

# Basic Wireless Infrastructure and Topologies

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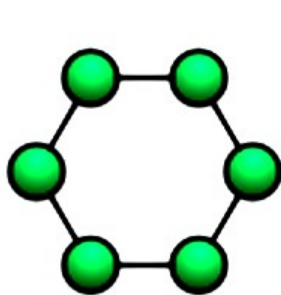
# Goals

- To be aware of the most common wireless topologies
- To be able to identify and plan suitable topologies for real scenarios
- To give a brief introduction to practical setup

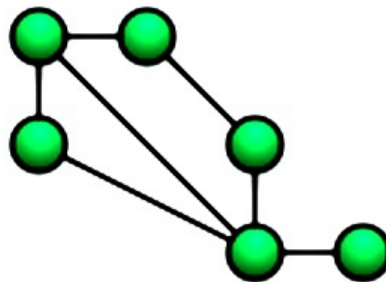
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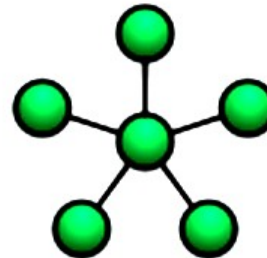
# Basic Network Topologies



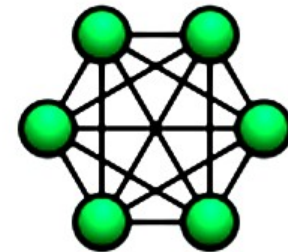
Ring



Mesh (partial)



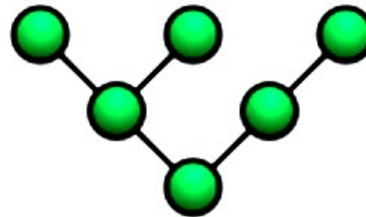
Star



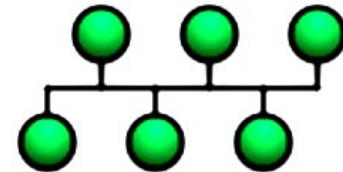
Mesh Fully Connected



Line



Tree



Bus

# Topologies Relevant for Wireless Networking

- Star Yes, standard wireless topology
- Tree Yes (a combination of star and line)
- Line Yes, with two or more elements (PtP)
- Mesh Yes, mainly partial mesh
- Ring Possible, but rarely found
- Bus Not applicable. Why?

# Some General Remarks

- Wireless communication needs no medium
  - EM waves travel through “nothing”
  - The “line” in a network diagram is the connection that is being made
- Wireless communication is always 2-way
  - Except for passive sniffing
  - Applies to transmitters/receivers, clients/masters

# Wireless Components

- Access Point
  - Wireless transmitter/receiver that bridges between wireless nodes and a wired network
  - IEEE 802.11 + Wired Ethernet connection
- Wireless clients
  - Any computer with a wireless network adapter card that transmits and receives RF signals
  - Laptop, PDA, surveillance equipment, VoIP phone

# Two Basic Wireless Modes

1. Ad Hoc (IBSS)

2. Infrastructure (BSS)

# Mode 1: Ad hoc (Peer-to-peer)

- Independent Basic Service Set (IBSS)
- No need of central access point
- All nodes need to use the same SSID and channel
- Not scalable

# Mode 2: Infrastructure

- Extended Service Set (ESS)
- Central access point is needed
- “Connects“ a WLAN to an Ethernet network
- Clients and AP's must use the same SSID
- Channel is set in AP and discovered by clients
- Scalable

# Remarks about Wireless Modes

- In both modes, the SSID identifies the network
- Consider the SSID as the “label” of a Ethernet jack on the wall
- Modes (modes of operation) can be hidden and not noticeable in a topology
  - ex: A PtP link can be *ad hoc* or *infrastructure*

# Ad hoc case 1: Point-to-point

- Connecting two wireless clients directly
- Building to building (when one has Internet connection and the other one does not)
- Inside an office

