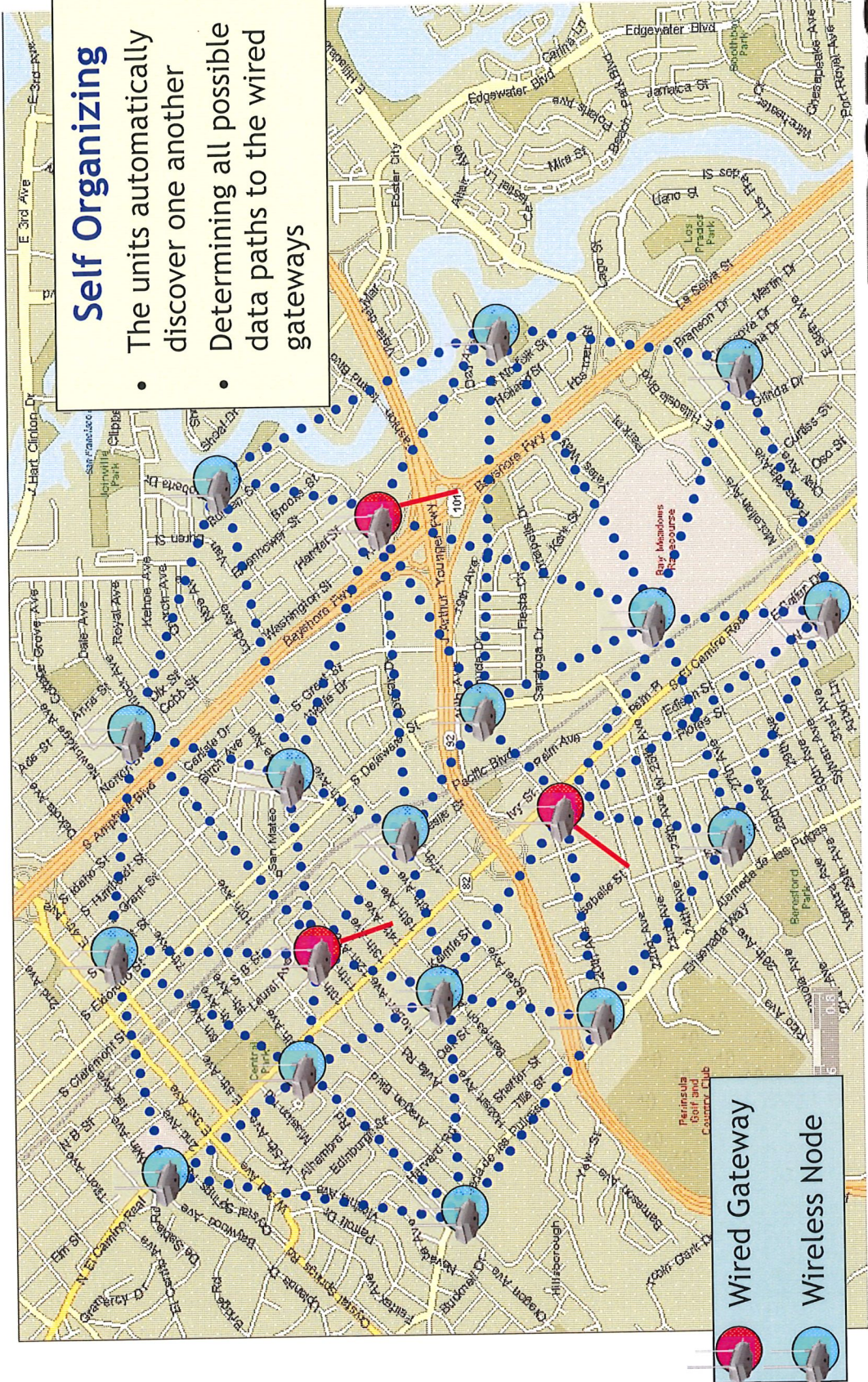
- Movement of data through the mesh must be managed by a true **mesh routing protocol**
  - Throughput-optimized for wireless
    - Based on measured wireless data throughput (not shortest path/ spanning tree)
  - Dynamic, to cope with the changing RF environment
    - Multi-path fading
    - Interference
  - With seamless roaming throughout the coverage area
    - Operates as a single, contiguous hot zone
    - Preserving authentication and security throughout



# Predictive Wireless Routing Protocol

## Self Organizing

- The units automatically discover one another
- Determining all possible data paths to the wired gateways

