# WiFi Mesh Metropolitan Area Network

- Introduction to Wireless (WiFi) Mesh Network

- EnGenius Mesh AP Technologies and Architecture

  – Seamless Integration with other WiFi Networking Technologies and Backbone Infrastructure

- EnGenius Mesh AP Features

  – Water-proof

  – Lightning Protection

  – Installation

  – Security

  – Performance

  – Management

- Example of EnGenius Mesh Network Applications

- Market Opportunities

# Introduction to Wireless (WiFi) Mesh Network
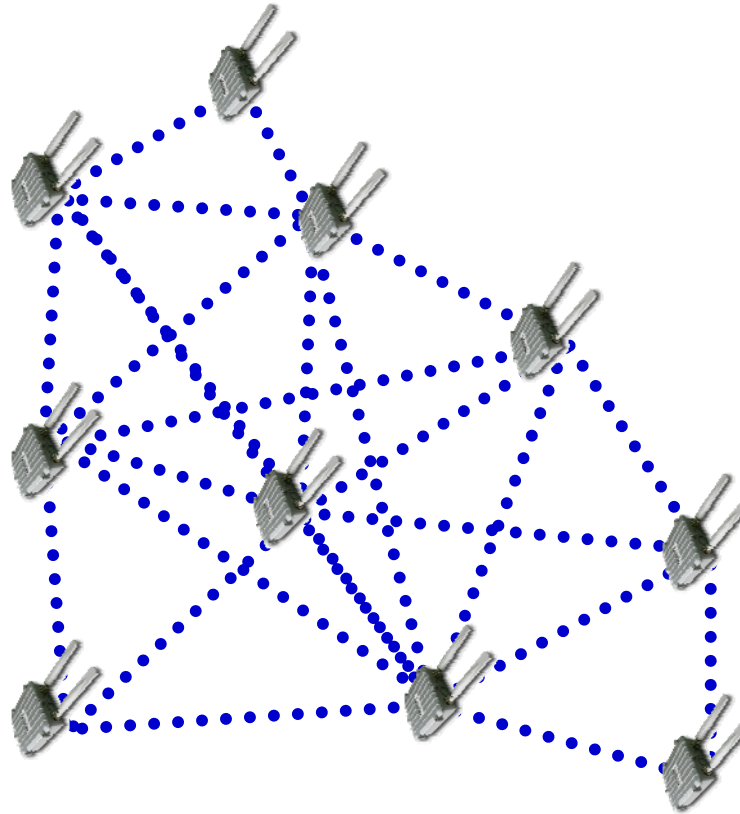
What is WiFi Mesh Network?

- *A collection of wireless devices maintaining RF connectivity to create a seamless path for data packets to travel.*
  - At least one wireless device (or node) is connected to a wired Internet backbone and each data packet is bound for the same destination but not necessary using the same sequential path of nodes.

- *The Internet router determines a path between the user and the physical backbone.*
  - In the wireless mesh environment, a network can be envisioned as a collection of access points, routers, or end users (equipped with wireless receiver/transmitters) that are free to move arbitrarily but maintain a reliable communication that sends and receive messages.

- *A semi-mobile system*
  - the connectivity position among the nodes may vary with time due to node departures, new node arrivals, and roaming nodes

- *Combining at least two P-to-P or P-to-MP wireless cells create a roaming effect*
  - Roaming is the ability to maintain network connectivity while moving from one access point to another
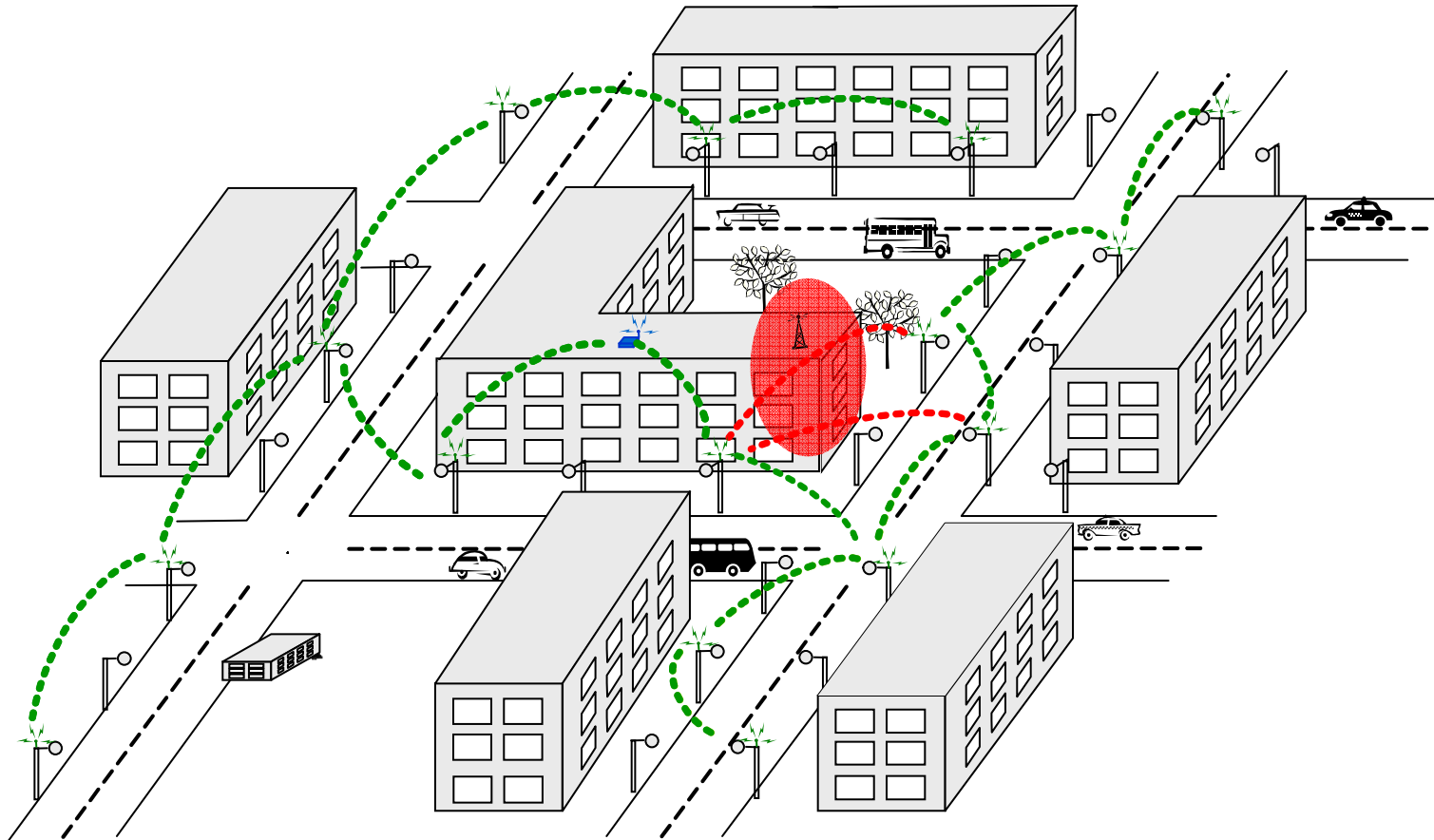
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What is WiFi Mesh Network?