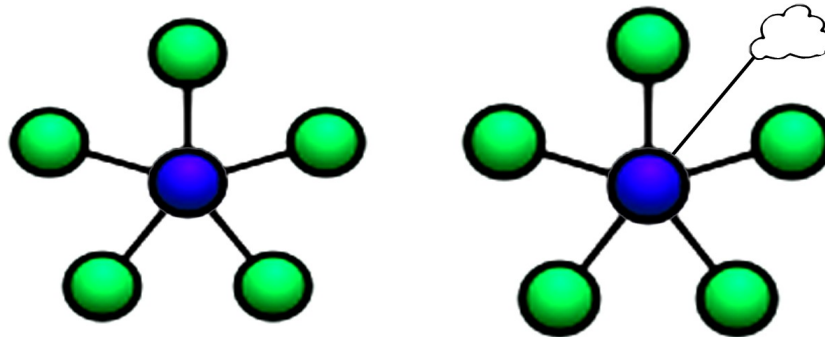


# Ad hoc Case 1: Point-to-point

<b>Setting</b>	<b>Node 1</b>	<b>Node 2</b>
Mode	ad hoc	ad hoc
SSID	MY_SSID	MY_SSID
Channel	Need to agree and know each others	Need to agree and know each others
IP address	Typically fixed	Typically fixed

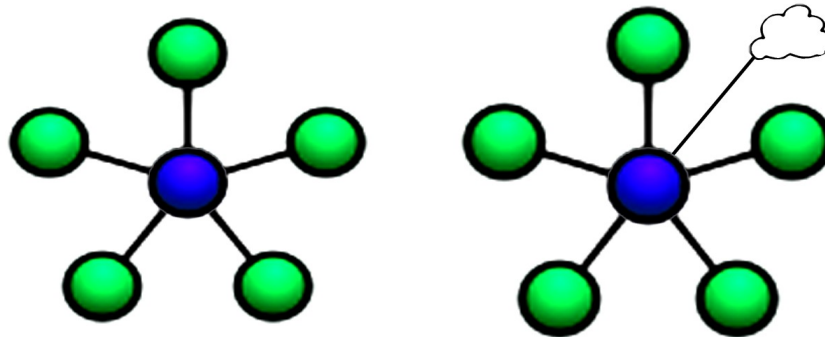
# Infrastructure Case 1: Star

- Hotspots, Telecenters, Offices and WISP's
- Point to Multi-point
- The most common infrastructure in wireless networking



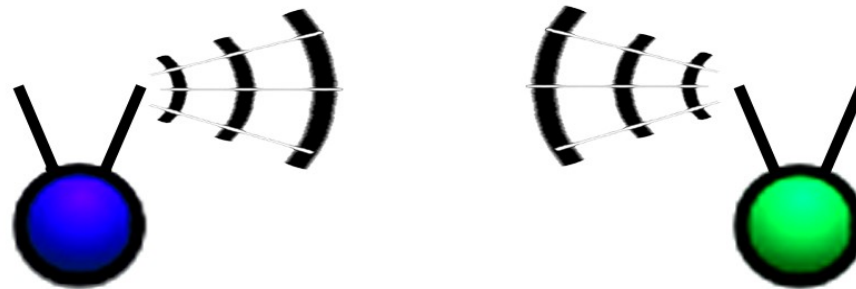
# Infrastructure Case 1: Star

Setting	AP/Gateway	Node x
Mode	Infrastructure	Infrastructure
SSID	Sets MY_SSID	Connects to MY_SSID
Channel	Sets channel x	Discovers channel from AP
IP address	Typically runs DHCP server	Typically gets IP via DHCP lease



