

# IEEE 1900.7 White Space Radio Use Cases

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# Summary of Use Cases

➔ Four categories of use cases are identified

- Wireless backbone networks
  - Wireless access backbone network
  - Wireless mesh backbone network
  - High speed vehicular backbone network
  - Rural broadband network
- Land fixed/mobile networks
  - Smart home network
  - Digital signage network
  - Transportation logistics network
  - Wireless access network
- Maritime networks
  - Maritime wireless access network
  - Inter-ship mesh network
  - Maritime grid network
- Home/office networks
  - Home/office Network

# I. Wireless Backbone Networks

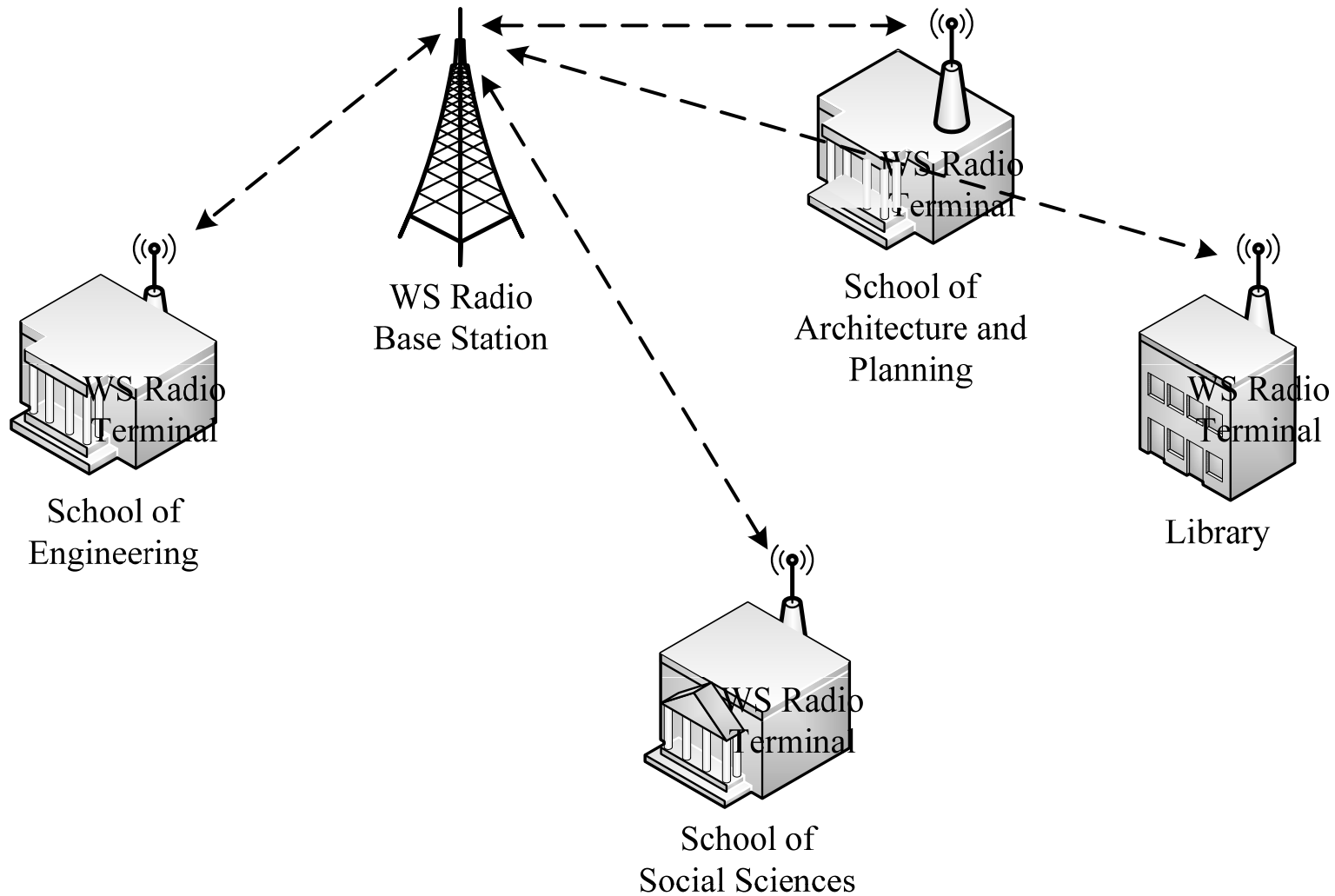
➔ This category includes three use cases

- Wireless Access Backbone Network
  - High data rate wireless access network serving as a backbone network for fixed stations that provide wireless/wired access service to their users
- Wireless Mesh Backbone Network
  - High data rate mesh backbone network connecting fixed stations that provide wireless/wired access service to their users
- High Speed Vehicle Backbone Network
  - High data rate backbone network for high speed vehicles
- Rural broadband network
  - Broadband access to homes

# Wireless Access Backbone Network

- ➔ White space radio is used to provide high data rate wireless access network serving as a backbone network for fixed stations that provide wireless/wired access service to their users
- ➔ Potential applications
  - Campus connectivity
  - Enterprise connectivity
  - Dynamic backhaul
  - Quick-to-deploy temporary networks

# Wireless Access Backbone Network



# Wireless Access Backbone Network

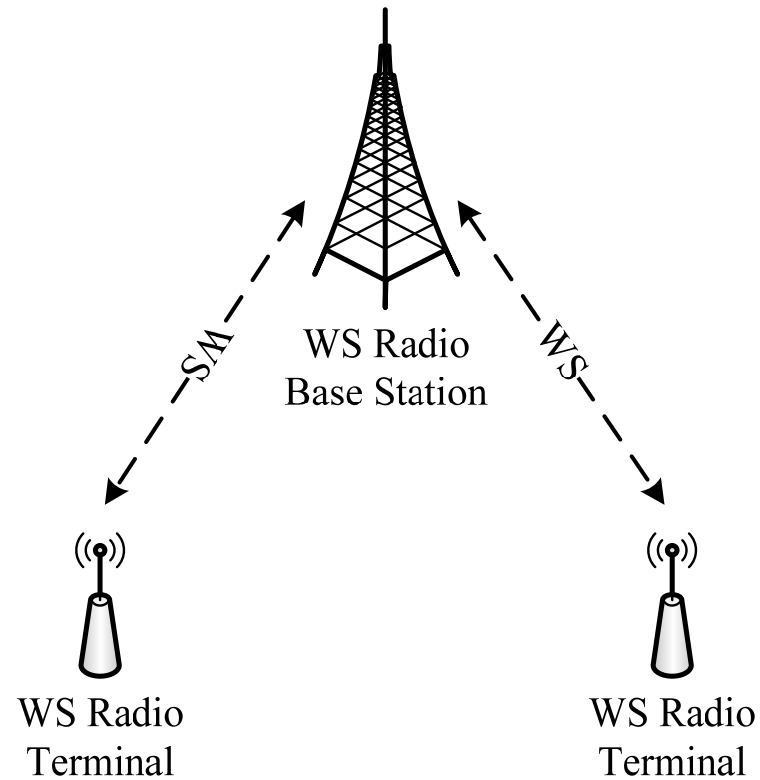
<b>Propagation environment</b>	Outdoor LOS, NLOS
	Outdoor to indoor LOS, NLOS
<b>Expected data rate per terminal (1)</b>	30 Mbps
<b>Maximum transmission range</b>	10 km
<b>Maximum mobility speed</b>	fixed
<b>Tolerable delay</b>	High
<b>Security level</b>	High
<b>Number of terminals per base station (2)</b>	5-10

(1) Expected data rate per terminal is the maximum rate that a terminal is able to achieve theoretically .

(2) Number of terminals per base station is the number of connected devices (active and in sleep mode) .