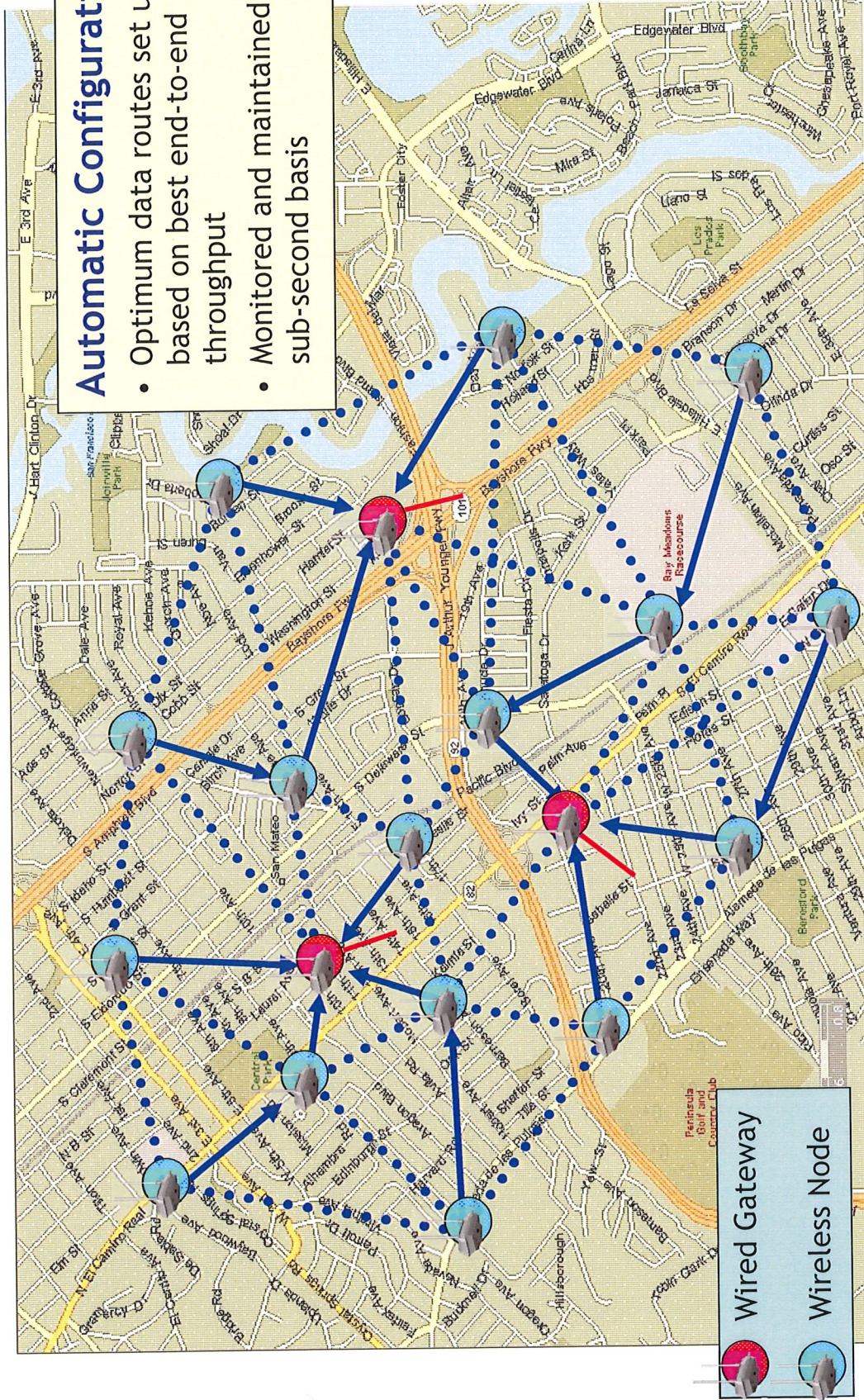




# Predictive Wireless Routing Protocol

## Automatic Configuration

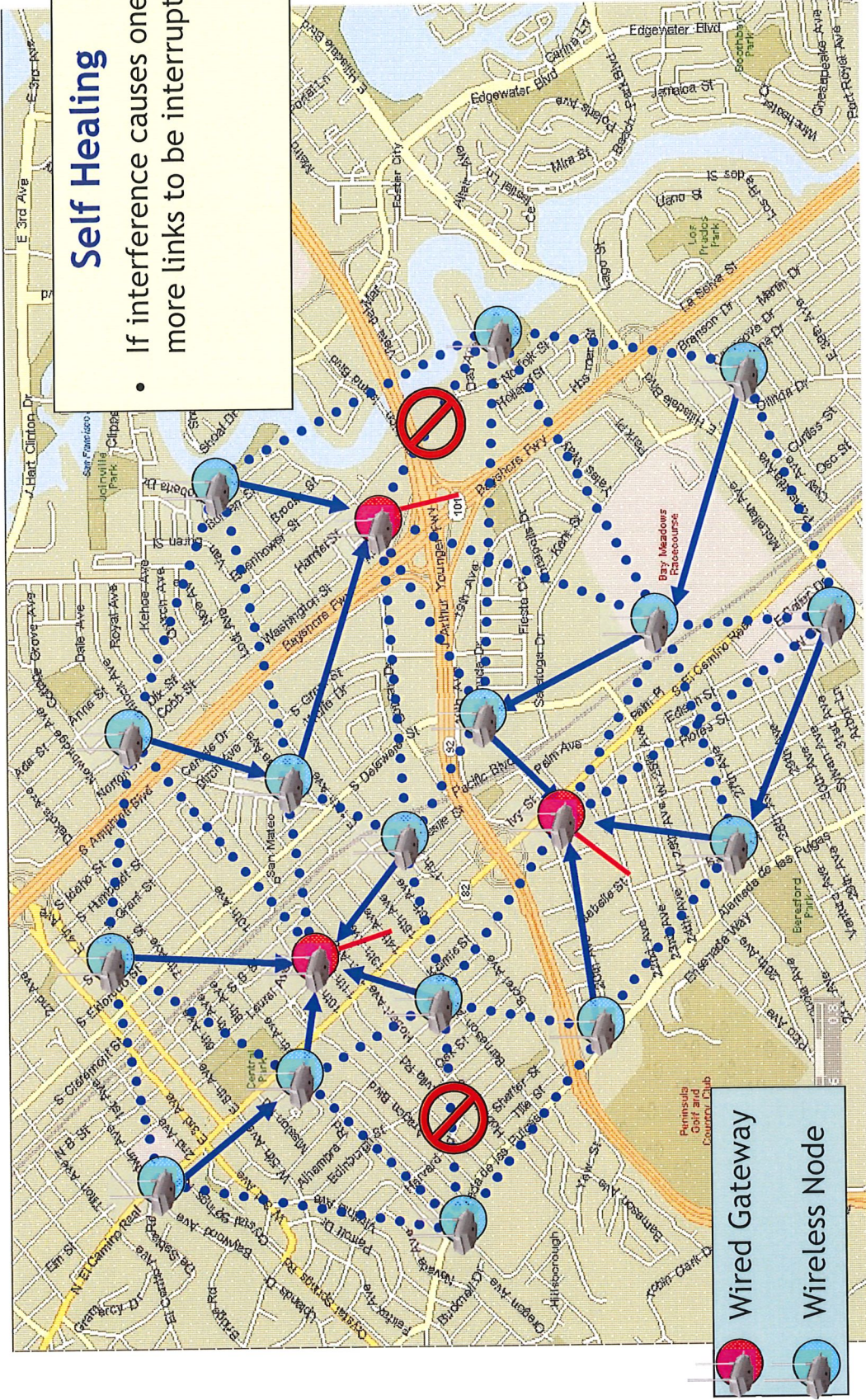
- Optimum data routes set up based on best end-to-end throughput
- Monitored and maintained on sub-second basis