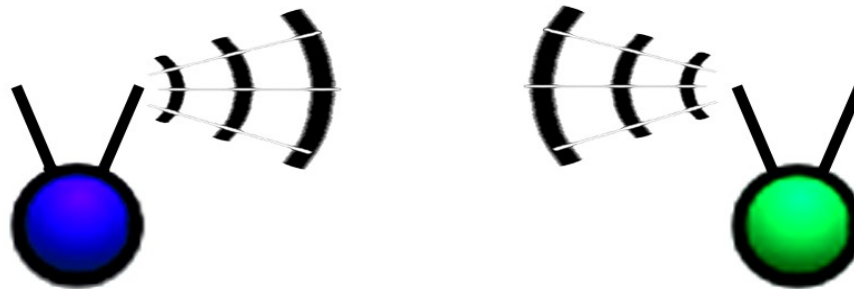
# Infrastructure Case 2: Point to Point

- Standard element of wireless infrastructure
- A PtP link may be part of
  - a star, a tree, a two point line or other topology



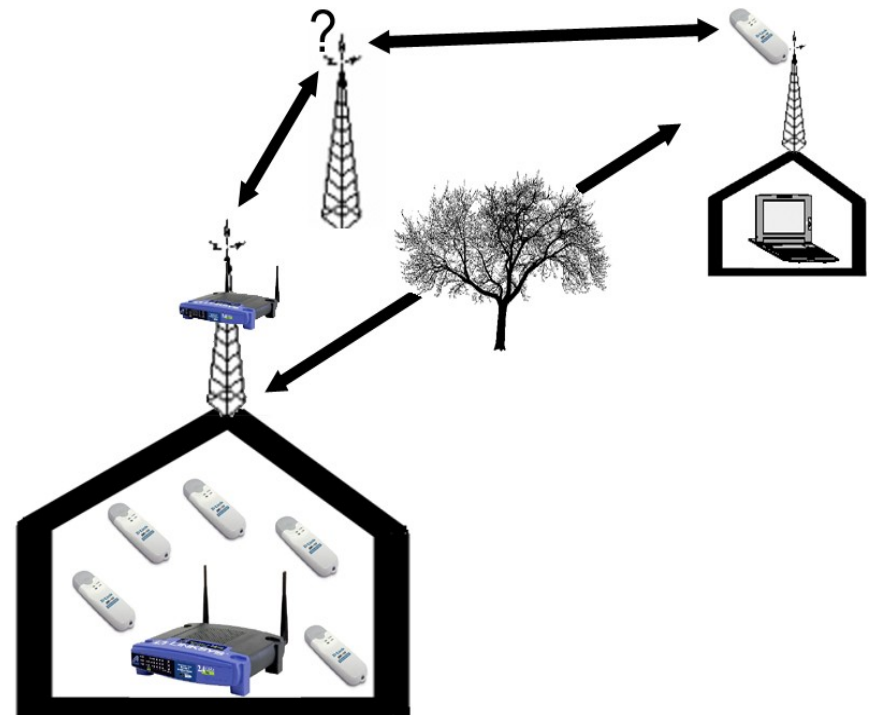
# Infrastructure Case 2: Point to Point

Setting	Node 1	Node 2
Mode	Any	Any
SSID	MY_SSID	MY_SSID
Channel	Set the Channel	Discovers the channel
IP address	Typically fixed	Typically fixed
MAC address	Might be fixed to one another's MAC	Might be fixed to one another's MAC



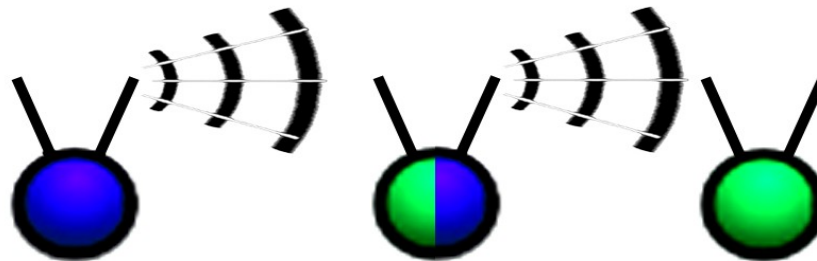
# Infrastructure Case 3: Repeating

- Necessary when direct line of sight (LOS) is obstructed



# Infrastructure case 3: Repeating

- The repeating unit consist of
  - One or two physical devices
  - Two radios or one radio and “isolated antennas”
- Can be seen as a “receiving client and a re-transmitting access point”