# Wireless Access Backbone Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Terminals are fixed

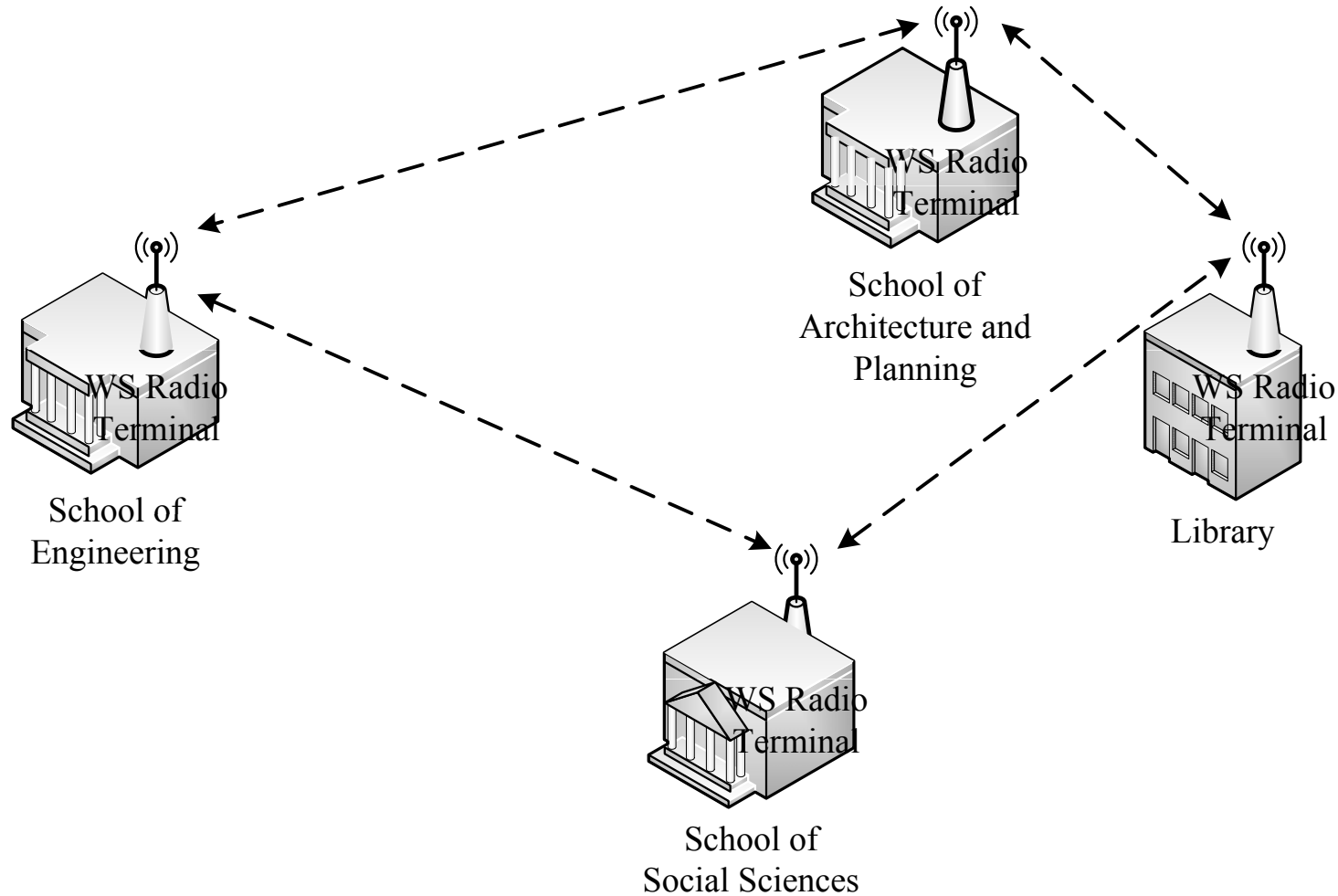


# Wireless Mesh Backbone Network

- ➔ White space radio is used to provide high data rate mesh backbone network connecting fixed stations that provide wireless/wired access service to their users
- ➔ Potential applications
  - Campus connectivity
  - Enterprise connectivity
  - Quick-to-deploy temporary networks



# Wireless Mesh Backbone Network

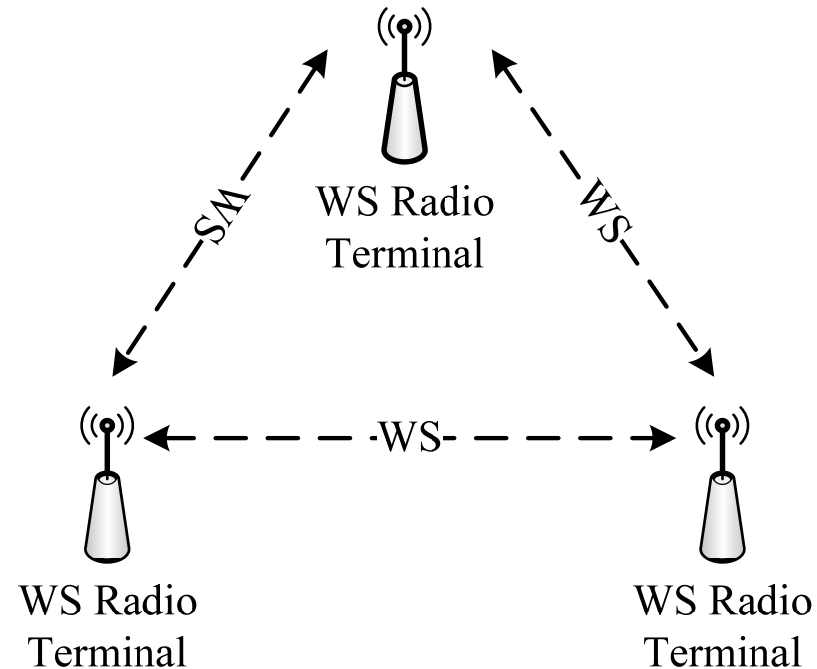


# Wireless Mesh Backbone Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
	Outdoor to indoor NLOS
<b>Expected data rate per terminal</b>	20 Mb/s
<b>Maximum transmission range</b>	5 km
<b>Maximum mobility speed</b>	fixed
<b>Tolerable delay</b>	High
<b>Security level</b>	High
<b>Number of terminals</b>	5 – 10