# Predictive Wireless Routing Protocol

## Self Healing

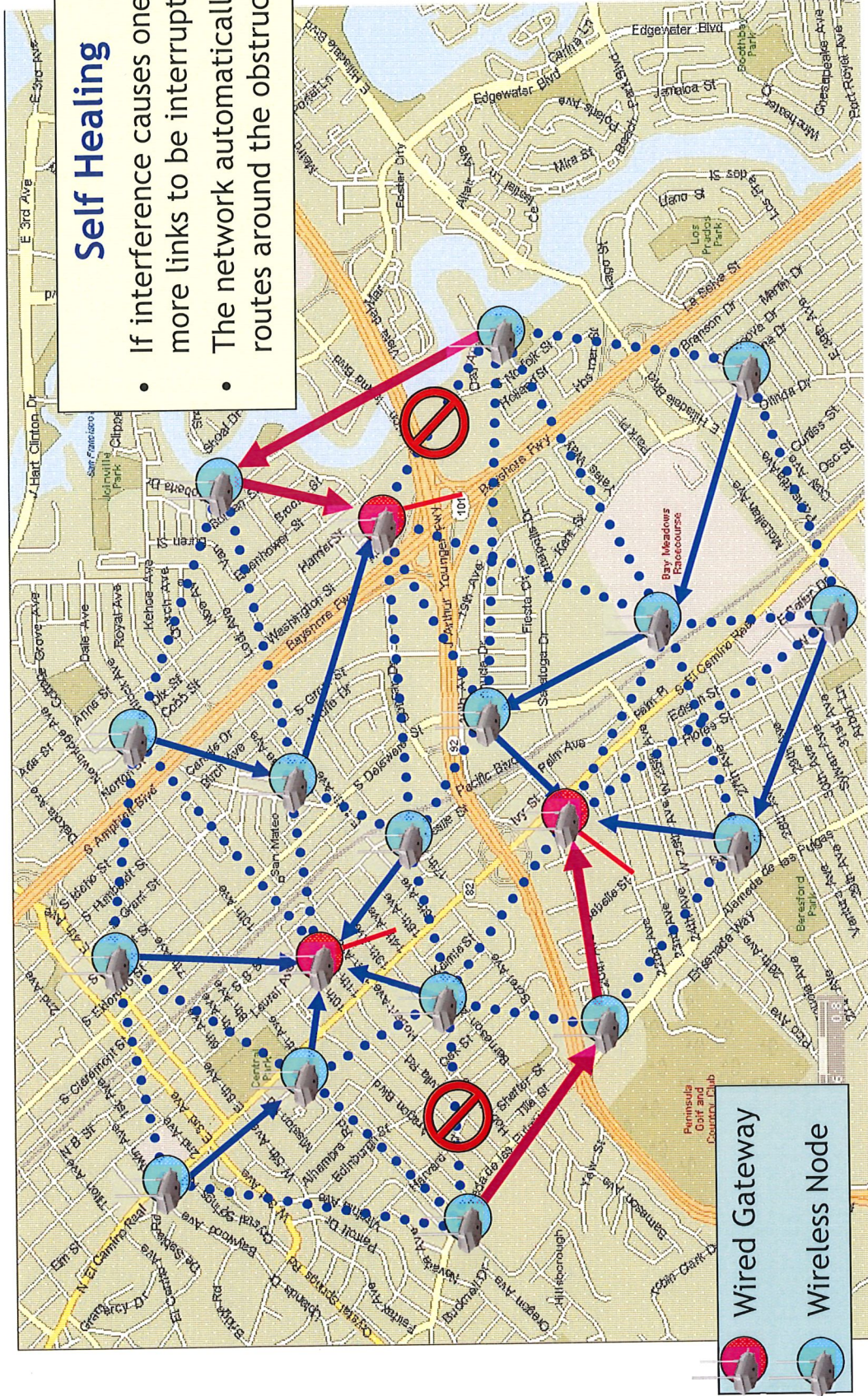
- If interference causes one or more links to be interrupted...