Transit Access
Point (TAP)
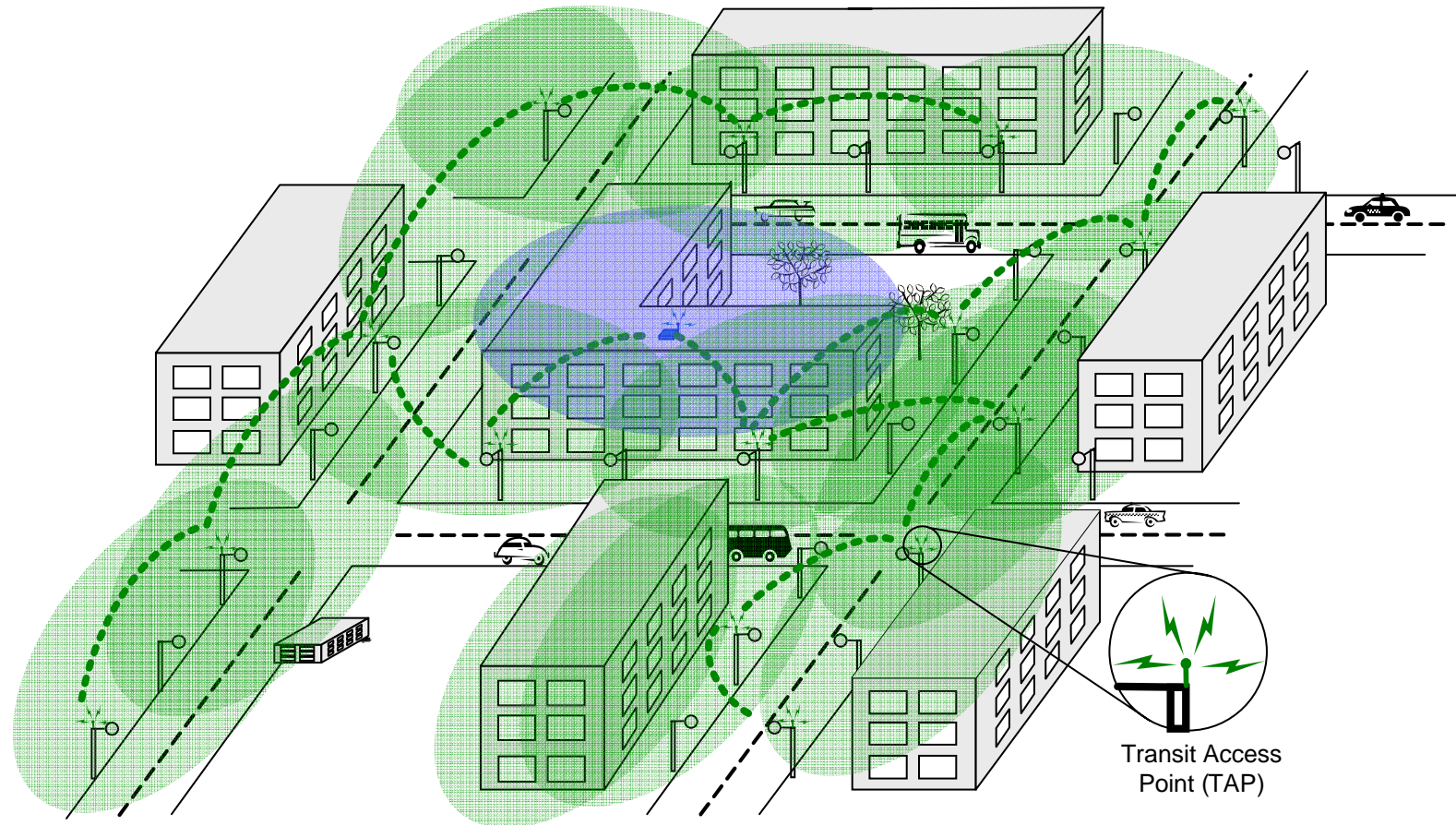
WiFi Mesh Network – Node Compromise
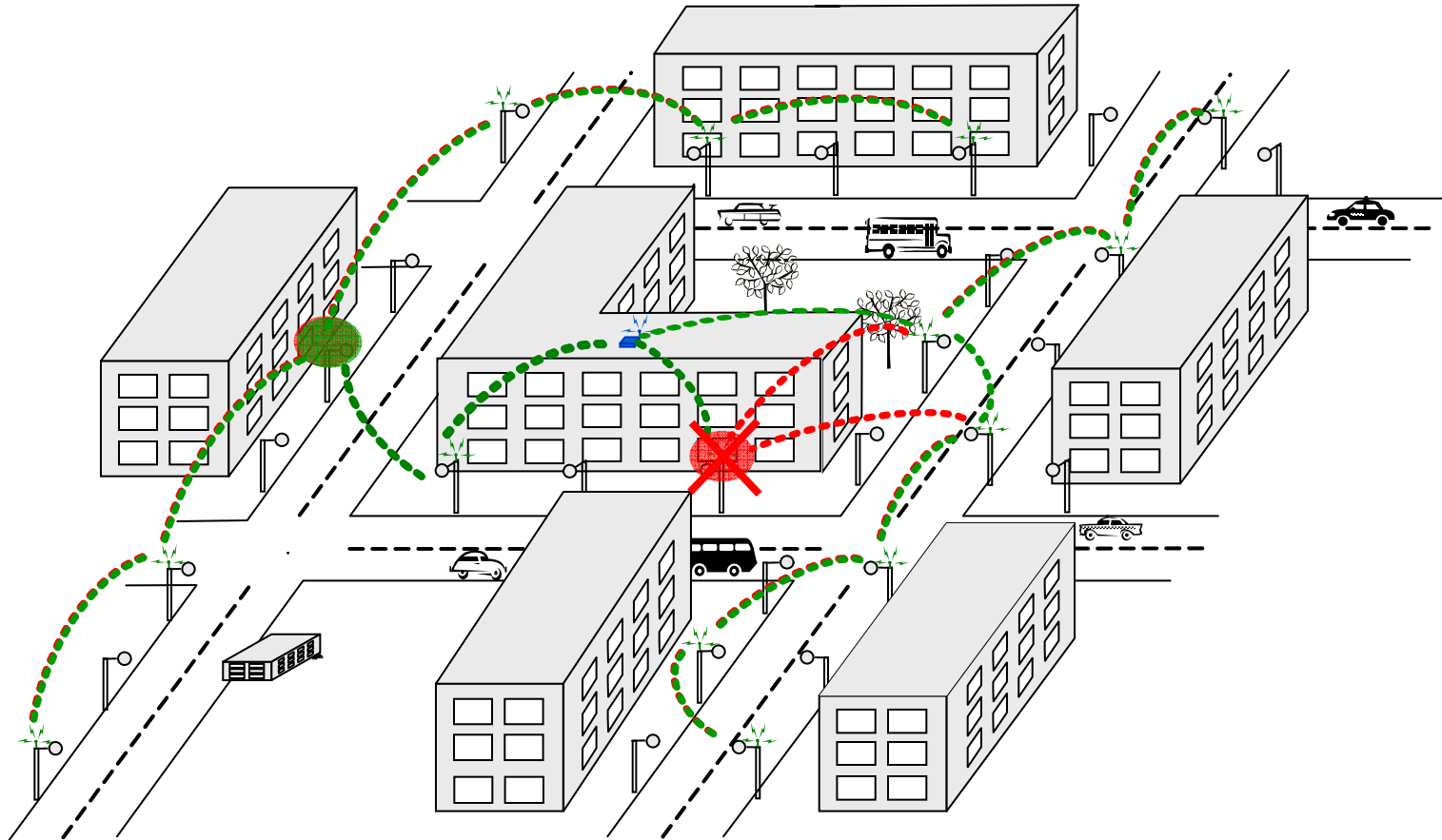
WiFi Mesh Network – Jamming

More on Mesh Networks:

• *IEEE Wireless Communications*, Special Issue on Wireless Mesh Networking, Vol. 13 No 2, April 2006
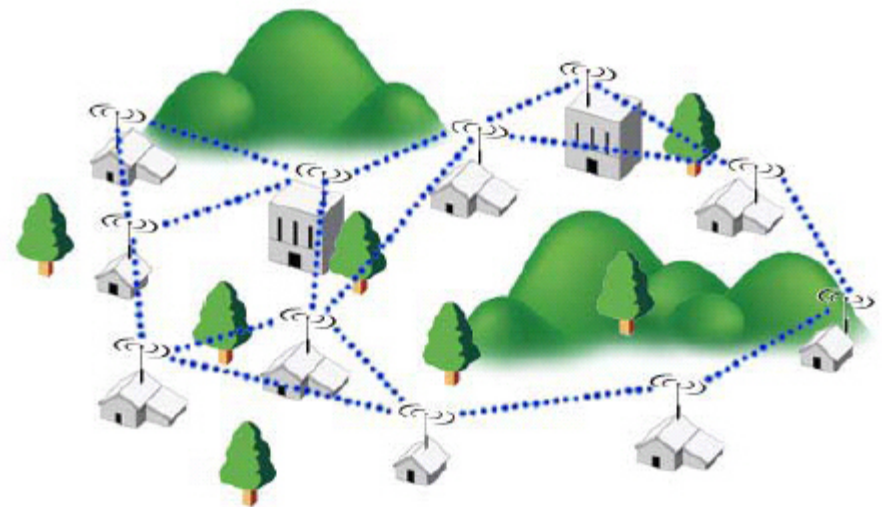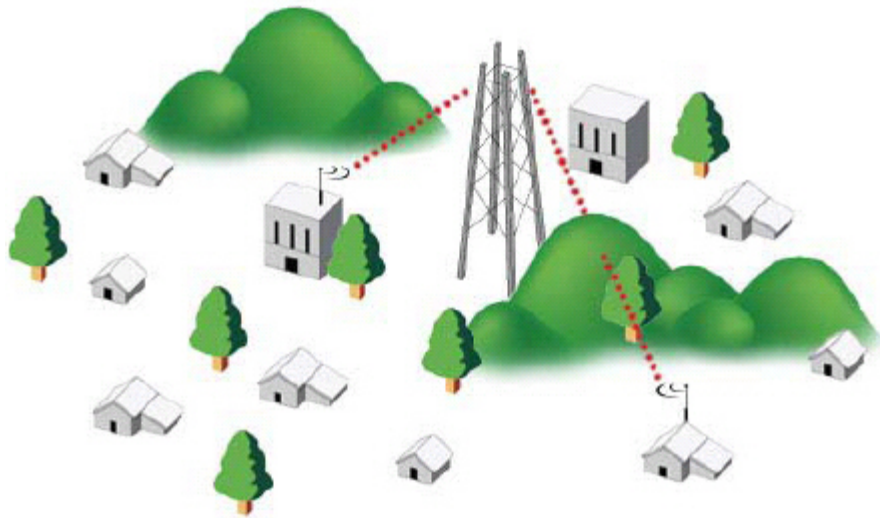
WiFi Mesh Network – Solving Coverage

PMP Approach:
Focus is on RF & Deployment

Blast over & through obstacles

Mesh Approach:
Focus is on smart software

Skip around obstacles

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Vehicular networks

- Combat the awful side-effects of road traffic
  - In the EU, around 40'000 people die yearly on the roads; more than 1.5 millions are injured
  - Traffic jams generate a tremendous waste of time and of fuel
- Most of these problems can be solved by **providing appropriate information** to the driver or to the vehicle

Vehicular networks

SLOW
DOWN

The way
is clear
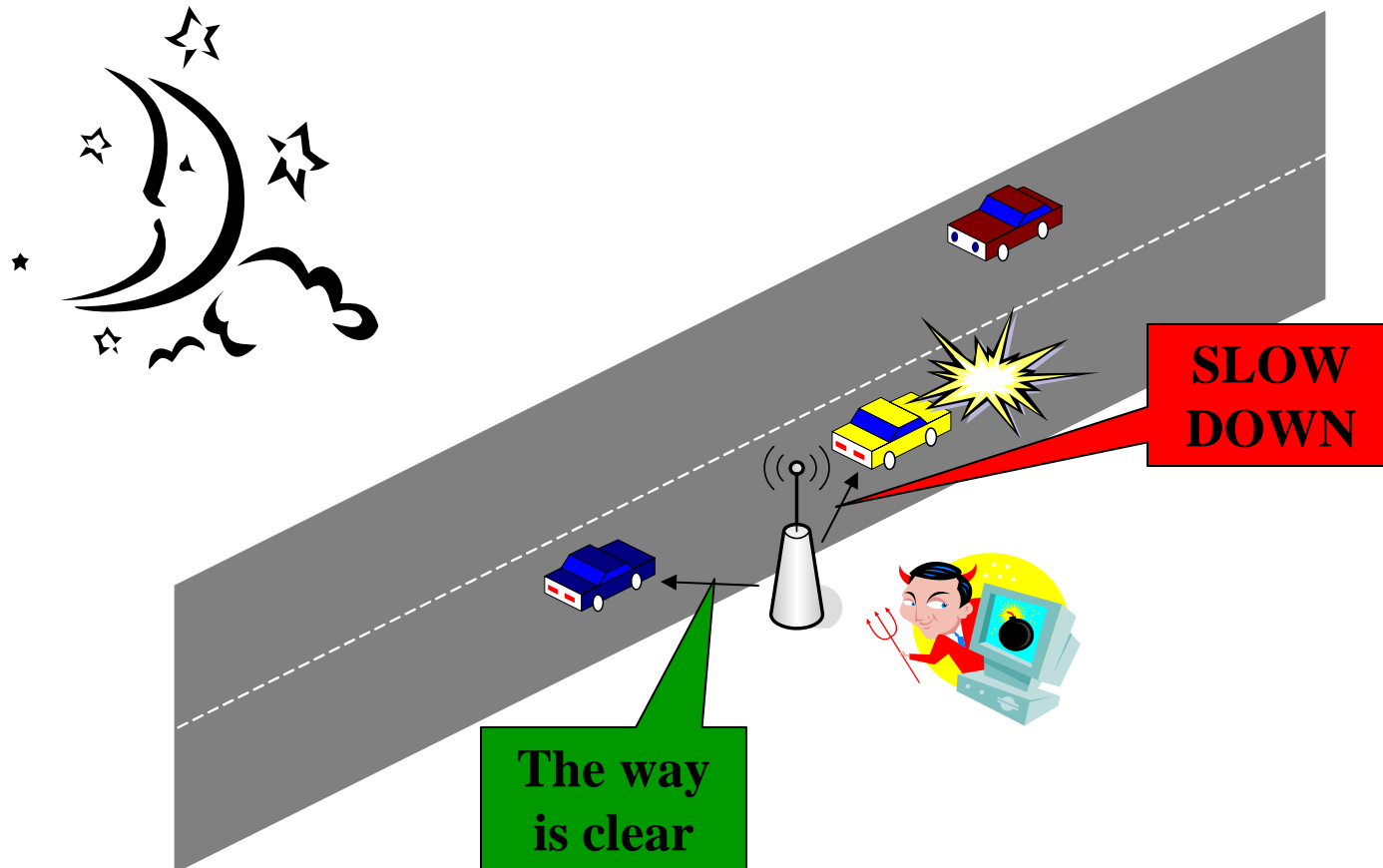
- All automakers are working on vehicular comm.
- Vehicular networks will probably be the largest incarnation of *mobile* Mesh Networks

- A Wireless Mesh Network constructed from WiFi Technology alleviate a number of roaming challenges from laptops, IP phones, PDAs, and IP base devices:

  - *No geographical limitations* – User can take a handheld or laptop computer anywhere without losing the connection in their home

  - *No physical connection required* – Mobile IP connect automatically and obtain local IP router information

  - *Supports security* – Authentication is performed to ensure that rights are being protected

  - *Access Anytime, Anywhere* – Network access is assured at all times and from all locations. No missed E-mails and increase productivity due to constant connectivity.