# Infrastructure Case 4: Mesh

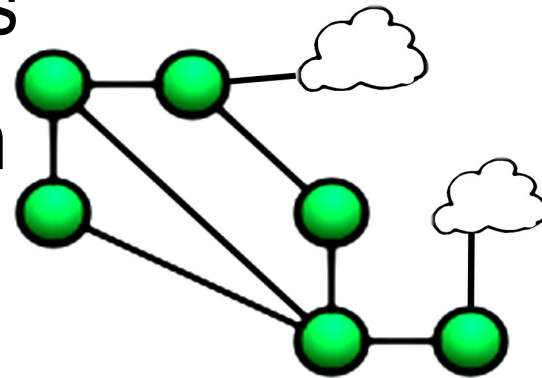
- Mesh topologies are an interesting option mainly in
  - dynamic environments (urban areas)
  - where central infrastructure is hard to implement
  - when redundancy is desired
- Typical cases are: municipal networks, campus networks and neighborhood communities

# Infrastructure Case 4: Mesh

- Full mesh topology (each node is direct connected to all other nodes)
- Partial mesh topology (each node is direct connected to some but not all nodes)
- Nothing is necessarily dynamic in a mesh
- Used as synonym for "ad hoc" or "mobile" network

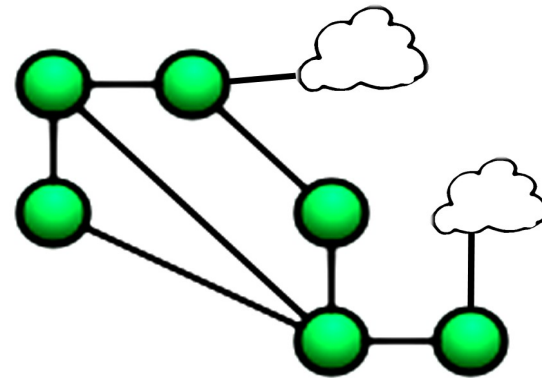
# Infrastructure case 4: Mesh

- All mesh nodes need to run the same mesh routing protocol
- The nodes can be of different operating systems and hardware types if they comply with the mesh protocol specification