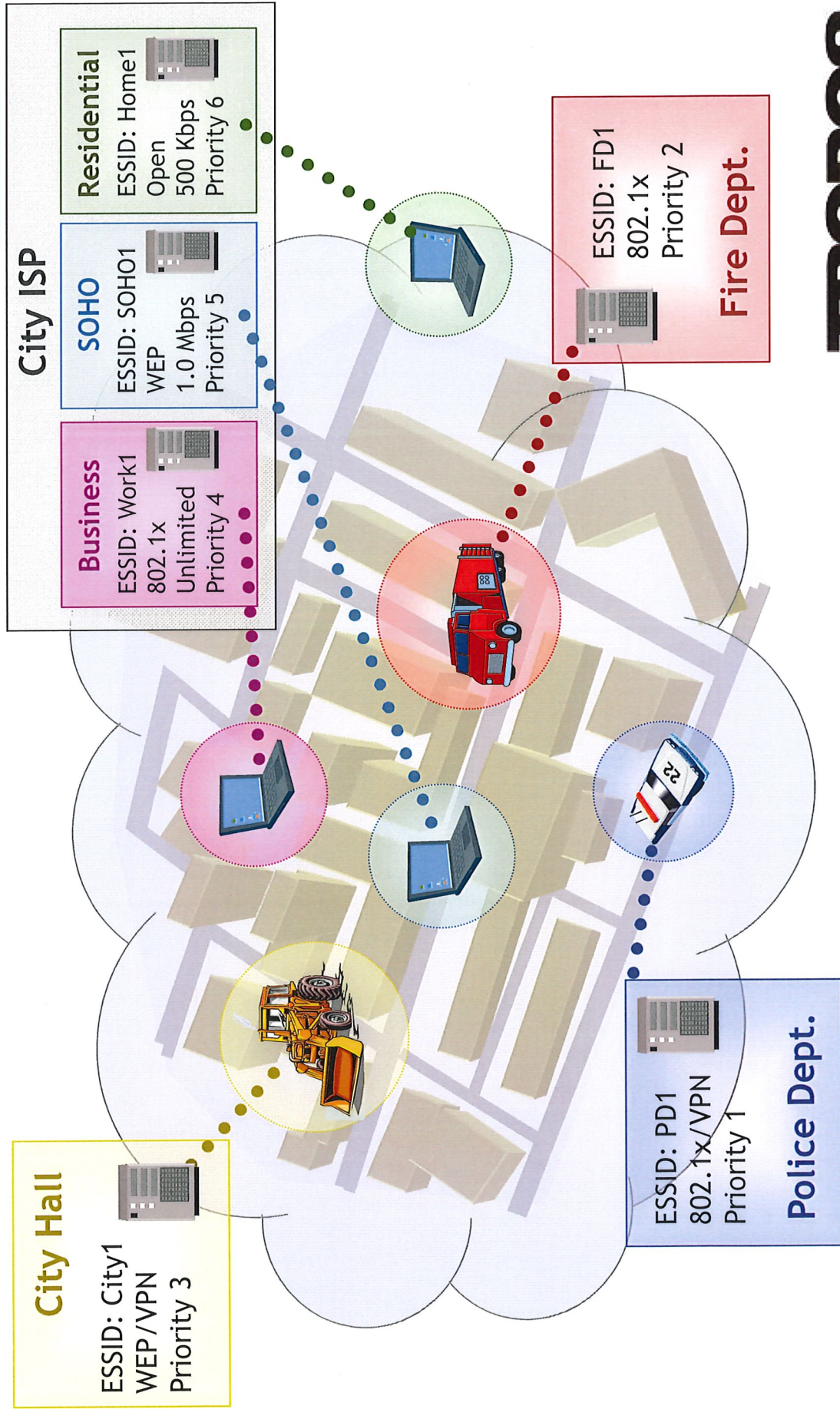
# Predictive Wireless Routing Protocol

## Self Healing

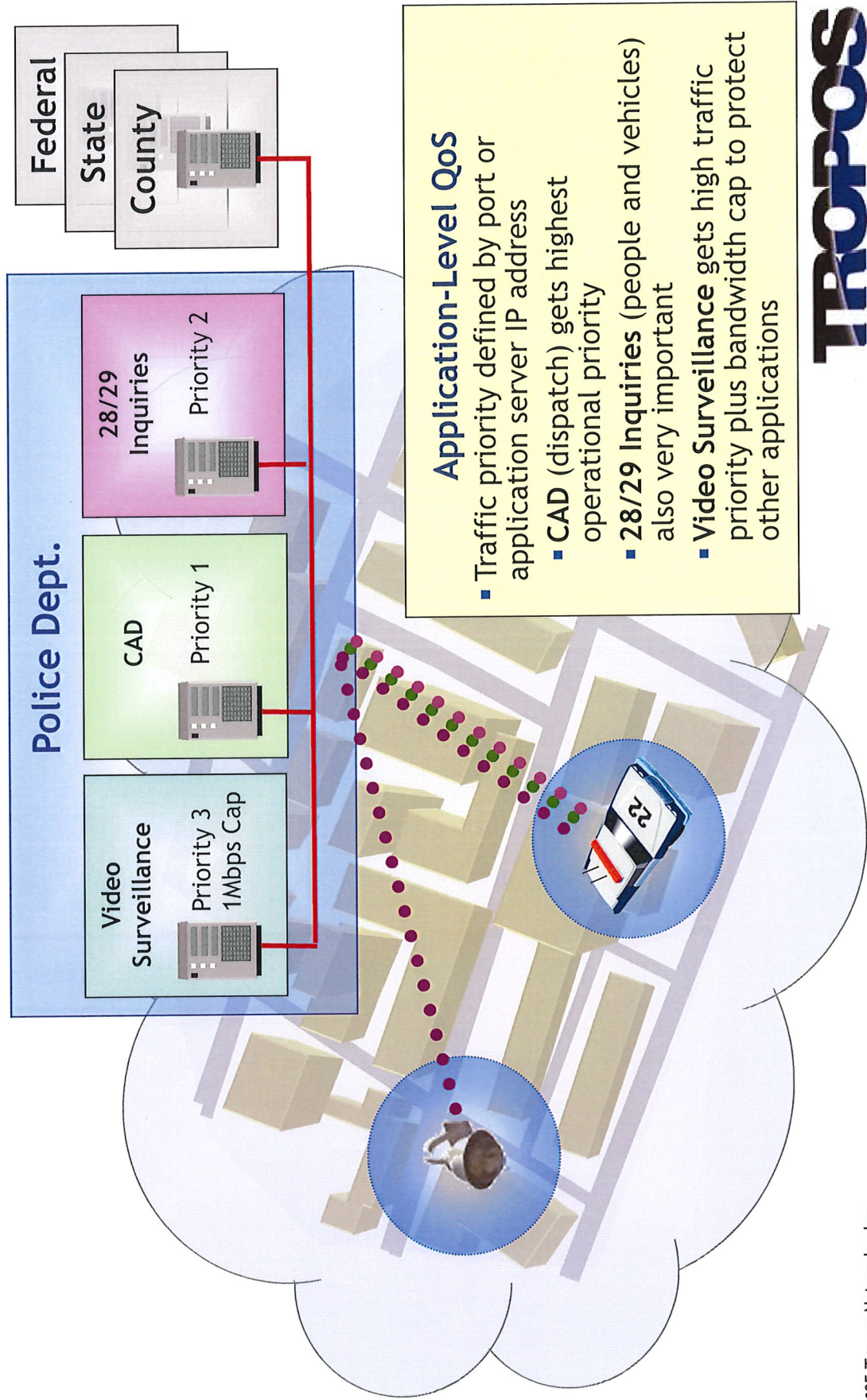
- If interference causes one or more links to be interrupted...
- The network automatically routes around the obstructions