  - *Emergencies* – Rapidly deployable and robust communications between each member when emergencies are involved in difficult operations inside buildings, towers, or surrounded in forest fires

  - *Military Usage* – Soldiers in a battlefield are exchanging information about their position and giving and receiving orders, or the instructions

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EnGenius Mesh Network
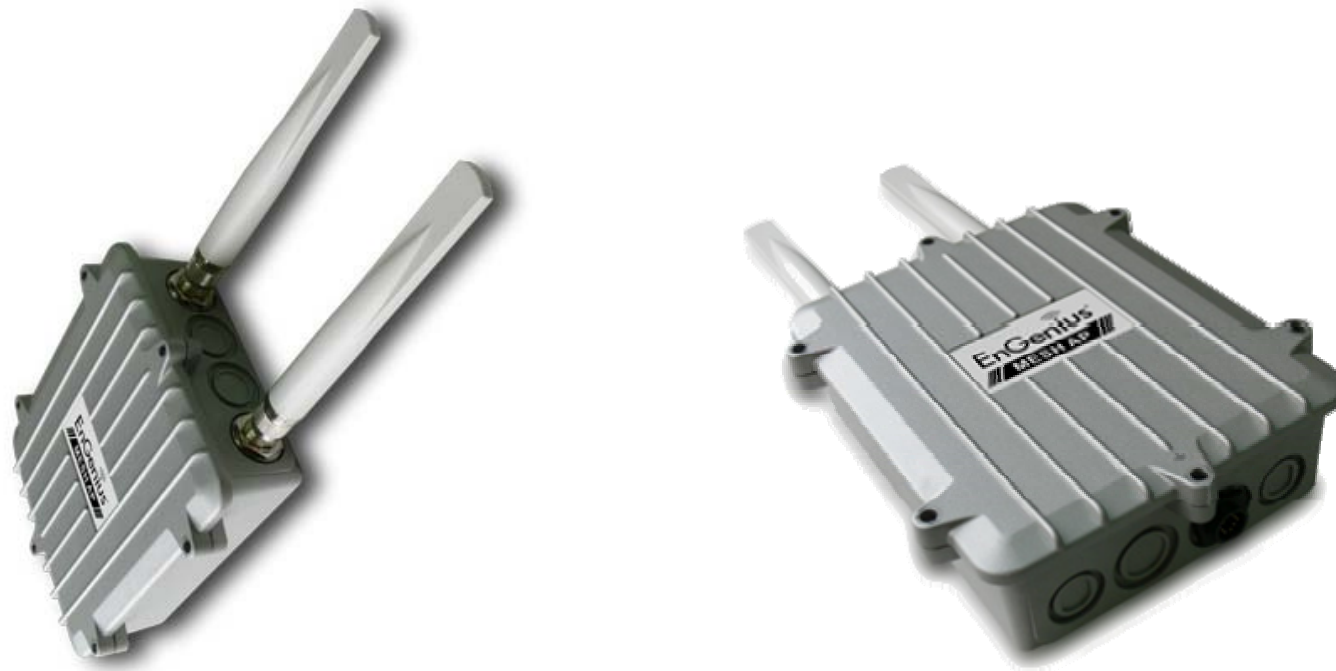
EnGenius Mesh Topology
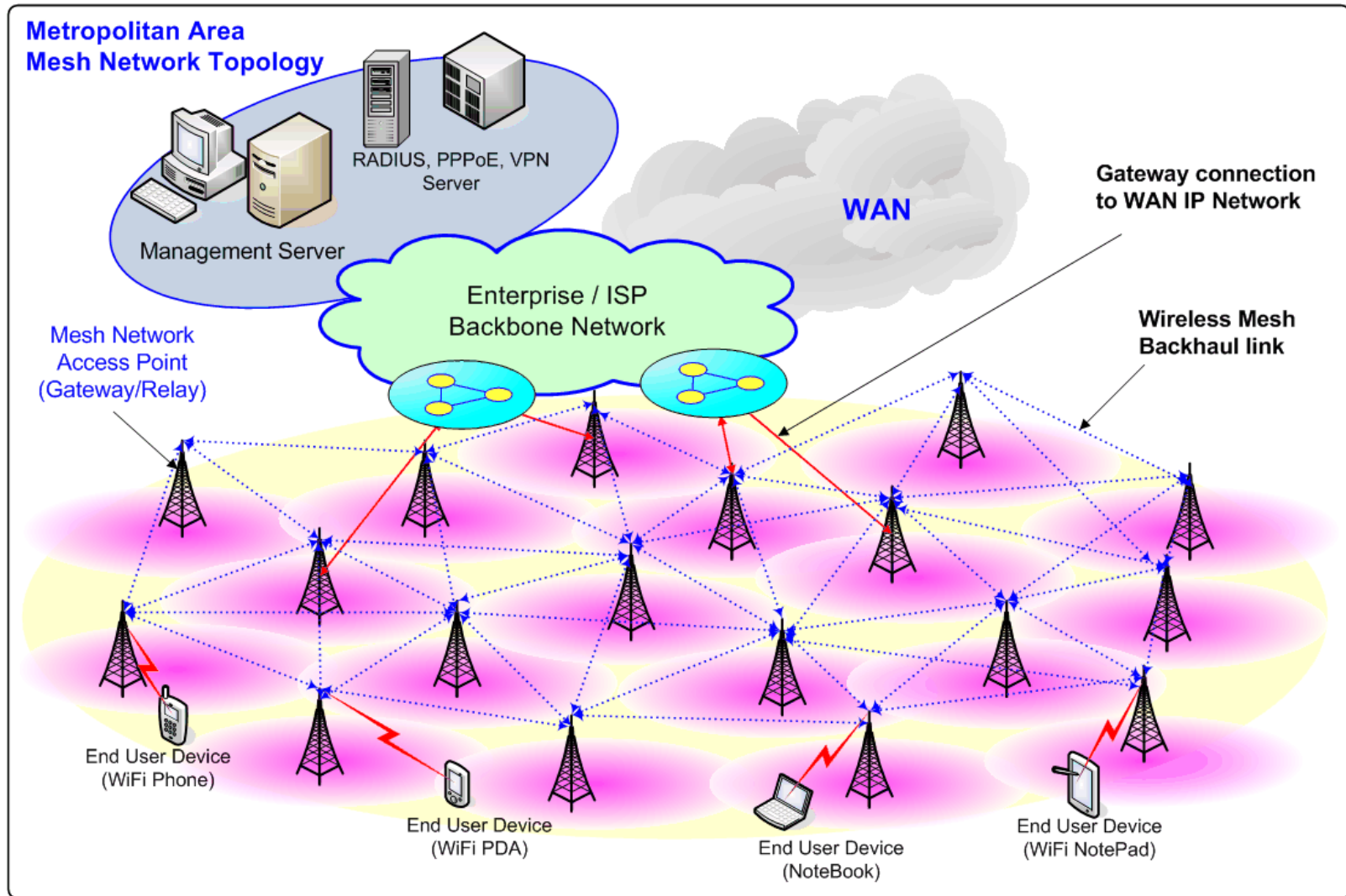
- EnGenius WiFi Mesh Metropolitan Area Network Solution includes
  - Point-to-point and Point-to-Multipoint architecture
  - External omni-direction or directional/sector antenna
  - Integrated routers with adaptive routing and security capabilities
  - Single Equipment with Software configurable to Gateway, Relay or Bridge Topology
  - EnGenius also equips with feature for (wired or wireless) LAN extension via LAN port connection