# Infrastructure Case 4: Mesh

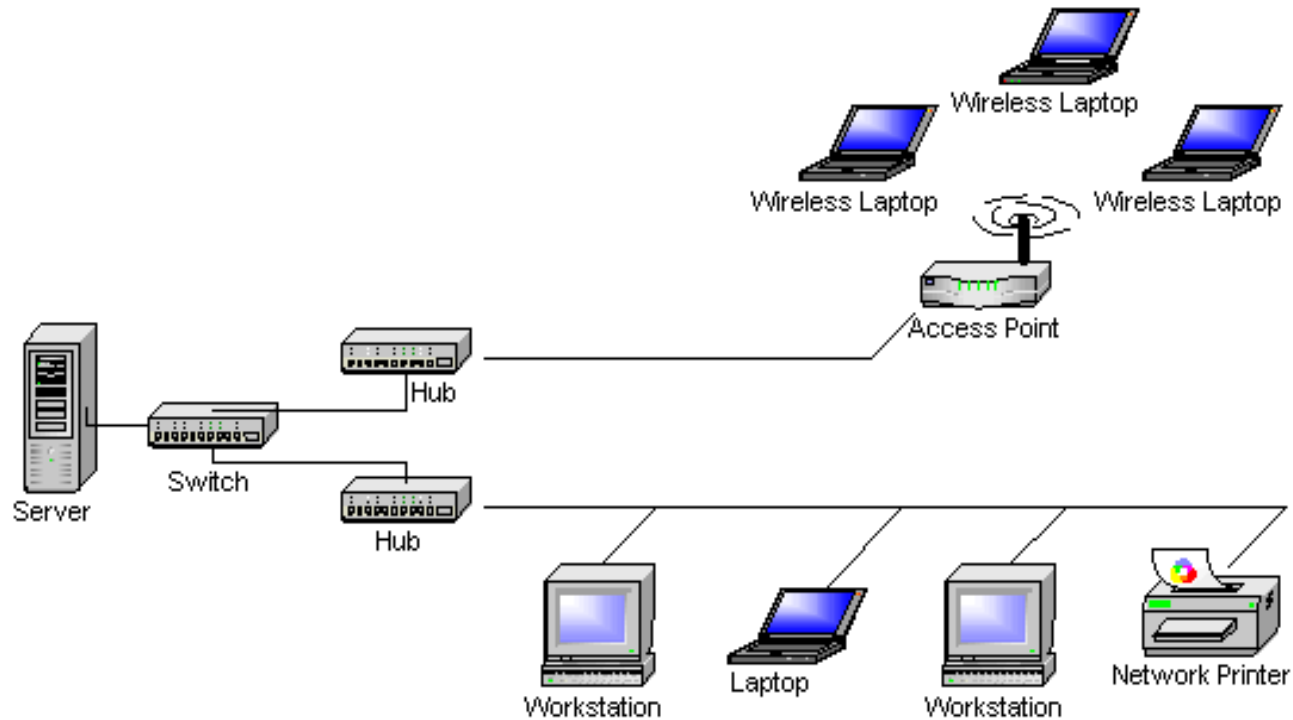
Setting	Node x1	Node x2
Mode	ad hoc	ad hoc
SSID	MY_SSID	MY_SSID
Channel	Channel x	Channel x
IP address	Typically static and manually set	