# Wireless Mesh Backbone Network

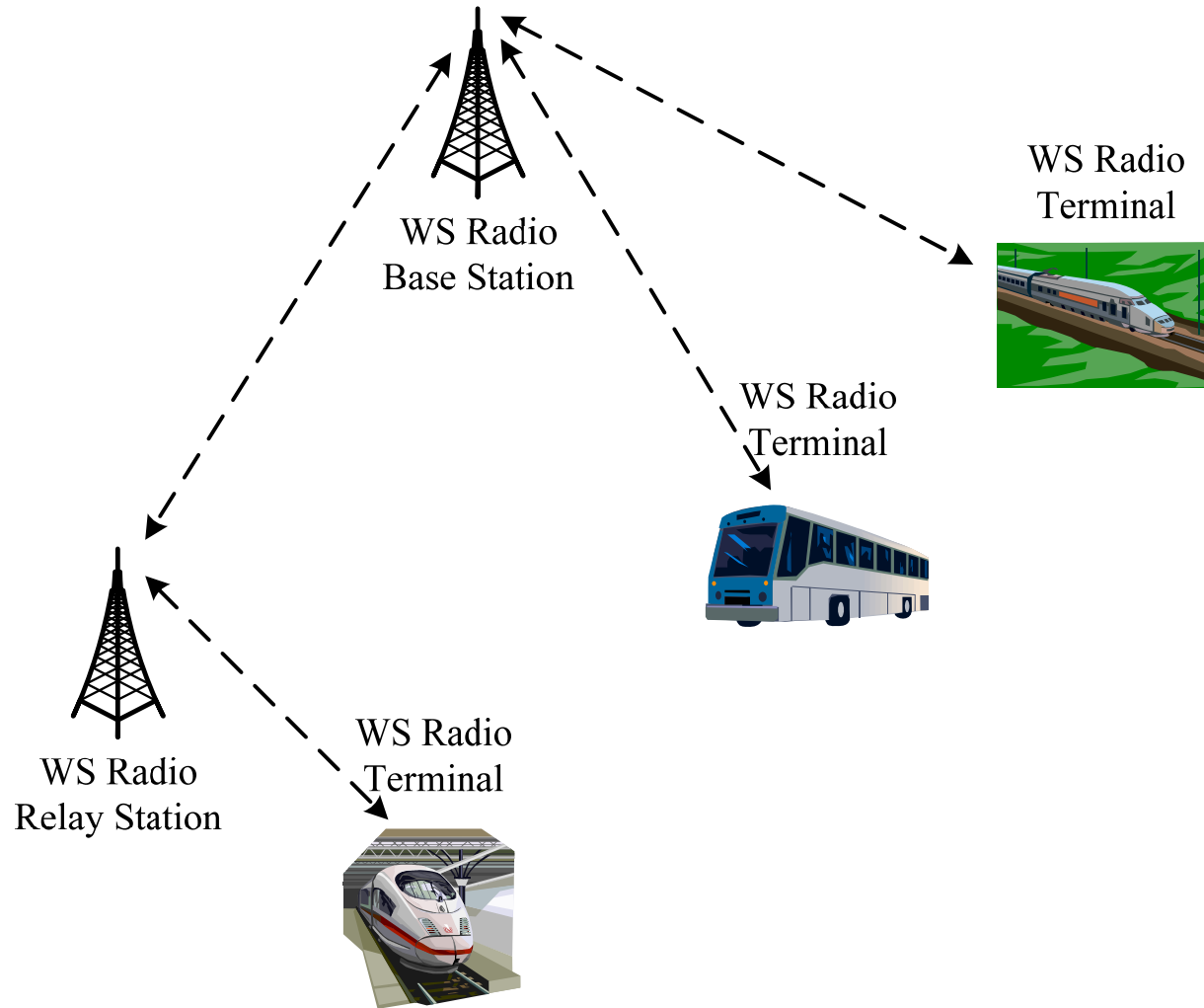
- ➔ WS Radio Terminals are fixed



# High Speed Vehicle Backbone Network

- ➔ White space radio is used to provide high data rate backbone network for high speed vehicles
- ➔ Potential applications
  - Backbone network for high-speed trains
  - Backbone network for long distance buses

# High Speed Vehicle Backbone Network

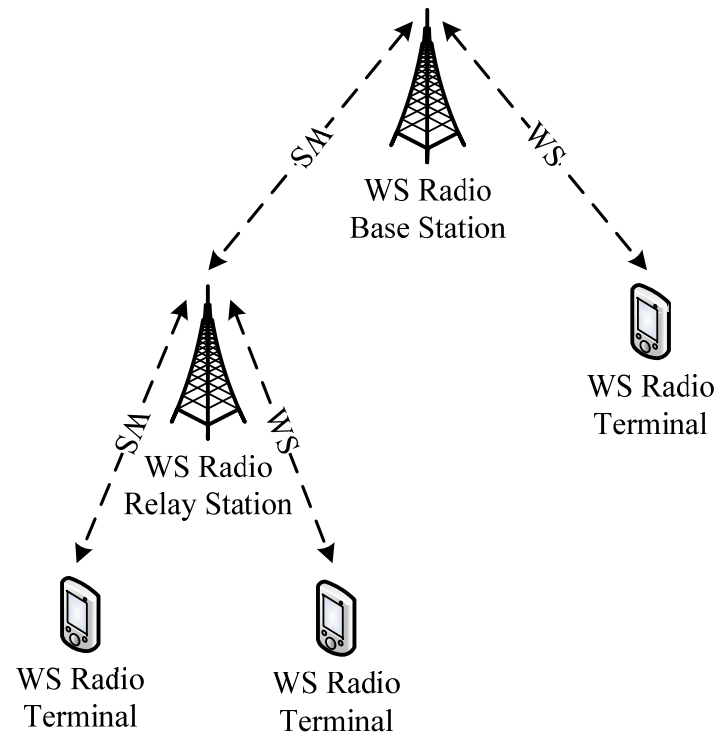


# High Speed Vehicle Backbone Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
<b>Expected data rate per terminal</b>	10 Mbps
<b>Maximum transmission range</b>	10 km
<b>Maximum mobility speed</b>	300 km/h
<b>Tolerable delay</b>	Medium
<b>Security level</b>	Medium
<b>Number of terminals per base station</b>	1-10

# High Speed Vehicle Backbone Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Relay Stations are fixed
- ➔ WS Radio Terminals are mobile

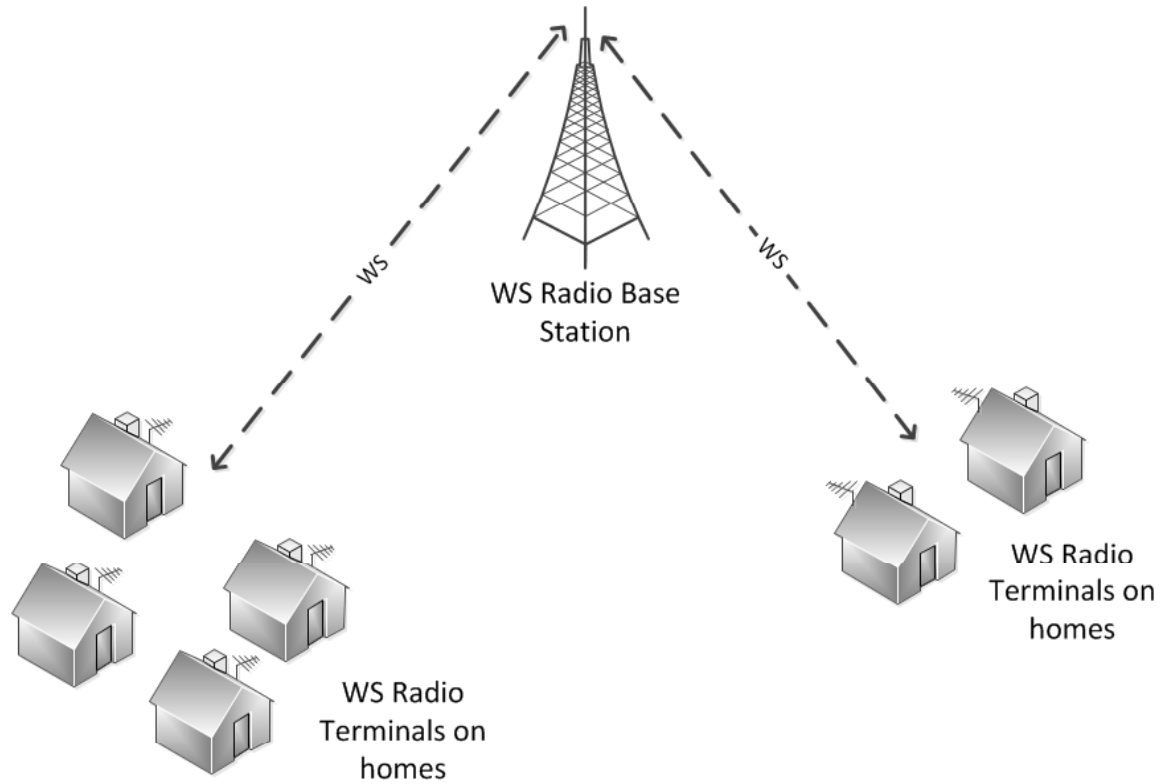


# Rural Broadband network

- ➔ White space radio is used to provide broadband access to homes.
- ➔ Base stations are fixed
- ➔ Home terminals are fixed
- ➔ Distribution around homes is not part of this use case (possibly home/office network solution later in this document)



# Rural Broadband network



# Rural Broadband network

<b>Propagation environment</b>	Outdoor LOS, NLOS
	Outdoor to indoor LOS, NLOS (possibly)
<b>Expected data rate per terminal</b>	30 Mbps
<b>Maximum transmission range</b>	10 km
<b>Maximum mobility speed</b>	fixed
<b>Tolerable delay</b>	High
<b>Security level</b>	High
<b>Number of terminals per base station</b>	30

## II. Land Fixed/Mobile Networks

➔ This category includes three use cases

- Smart Home Networks

- Low data rate network for collecting data from low power consumption stations gathering measurements from utility devices (e.g., gas, water, and electricity meters)

- Digital Signage Network

- Distribution network for digital signs

- Transportation Logistics Network

- Low data rate network for tracking and controlling mobile stations (e.g., post delivery vehicles)