- EnGenius Mesh Network – Backbone WAN connection can be via ADSL, Lease Line, Cable, VSAT, etc…

- Recommended 1 Gateway with 4 Relay Linear deployment scenario

EnGenius Mesh AP:

- Backhaul Mesh (20dBm Radio)

  – IEEE802.11g (2.4GHz) or .11a (5GHz, recommended)

  – Antenna : Omni-directional or Patch Antenna

  – Data rate ~ 54Mbps

  – AES Protection between links

  – VLAN support

  – Layer-3 OLSR Routing

- Client Access Point (26dBm Radio)

  – IEEE802.11b/g (2.4GHz)

  – Antenna : Omni-directional (Recommended)

  – Data rate ~ 11 or 54Mbps

  – Full Security (802.11i, 802.1x)

EnGenius Mesh AP:

- The fundamental architecture of EnGenius Mesh AP is built Dual-Radio Access Point Architecture,

    - One of the Radios provides the backhaul mesh connectivity between all Mesh AP, forming the backbone Layer-3 routing for the entire Mesh Network

    - The 2nd Radio provides the user/subscriber wireless access connectivity for up/down stream

- Each Dual-Radio Mesh Access Point form an *individual operational "Node",* where the EnGenius MESH AP will *automatically* locate & associate with the required designated backhaul mesh links and "Join-In" the Mesh Network

- *Optimal Link State Routing (OLSR)* Protocol form the fundamental routing algorithm on the Backhaul mesh network infrastructure, to provide optimal network throughput to the WAN access

EnGenius Mesh AP:

- The fundamental operation of EnGenius is based on IEEE802.11 (b/g/a or n) standard and RF (2.4GHz, 5GHz) technologies.

- In particular, EnGenius MESH AP built on the Dual WiFi Radios with *Business Class High Power Technology* to provide Backhaul Mesh and Client-end access.

  – Backhaul mesh connection radio on IEEE802.11g or IEEE802.11a (Recommended) with RF output power of 400mW (802.11g) or 200mW (802.11a) and with Omni-directional Antenna or other Directional Patch Antenna depending on backhaul interconnection range and coverage requirement

  – Client access wireless link on IEEE802.11b/g (automatic selection) with RF output power of 400mW and with Omni-directional Antenna

    **EnGenius Mesh AP, available with outdoor deployment – with different combination of Antenna (N-Type Connector) and RF power

EnGenius Mesh AP:
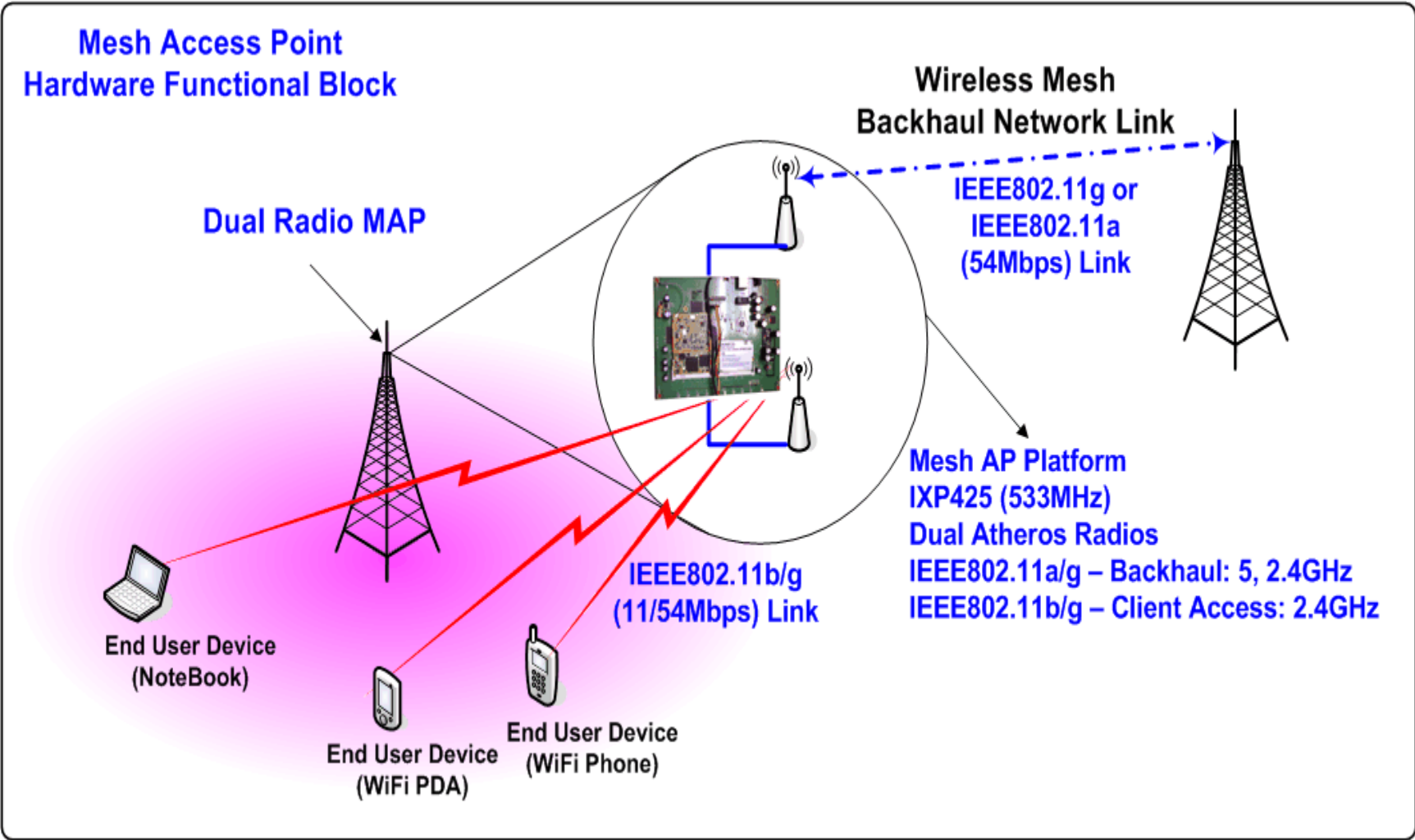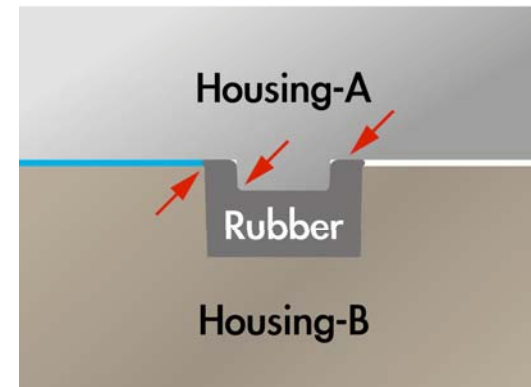
EnGenius Mesh AP Features

Robust Design for Water Proofing
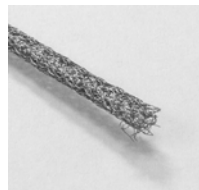
IP67/ 68 Compliant Design Rules