# Multiple ESSID and VLAN Support



# Application Prioritization



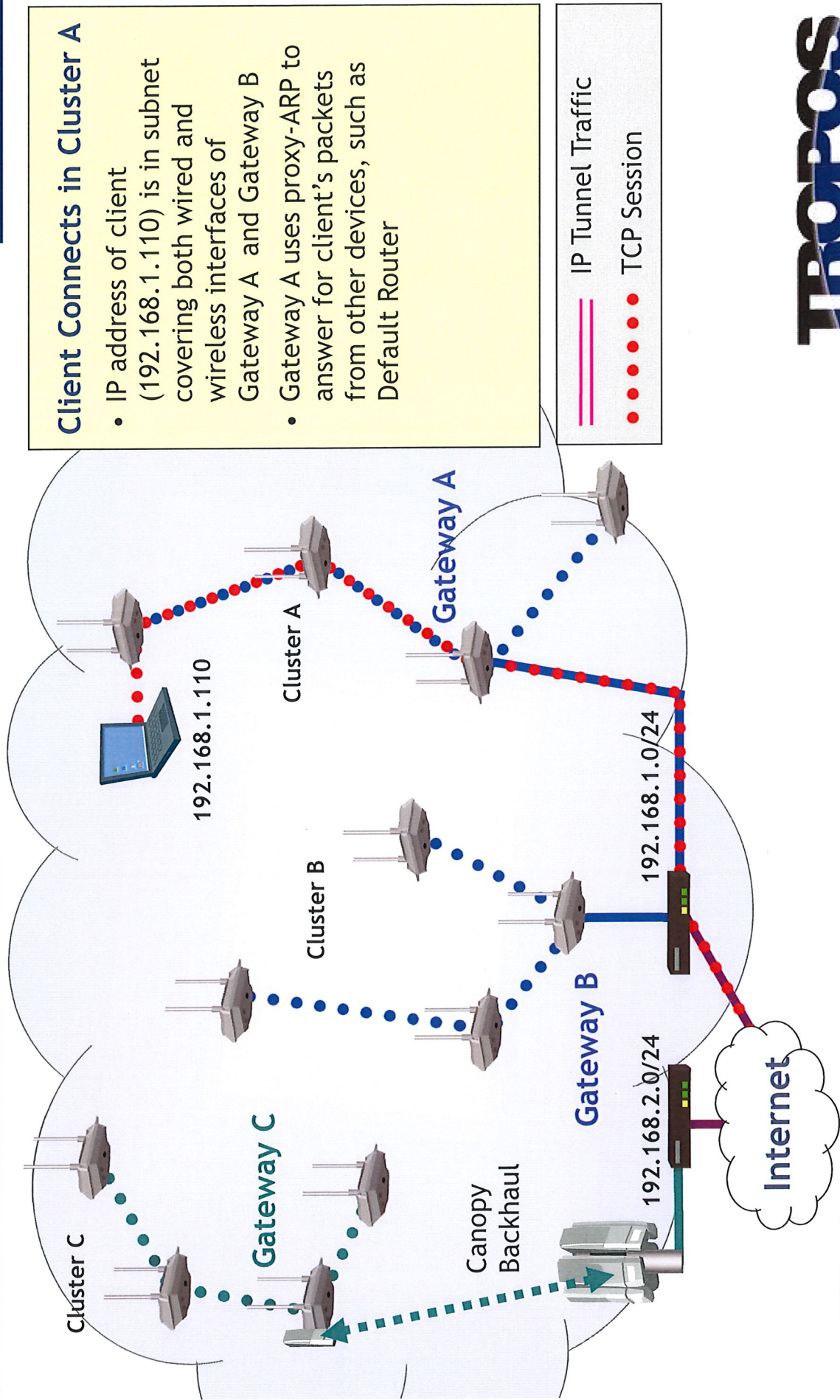
# Metro-Scale Roaming

**VPN  
Authentication**  
User ID:   
PW:

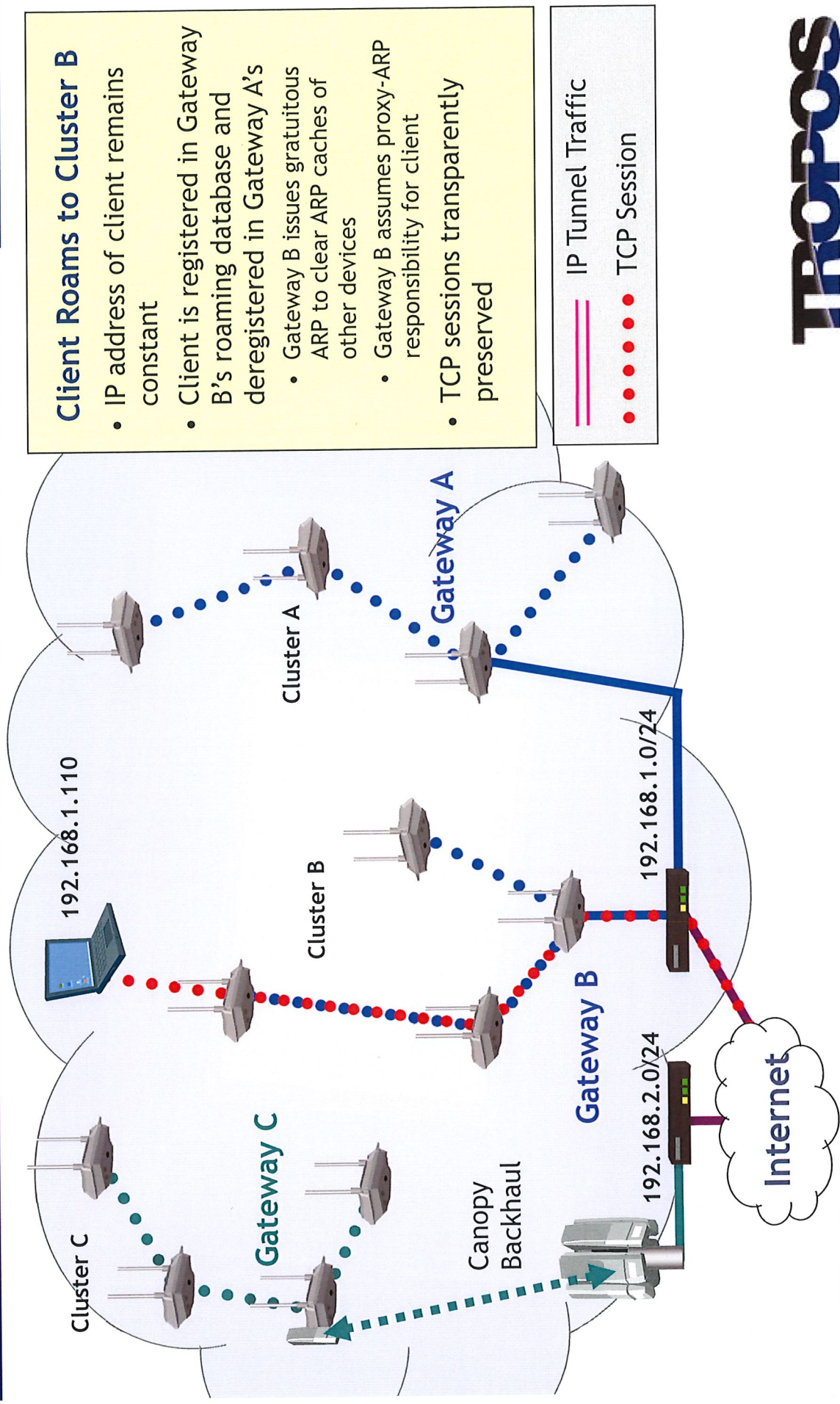
## Authentication Preserved Throughout the Network

- Sign-on required only at start of session
- Secure connectivity continues during re-association with nodes
- ESSID, WEP/802.1x and VPN links maintained across entire network