Typically static and manually set
MAC address	Might be fixed to one another's MAC	Might be fixed to one another's MAC



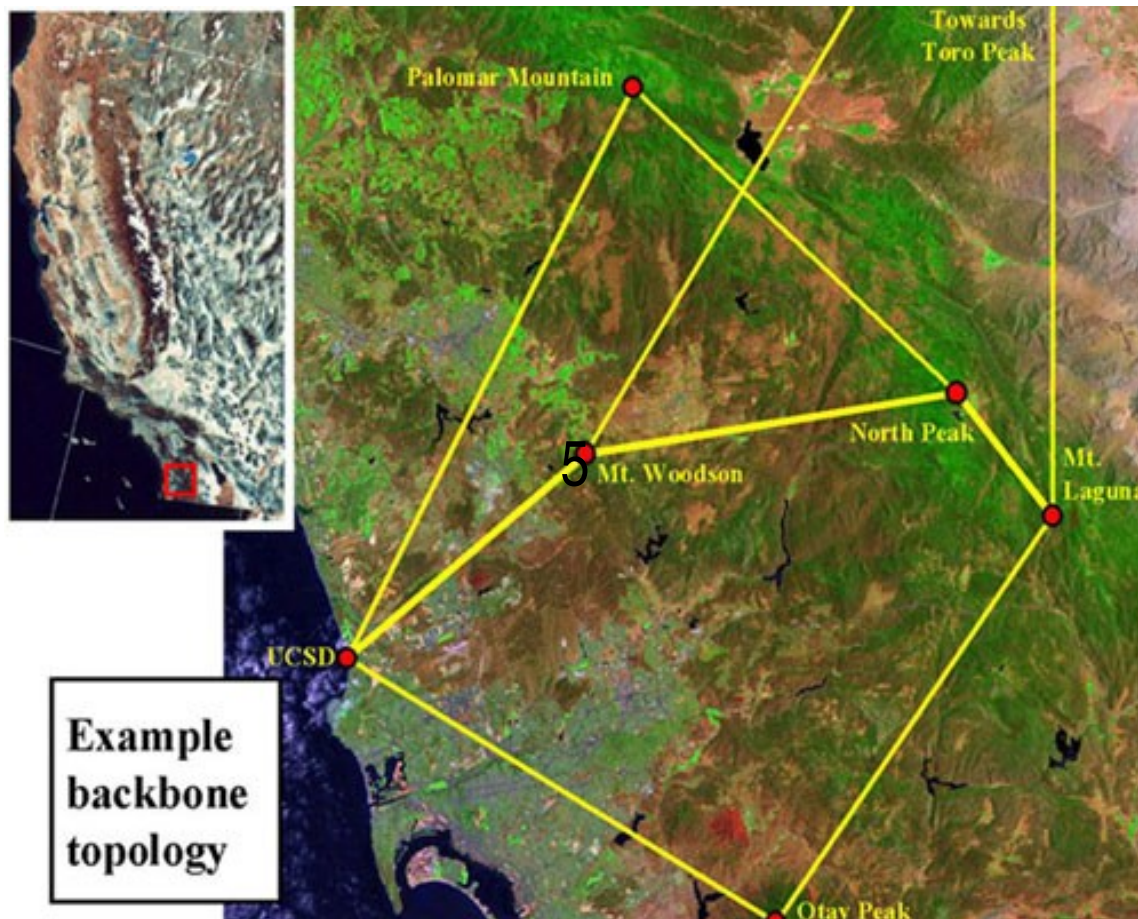
# Real Life Examples of Wireless Infrastructure