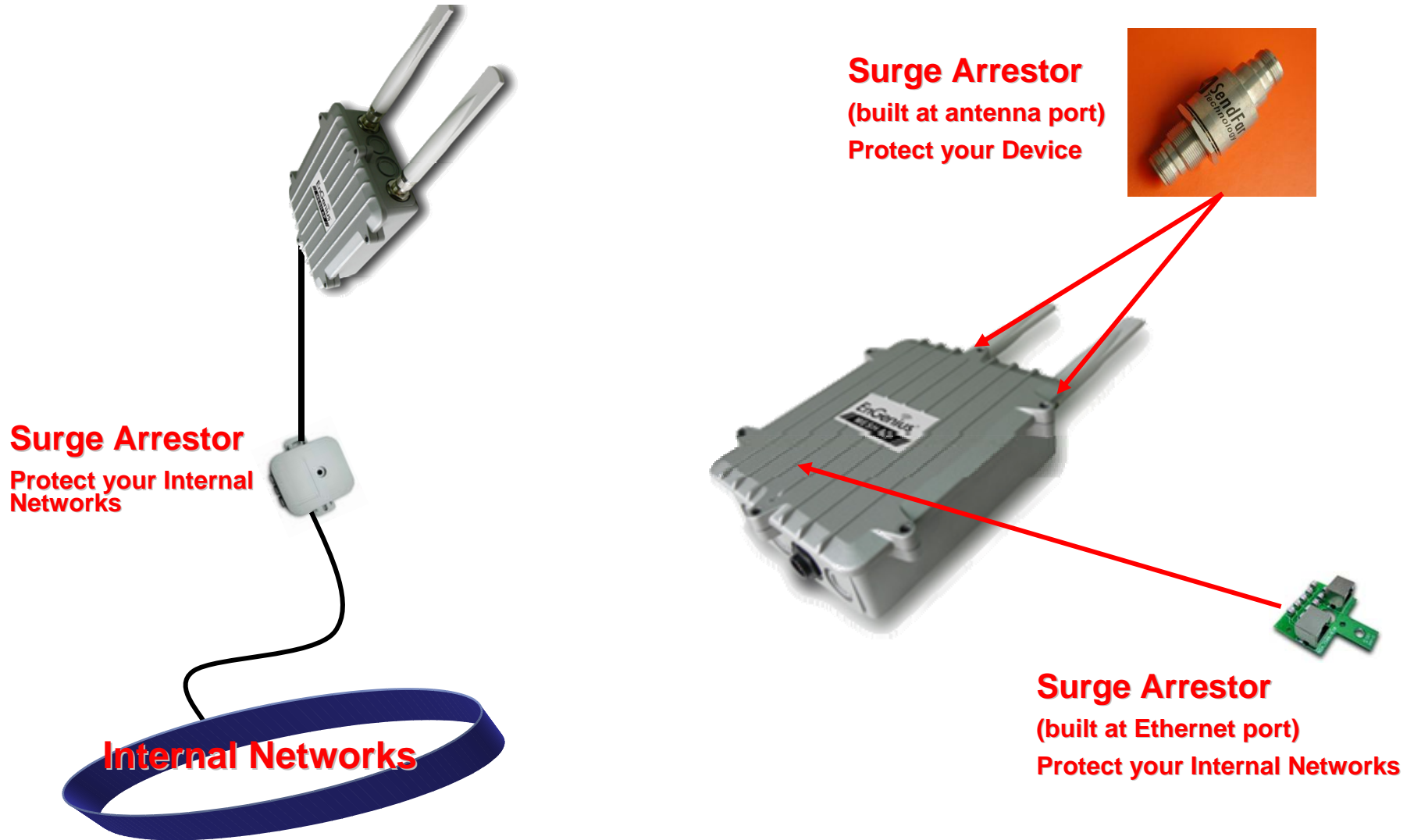IP68 rubber (CR, EPDM, IIR….)/cable connecter/cable glands

- Rubber strip design

- EMI/RFI

Mesh wire material: monel, stainless steel

Robust Design for Lightning Protection

Surge Arrestor
(built at antenna port)
Protect your Device

Surge Arrestor
Protect your Internal Networks

Internal Networks

Surge Arrestor
(built at Ethernet port)
Protect your Internal Networks

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Installation

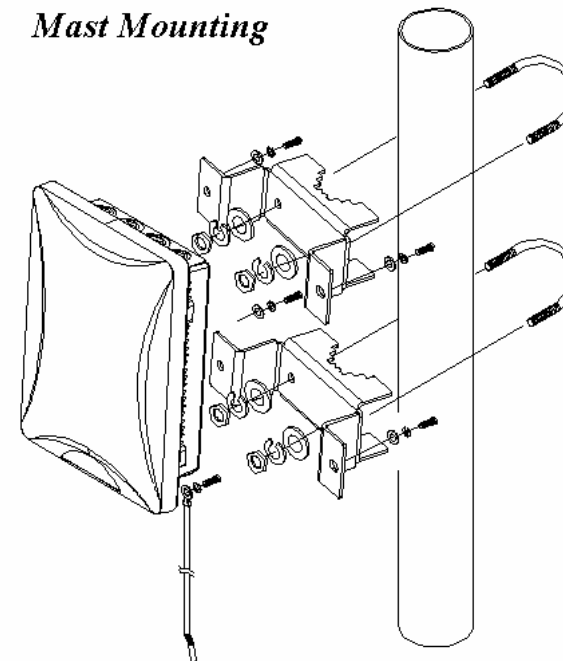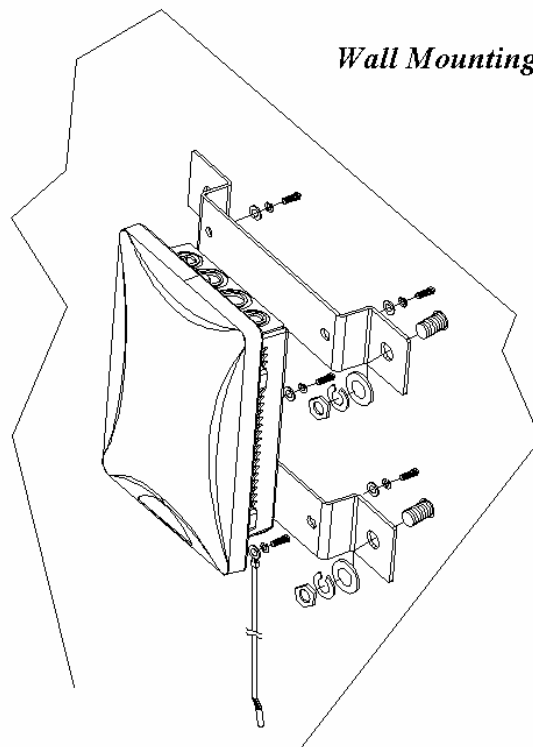## ❑ Power Over Ethernet (Proprietary)

- ❑ Combine cable and power line、From indoor to outdoor **only needs one wire**
- ❑ Supports *100m* Cat5 Ethernet cable (UTP) for your deployment
- ❑ Telco spec, work well with carrier's equipments to **SAVE Operating cost**