# Metro-Scale Roaming



# Metro-Scale Roaming



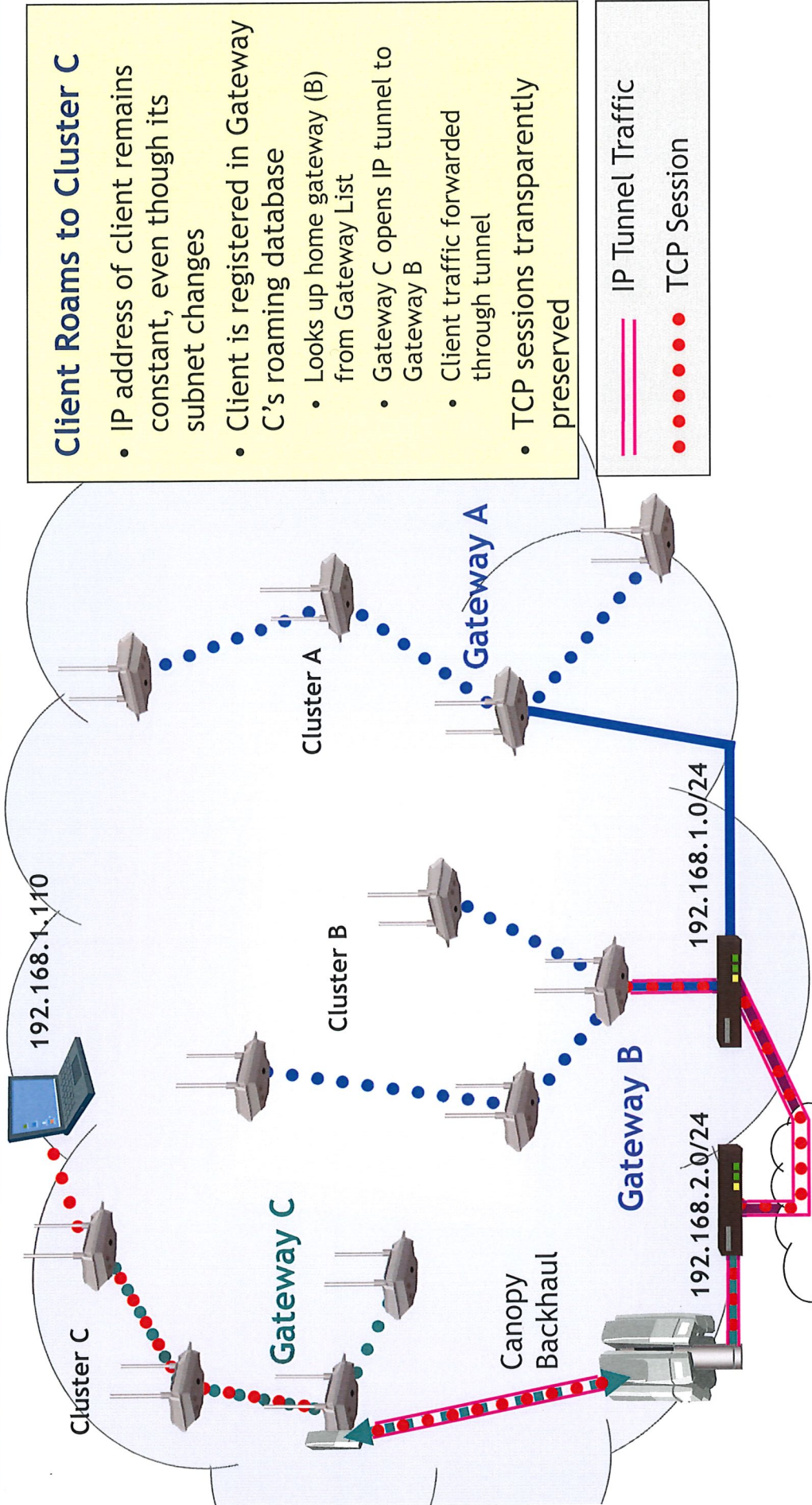
## Client Roams to Cluster B

- IP address of client remains constant
- Client is registered in Gateway B's roaming database and deregistered in Gateway A's
  - Gateway B issues gratuitous ARP to clear ARP caches of other devices
  - Gateway B assumes proxy-ARP responsibility for client
- TCP sessions transparently preserved