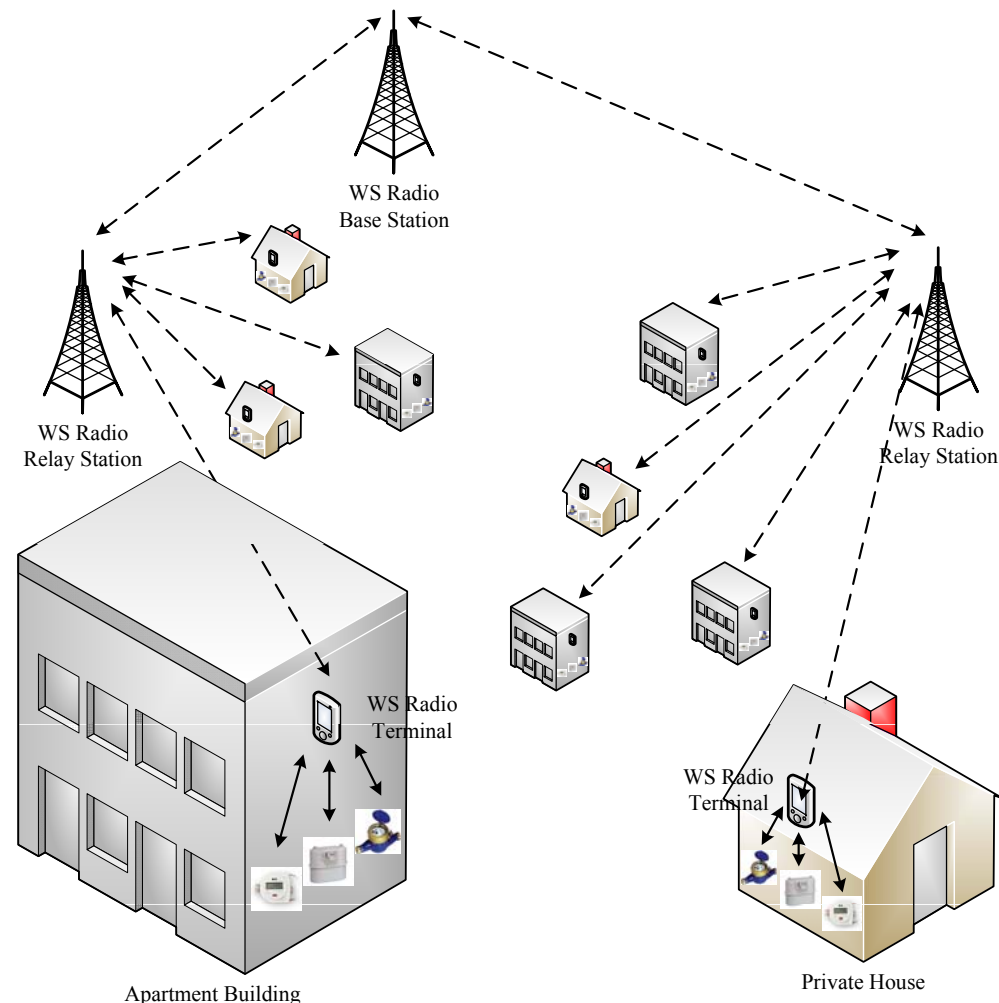
- Mobile Wireless Access Network

- Providing wireless access to mobile stations

# Smart Home Network

- ➔ White space radio is used to provide low data rate network for collecting data from low power consumption stations gathering measurements from devices, e.g., gas, water, electricity meters, and to control such devices from a server
- ➔ Potential applications
  - Smart metering
  - Monitoring and control

# Smart Home Networks

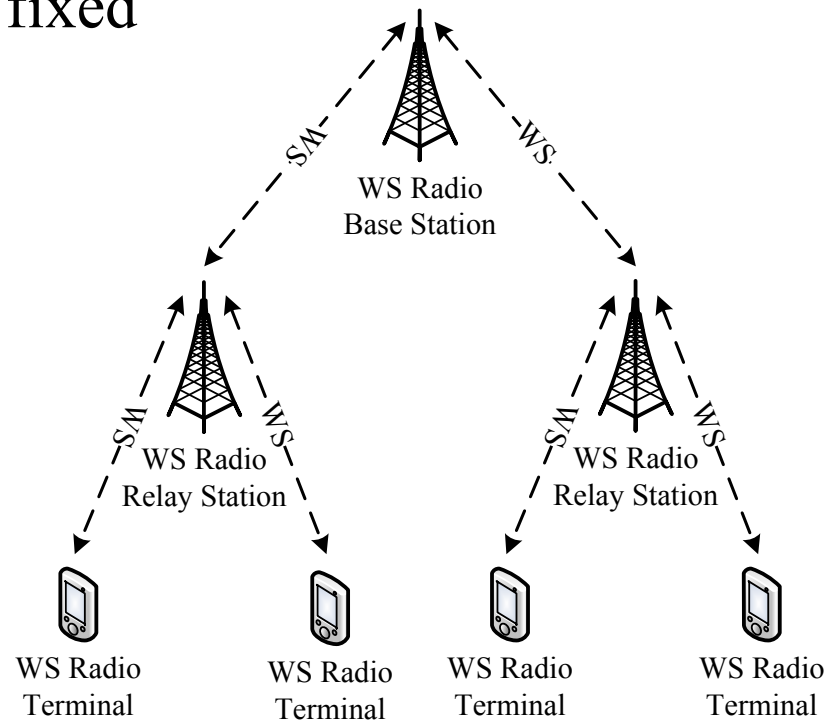


# Smart Home Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
	Outdoor to indoor NLOS
<b>Expected data rate per terminal</b>	10 kbps
<b>Maximum transmission range</b>	10 km
<b>Maximum mobility speed</b>	fixed
<b>Tolerable delay</b>	High
<b>Security level</b>	High
<b>Number of terminals per base station</b>	100-1000

# Smart Home Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Relay Stations are fixed
- ➔ WS Radio Terminals are fixed

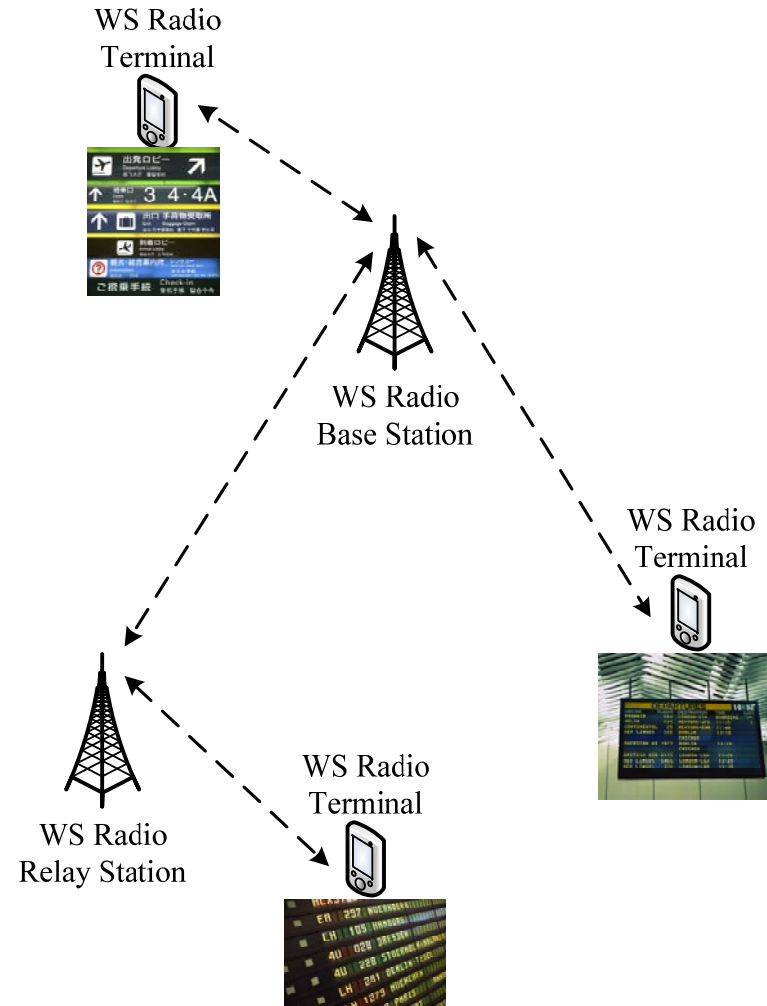


# Digital Signage Network

- ➔ White space radio is used to provide data distribution network for digital signs
- ➔ Potential applications
  - Digital signage