Internet

XDSL / Cable Modem

PoE Injector (EPE-4818)
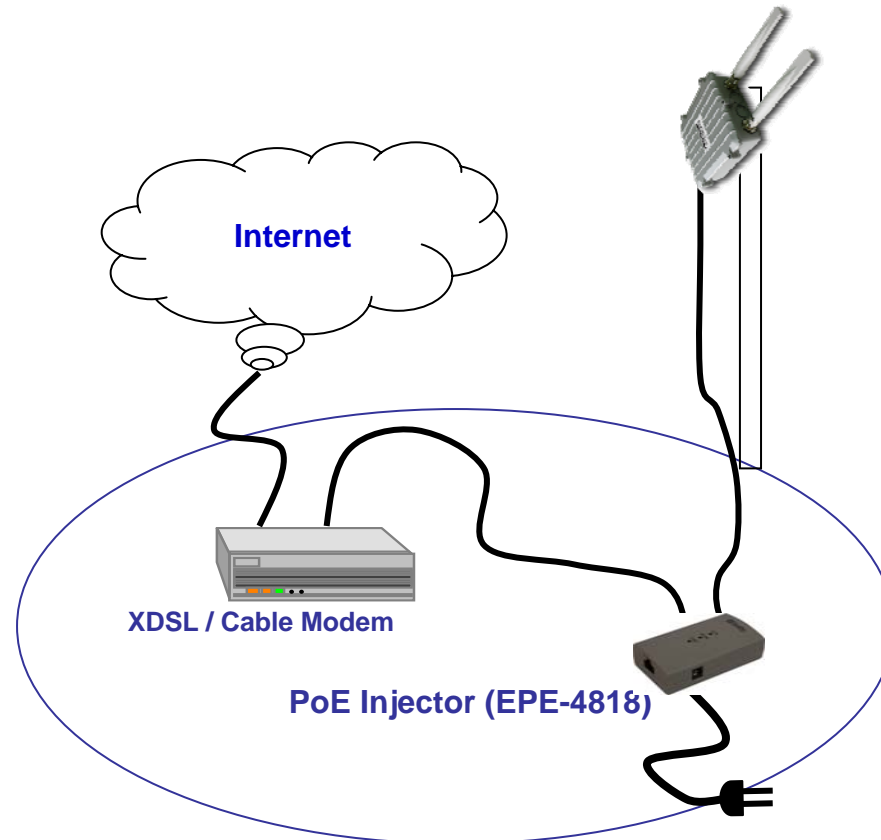
Installation (Cont.)

❑ **Mounting (IP68)**

•Security

EnGenius built-in with standard and enhanced security features for which protecting the Backhaul Mesh connection as well as the Client end-user access

Privacy & Security is established via the different combination of the following features provided

- 64/128 Bit WEP encryption
- AES and IEEE802.1x
- Both WEP and AES and WPA1/2
- Firewall (User configuration)
- VPN (all VPN protocol pass though, such as PPTP, L2TP) .
- HTTP Login
- HTTPS Login with SSL encryption
- Authentication via RADIUS server
- Zero Configuration for Clients Interface, with Proxy bypass, including DNS feed through

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•Performance

- Backhaul link via IEEE802.11g or .11a providing 54Mbps routing for mesh MAP-to-MAP connection and 10/100 BaseT WAN connection

- Client-end connection via IEEE802.11b/g providing either 54Mbps or 11Mbps connectivity (depending on Client-end devices) for wireless LAN access

- Fundamental data-rate access is given in the following scenario depending on link quality and RF signal coverage
  - IEEE802.11b (2.4~2.4835GHz)
    - **11Mbps, 5.5Mbps, 2Mbps, 1Mbps**
  - IEEE802.11g (2.4~2.4835GHz)
    - **54Mbps, 48Mbps, 36Mbps, 24Mbps, 18Mbps, 12Mbps, 9Mbps, 6Mbps**
  - IEEE802.11a (5.1~5.8GHz)
    - **54Mbps, 48Mbps, 36Mbps, 24Mbps, 18Mbps, 12Mbps, 9Mbps, 6Mbps**

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•Network Services

- Mesh AP equips with 1 x 10/100Mbps RJ-45 Auto-negotiation network interface for WAN and/or Local Server connection, and also to provide network extension via UTP Cable (when necessary)

- PoE (IEEE802.3af) via WAN Port or Alternative DC Power Supply via Adapter

- The following are the Services that provided within the EnGenius MAP Solution

  – Static IP address, DHCP Server/Client

  – PPPoE client with PAP, CHAP

  – PPTP Client

  – Firewall

  – NAT

  – VLAN (Depending on Customer Specification)

  – IPv6 Ready

  – 200kB Internal Web Space (Optional) at each Mesh AP

•Management

WiFi Mesh Metropolitan Area Network – Network Management Suite

Features	Benefits
Dual Radio for independent Backhaul and local access	Allow operators to set up at both 2.4GHz for long range and 5GHz to reduce the frequency interference.
Self Configuration and Healing	Automatically search and link with gateway AP and other nearest node Mesh AP for Ease of Deployment & Management
EnGenius Business Class High Power Technology	Get more coverage and distance to save the installation fee
Lightning Protector in both antenna ports and Ethernet port	Prevent a lightning stroke to damage the internal equipments
Wide temperature range and robust mechanical design (IP68)	Delivers reliable, top performance in the most demanding environments to Avoid water invaded and weather corroded
Power over Ethernet (PoE)	Easy installation and cost-effective
Support dynamic routing (layer3)	OLSR protocol provides optimized path of routing. The routing mechanism automatically finds the optimal link once the link status is changed or broken.
Supports NAT (Network Address Translation)/NAPT	Shares single Internet account and provides a type of firewall by hiding internal IP addresses for keeping hacker out
Static Route Support	Forwarding data in a network via a fixed path in multi-subnet
Support Multiple SSID for client access mode	Distinguish separate networks within the same wireless space to provide secure connection
Support VLAN	Reduce the size of each broadcast domain, which in turn reduces network traffic and increases network security
Support 802.1x (EAP-TLS/TTLS/SIM/PEAP), 802.11i (WPA/WPA2, AES), VPN pass-thru mechanisms	Provide mutual authentication (Client and dynamic encryption keys to enhance security
Hide SSID	Avoids unallowable users sharing bandwidth, increases efficiency of the network
Support MAC Address access control list	Ensures secure network connection
Support WMM Extension	Improve the user experience for audio, video, and voice applications by prioritizing data traffic
Bandwidth control	Enables operators to specify the maximum line bandwidth that a particular transfer operation can use
Support SNMP v2c/v3	Allow users to operate with existing network management tools
Centralized management software	Easy to manage volume Mesh AP via central control system to save the management cost

In Summary

- EnGenius WiFi Wireless Mesh AP solution addresses the market requirements for
    - Robust Design
    - Highly scalable
    - Self Configurable
    - Self Healing
    - Self Adaptation
    - Mobility

- In general, EnGenius Mesh Solution offers end users with *secure, seamless roaming* beyond traditional WLAN boundaries and our solutions provides easy deployment in areas that do not support (or do not have sufficient) wired backhaul.