- IP Tunnel Traffic
- TCP Session



# Metro-Scale Roaming

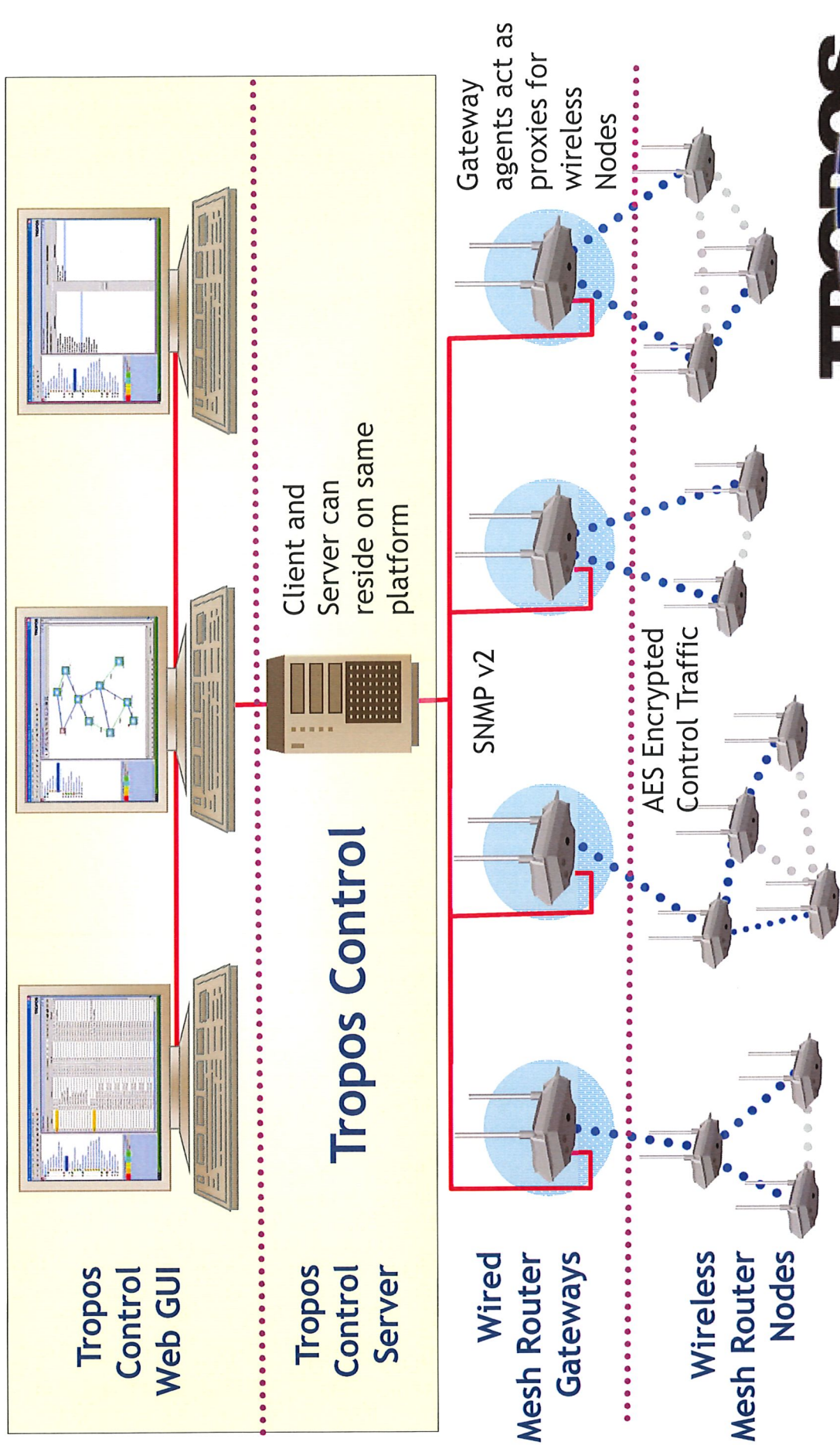


**Client Roams to Cluster C**

- IP address of client remains constant, even though its subnet changes
- Client is registered in Gateway C's roaming database
  - Looks up home gateway (B) from Gateway List
  - Gateway C opens IP tunnel to Gateway B
  - Client traffic forwarded through tunnel
- TCP sessions transparently preserved