- Real life wireless networks are very often combinations of more than one topology
- Graphical representations are totally arbitrary and different from one another

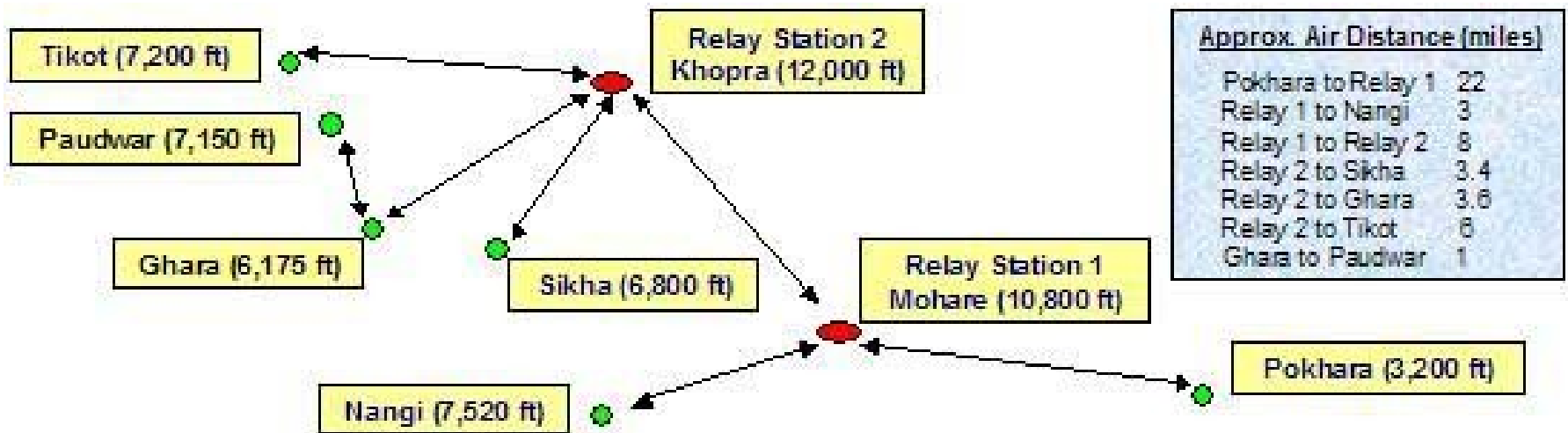
# Typical office network



# Wide-area Wireless backbone

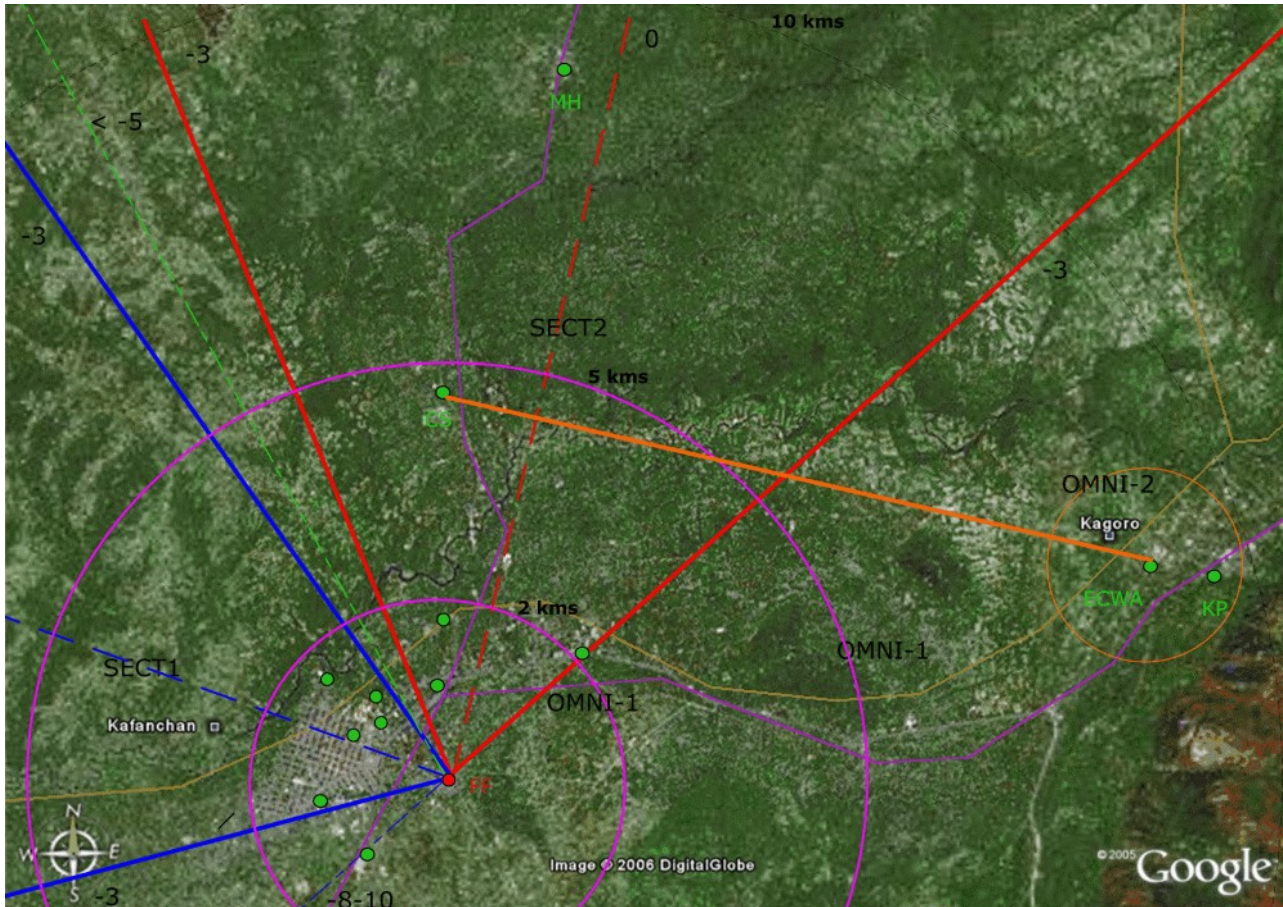


# Nepalwireless.net Backbone Topology





# Wireless Backbone, rural Nigeria



# Conclusions

- Most wireless implementations are based on
  - Star, tree or line topology
- In implementations we can find two modes:
  - Ad hoc or infrastructure (more common)
- The basics of any setup includes:
  - Mode, SSID, Channel + MAC/auth + IP
- Many wireless implementations are based on more than one topology