# Digital Signage Network

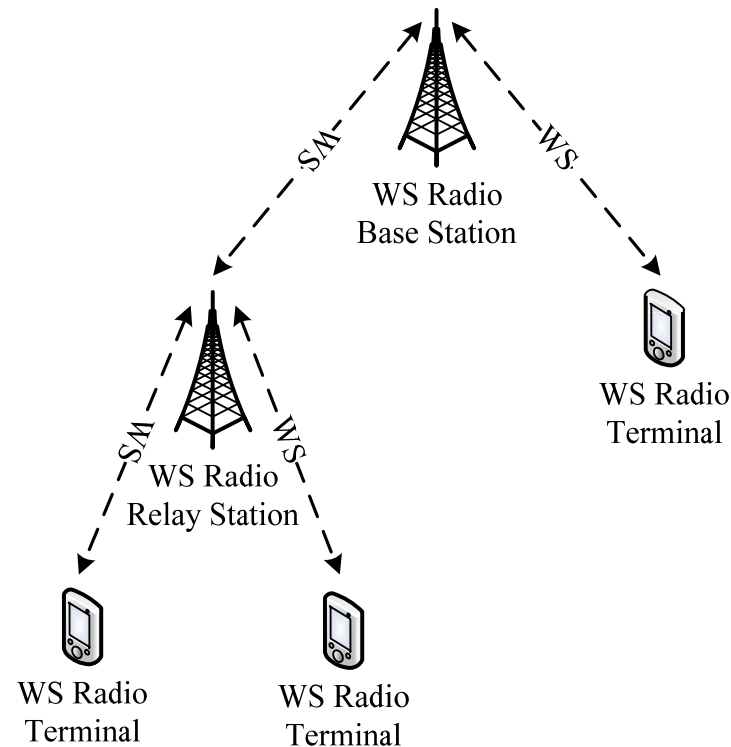


# Digital Signage Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
<b>Expected data rate per terminal</b>	1 Mbps
<b>Maximum transmission range</b>	10 km
<b>Maximum mobility speed</b>	fixed
<b>Tolerable delay</b>	High
<b>Security level</b>	High
<b>Number of terminals per base station</b>	10-100

# Digital Signage Network

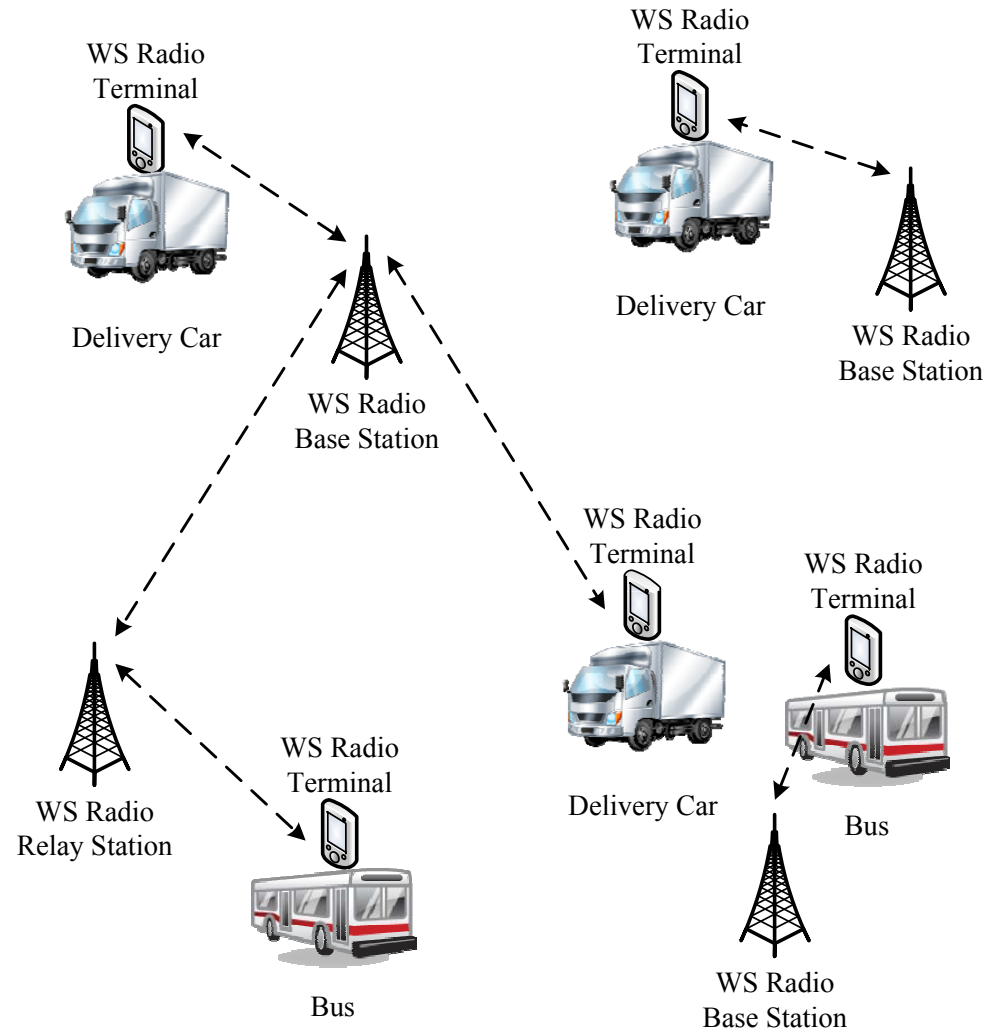
- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Relay Stations are fixed
- ➔ WS Radio Terminals are fixed



# Transportation Logistics Network

- ➔ White space radio is used to provide low data rate network for tracking and controlling mobile stations, e.g., post delivery vehicles
- ➔ Potential applications
  - Public transportation logistics
  - Control and management of postal and delivery services

# Transportation Logistics Network

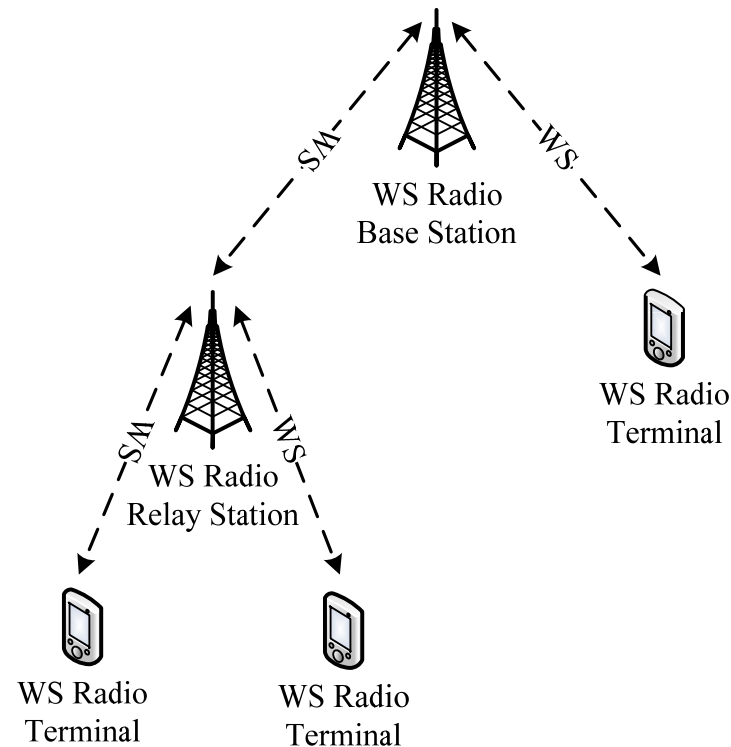


# Transportation Logistics Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
<b>Expected data rate per terminal</b>	10 kbps
<b>Maximum transmission range</b>	10 km
<b>Maximum mobility speed</b>	120 km/h
<b>Tolerable delay</b>	High
<b>Security level</b>	High
<b>Number of terminals per base station</b>	100-1000

# Transportation Logistics Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Relay Stations are fixed
- ➔ WS Radio Terminals are mobile