- WiFi Wireless Metropolitan Mesh Network solution is well-suited for providing broadband wireless access in areas *that traditional WLAN systems are unable to cover or there is/are limitation in deployment* (such as limited backbone or unable to deploy).
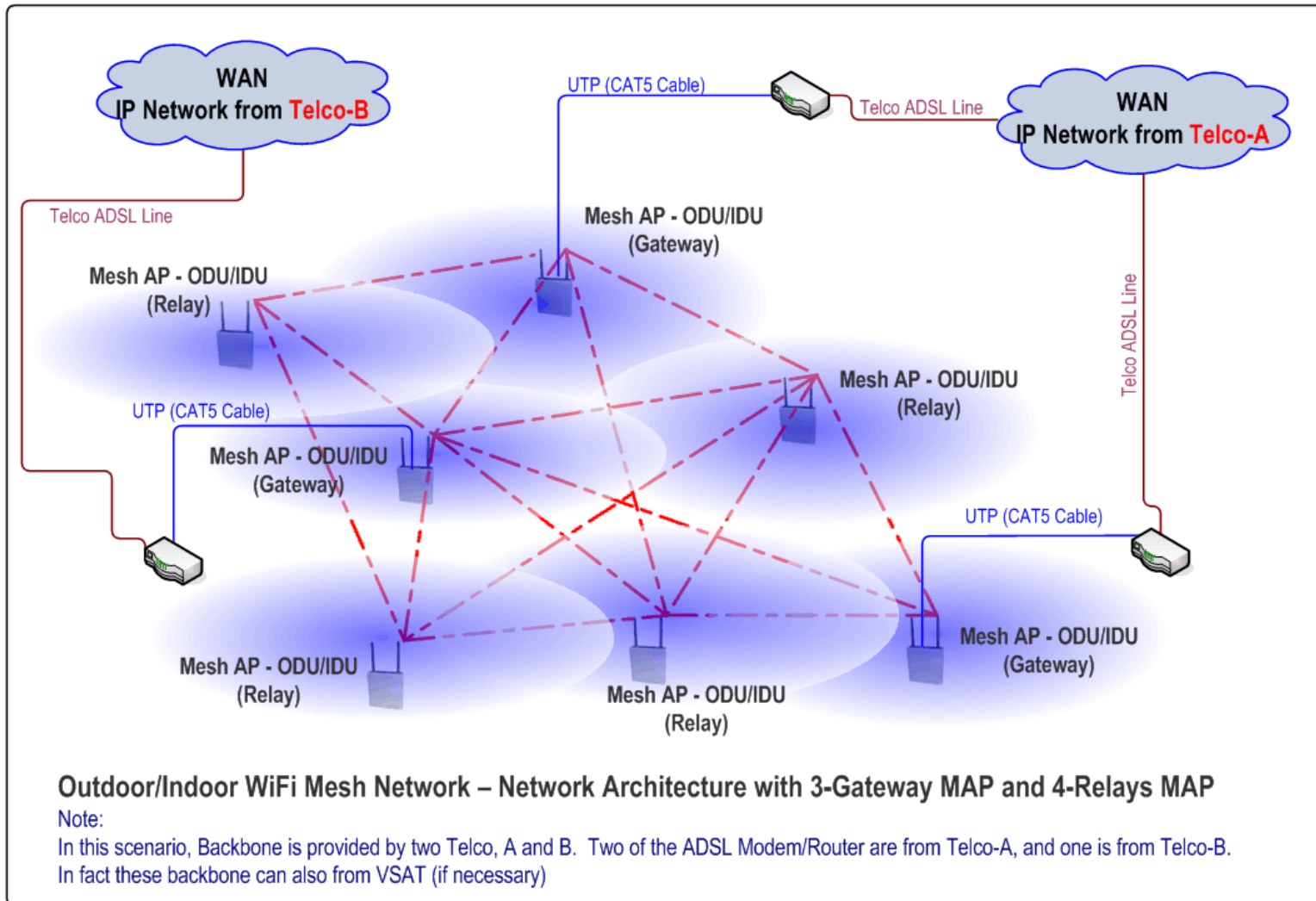
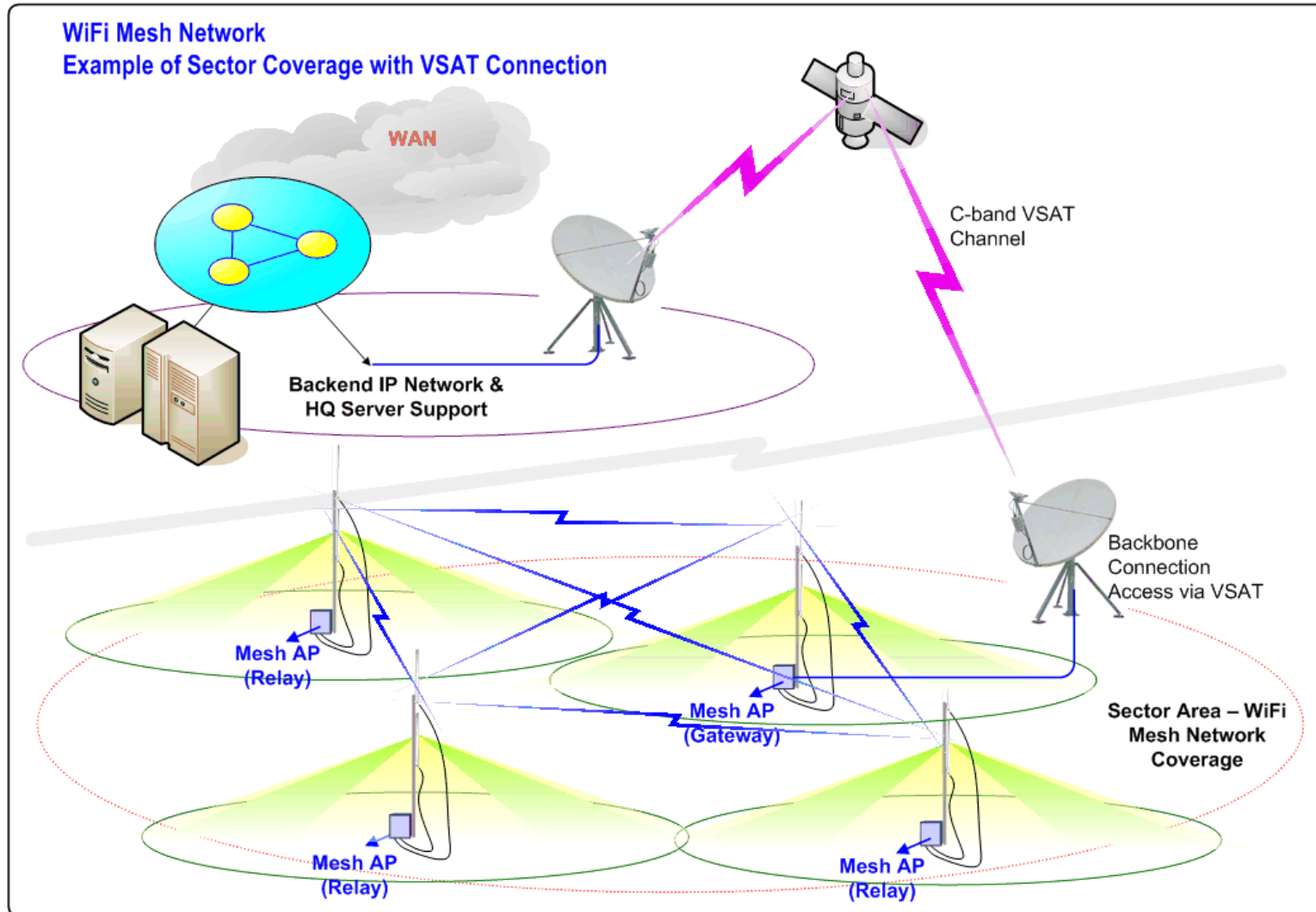# EnGenius Mesh Solution Applications

EnGenius Mesh Network:

- In general, EnGenius Mesh Network is designed for both *Enterprises* as well as *Residential* to have wireless broadband connectivity. EnGenius Mesh AP comes with both Outdoor and Indoor housing, offering wireless broadband access with new revenue generation opportunities, and in particular, the solutions can be deployed with the following applications:

  - WiFi City or Public Catchments Area Deployment,

  - WiFi Campus,

  - WiFi Wireless Local Loop,

  - WiFi Intra-local area network

EnGenius Mesh Network:

Outdoor/Indoor WiFi Mesh Network – Network Architecture with 3-Gateway MAP and 4-Relays MAP
Note:
In this scenario, Backbone is provided by two Telco, A and B. Two of the ADSL Modem/Router are from Telco-A, and one is from Telco-B.
In fact these backbone can also from VSAT (if necessary)

EnGenius Mesh Network:

Q & A

Thank You