— — — IP Tunnel Traffic  
• • • • • TCP Session

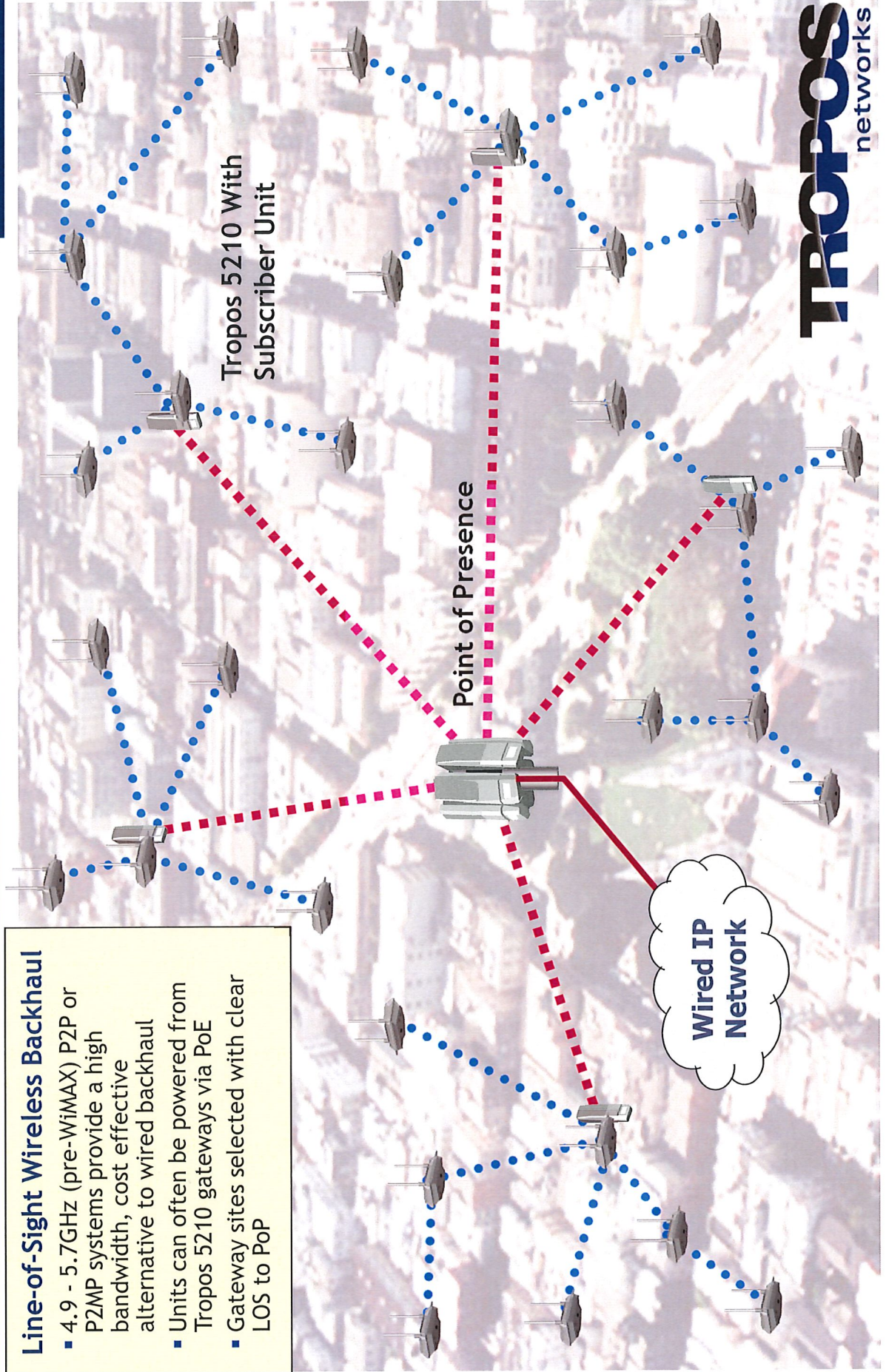
# Tropos Control Architecture



# 5GHz Wireless Provides Great Backhaul

## Line-of-Sight Wireless Backhaul

- 4.9 - 5.7GHz (pre-WiMAX) P2P or P2MP systems provide a high bandwidth, cost effective alternative to wired backhaul
- Units can often be powered from Tropos 5210 gateways via PoE
- Gateway sites selected with clear LOS to PoP



# APPLICATIONS

- 800-900 MHz AMR with Wi-Fi Concentrator
- Fixed Wireless
- Mobile Applications
  - Police
  - Fire
  - Emergency Medical
  - Utilities
  - Public Works
  - Network Access



## CASE STUDY

# Oklahoma City

- 427 Square Miles
- About 16 Nodes per Square Mile
- 10%-20% Wired to Network
- \$65k-\$70k per Square Mile
- 2-3 Square Miles per Day
- \$15.99 Per Month
- 24 Month ROI



# ISSUES

## Will WiMAX replace Wi-Fi?

- Wi-Fi is ubiquitous:
  - 125 million units
  - May double in next 2 months
- Wi-Fi is still developing
- ATM vs. Ethernet analogy



## Will WiMAX replace 3G?

### Nokia and Intel Collaborate on WiMAX Broadband Wireless Technology

ESPOO, Finland & SANTA CLARA, Calif. --(BUSINESS WIRE)--June 10, 2005--  
Nokia and Intel Corporation today announced a cooperation to accelerate the development, adoption and deployment of WiMAX technology, helping to bring new capabilities and data services to mobile users over high-speed broadband networks.

...Nokia and Intel will work together to ensure successful finalization of the 802.16e standard in IEEE and related specification work in the WiMAX Forum.

"Nokia's end-to-end multi-radio strategy covers many wireless technologies optimized for uses from local connectivity and fast data transport, to broadcasting technologies and full mobility of voice and data," said Tero Ojanpera, Senior Vice President and Chief Strategy Officer, Nokia. "WiMAX will be an important technology complementing 3GPP and 3GPP2 technologies. It will also create new opportunities for the consumer and enterprise markets."



## Will WiMAX Succeed?

**Cisco tries to pop the WiMax bubble**

'No business model', claims Cisco CTO Giancarlo

Tom Sanders at Networkers 2005 in Las Vegas, [vnunet.com](http://vnunet.com) 22 Jun 2005

The promise of [WiMax wireless wide area networking](#) is largely overrated, according to Cisco chief technology officer [Charles Giancarlo](#).

"Ninety-eight percent of the population of the developed world is going to be highly wired. We do not think that fixed wireless for the last mile makes a lot of sense," Giancarlo told [vnunet.com](http://vnunet.com) at Cisco's annual [Networkers 2005](#) user conference.

"Wired technologies are already highly deployed. We do not believe there is a good business model [for WiMax]."

In addition to competing with wired services to homes and businesses, WiMax has to battle against [3G on mobile devices](#).

Although Nokia earlier this month said that it expects the two technologies to [co-exist](#)...

**VNU Network VNU Business Publications**





CONCLUSION

# Questions?



# CONCLUSION

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Wi-Fi Standards Group

WiMAX Standards Group

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THANK YOU