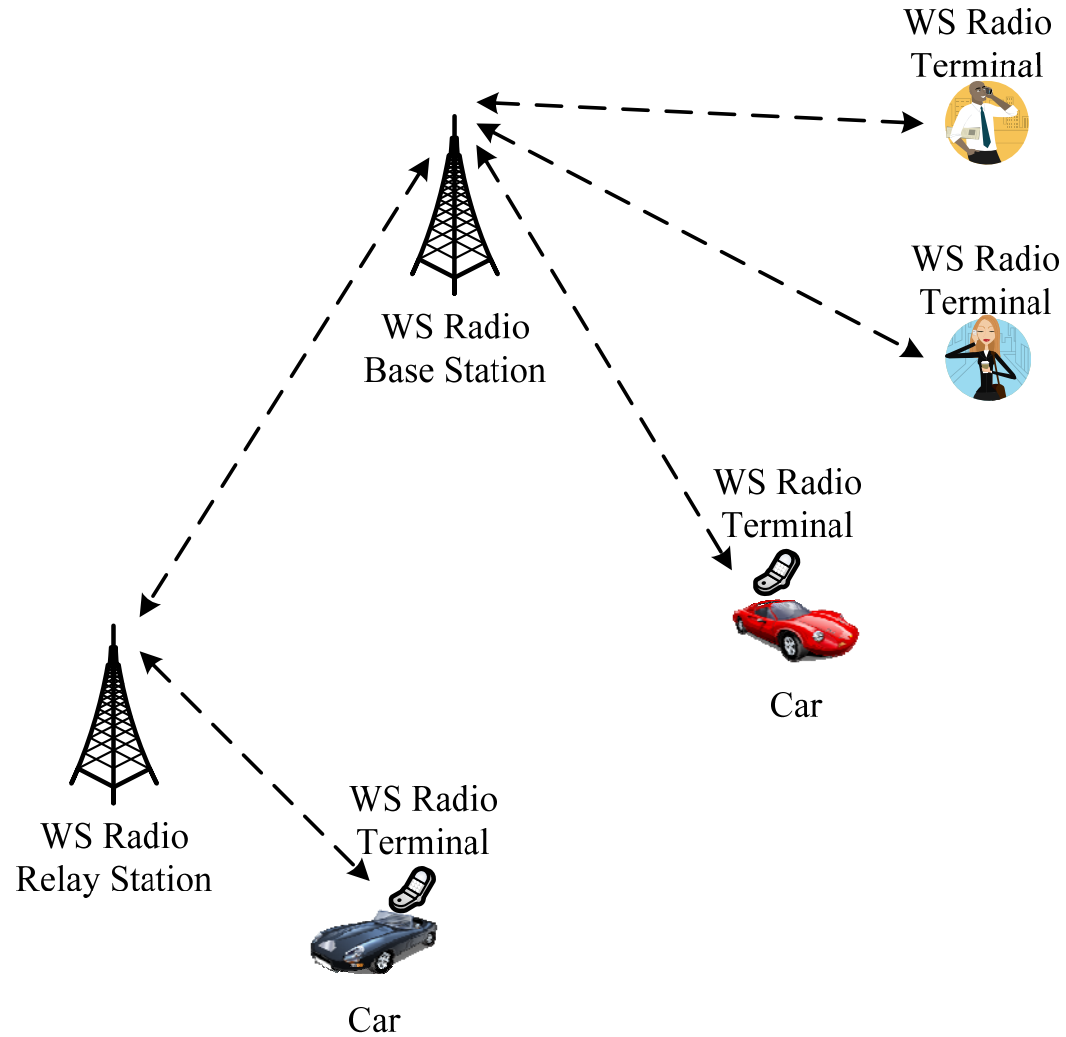


# Mobile Wireless Access Network

- ➔ White space radio is used to provide wireless access to mobile stations
- ➔ Potential applications
  - Mobile wireless access
  - Cellular network extension to white space



# Mobile Wireless Access Network

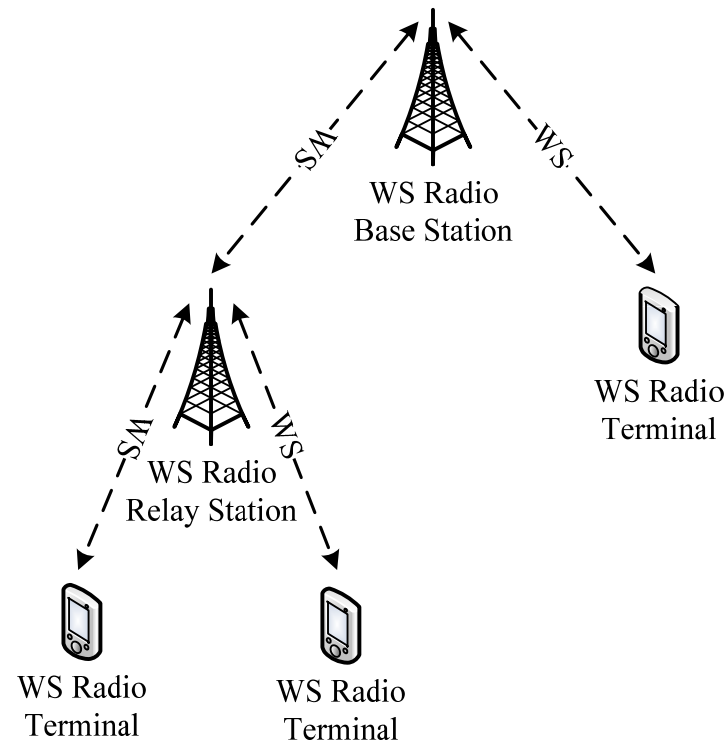


# Mobile Wireless Access Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
	Outdoor to indoor NLOS
<b>Expected data rate per terminal</b>	5 Mbps
<b>Maximum transmission range</b>	5 km
<b>Maximum mobility speed</b>	120 km/h
<b>Tolerable delay</b>	Low
<b>Security level</b>	Medium
<b>Number of terminals per base station</b>	10-100

# Mobile Wireless Access Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Relay Stations are fixed
- ➔ WS Radio Terminals are mobile and pedestrian



## III. Maritime Networks

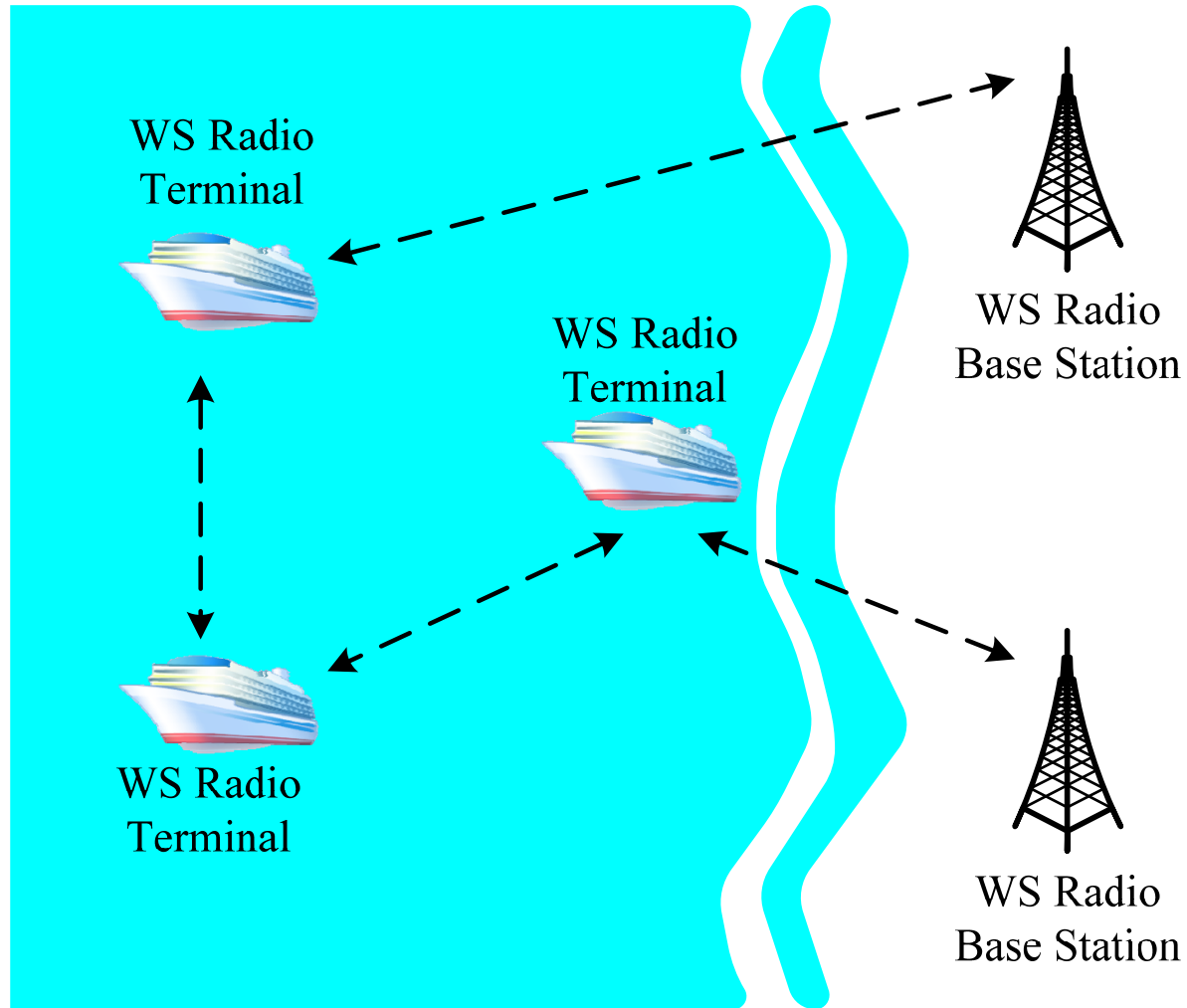
- ➔ This category includes three use cases
  - Maritime Wireless Access Network
    - Providing wireless access to ships and connecting ships with each other
  - Inter-ship Mesh Network
    - Mesh network connecting stations located on ships
  - Maritime Grid Network
    - Low data rate network collecting data from marine environment monitoring stations, oil/gas platforms, etc

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# Maritime Wireless Access Network

- ➔ White space radio is used to provide maritime wireless access network
- ➔ Potential applications
  - Wireless access for ship crew and passengers
  - Fleet and seaport management
  - Inter-ship communications

# Maritime Wireless Access Network

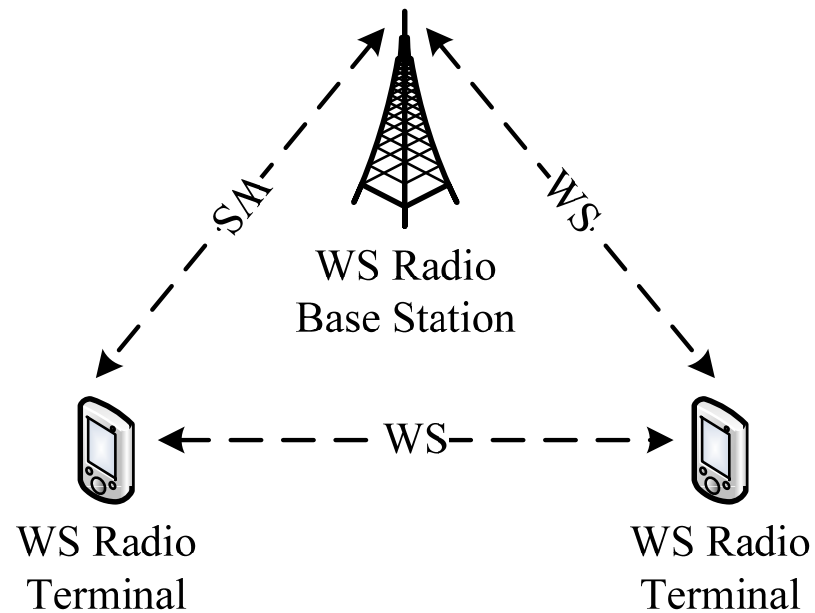


# Maritime Wireless Access Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
<b>Expected data rate per terminal</b>	10 Mbps
<b>Maximum transmission range</b>	20 km
<b>Maximum mobility speed</b>	60 km/h
<b>Tolerable delay</b>	Low
<b>Security level</b>	Medium
<b>Number of terminals per base station</b>	several-10

# Maritime Wireless Access Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Terminals are mobile

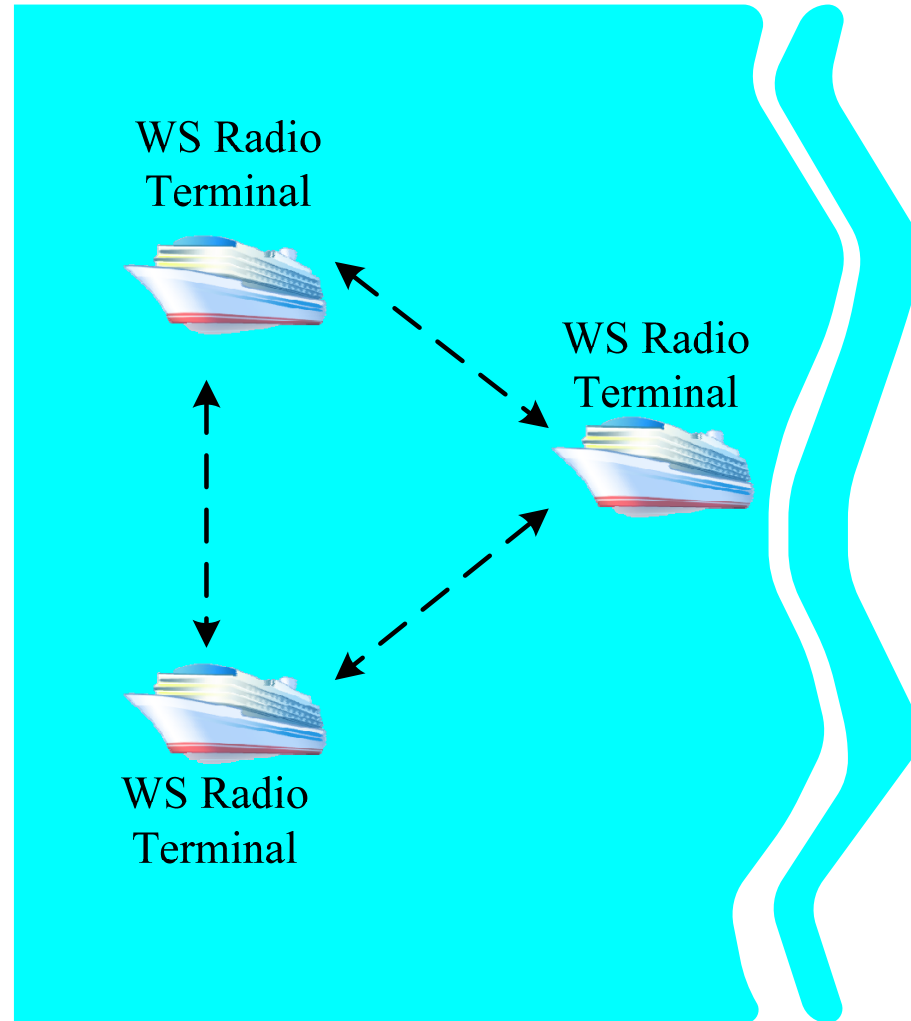




# Inter-ship Mesh Network

- ➔ White space radio is used to provide mesh network connecting stations located on ships
- ➔ Potential applications
  - Fleet management
  - Inter-ship communications
  - Disaster rescue
  - Anti-piracy

# Inter-ship Mesh Network

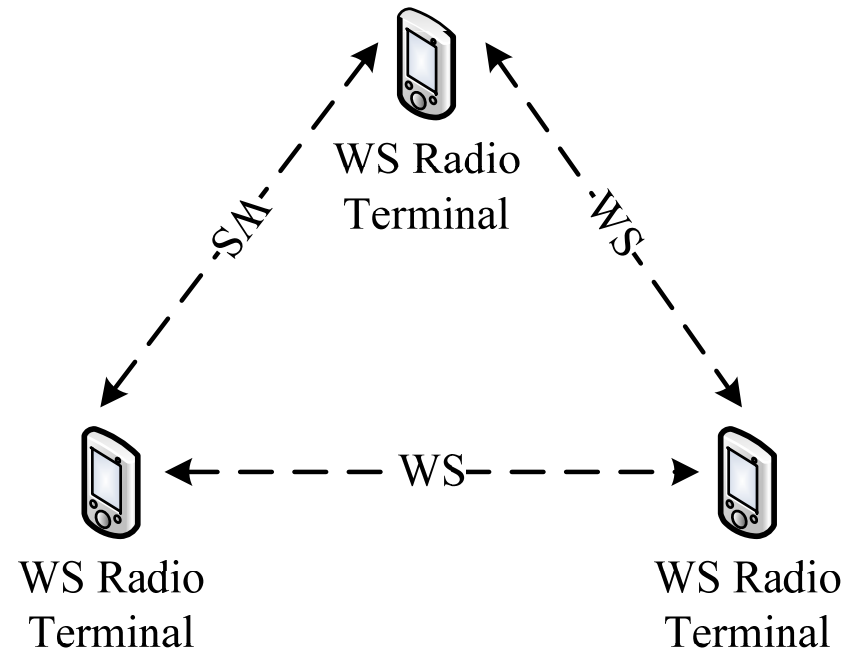


# Inter-ship Mesh Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
<b>Expected data rate per terminal</b>	5 Mbps
<b>Maximum transmission range</b>	20 km
<b>Maximum mobility speed</b>	60 km/h
<b>Tolerable delay</b>	Low
<b>Security level</b>	Medium
<b>Number of terminals</b>	several-10

# Inter-ship Mesh Network

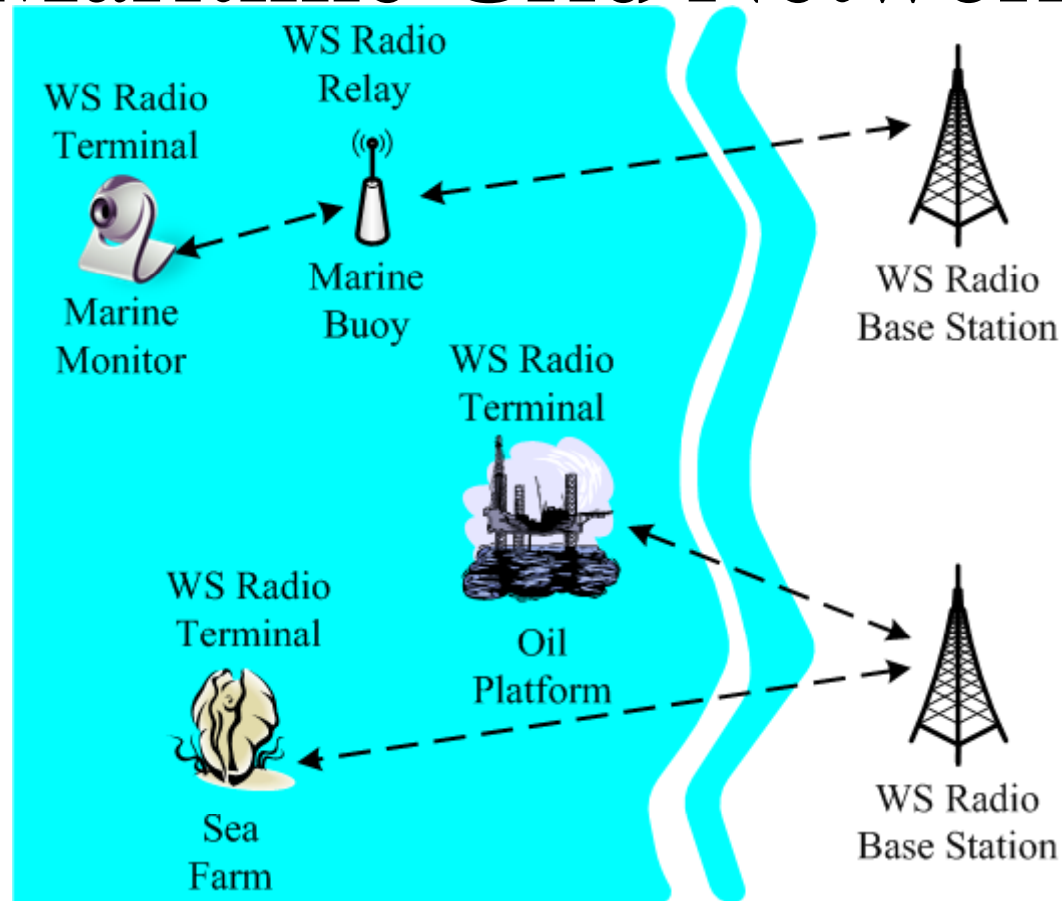
- ➔ WS Radio Terminals are mobile



# Maritime Grid Network

- ➔ White space radio is used to provide low data rate network collecting data from marine environment monitoring stations, oil/gas platforms, etc
- ➔ Potential applications
  - Seaport management
  - Control and management of oil platforms, sea farms
  - Marine environment monitoring and data collection

# Maritime Grid Network

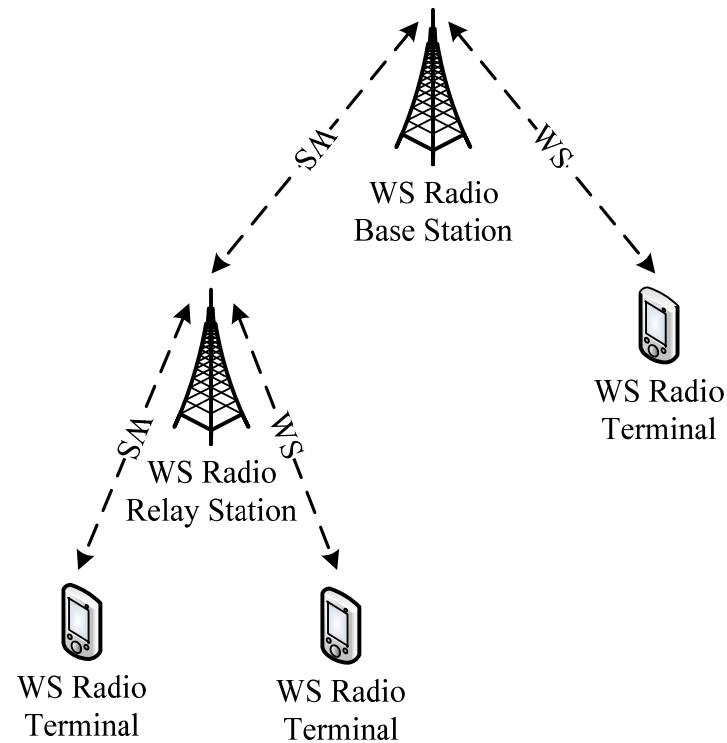


# Maritime Grid Network

<b>Propagation environment</b>	Outdoor LOS, NLOS
<b>Expected data rate per terminal</b>	10 Mbps
<b>Maximum transmission range</b>	20 km
<b>Maximum mobility speed</b>	Fixed/Mobile
<b>Tolerable delay</b>	High
<b>Security level</b>	High
<b>Number of terminals per base station</b>	100-1000

# Maritime Grid Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Relay Stations are fixed
- ➔ WS Radio Terminals are fixed, mobile





# Indoor Networks

- ➔ This category includes one use case
  - Indoor Network
    - Providing wireless access inside office or home

# Home/Office Network

- ➔ White space radio is used to provide wireless access inside home or office
- ➔ Potential applications
  - Wireless access inside office
  - Wireless access inside home
  - Inside-to-outside coverage

# Home/Office Network

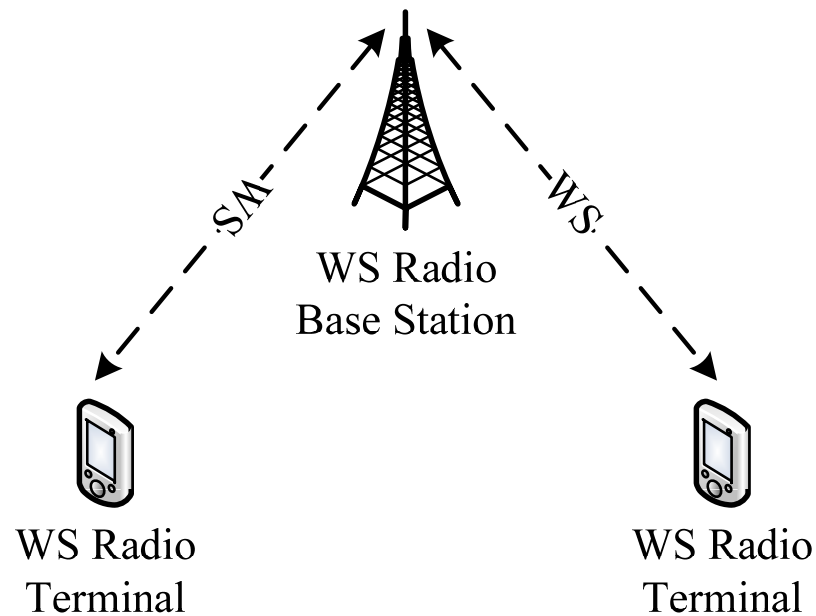


# Indoor Network

<b>Propagation environment</b>	Indoor LOS, NLOS
	Outdoor to indoor LOS, NLOS
<b>Expected data rate per terminal</b>	20 Mbps
<b>Maximum transmission range</b>	300 m
<b>Maximum mobility speed</b>	4 km/h
<b>Tolerable delay</b>	Medium
<b>Security level</b>	Medium
<b>Number of terminals per base station</b>	1-10

# Indoor Network

- ➔ WS Radio Base Station is fixed
- ➔ WS Radio Terminals are pedestrian



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