802.16j MMR
Mobile Multi-Hop Relay

林咨銘

2006/6/1
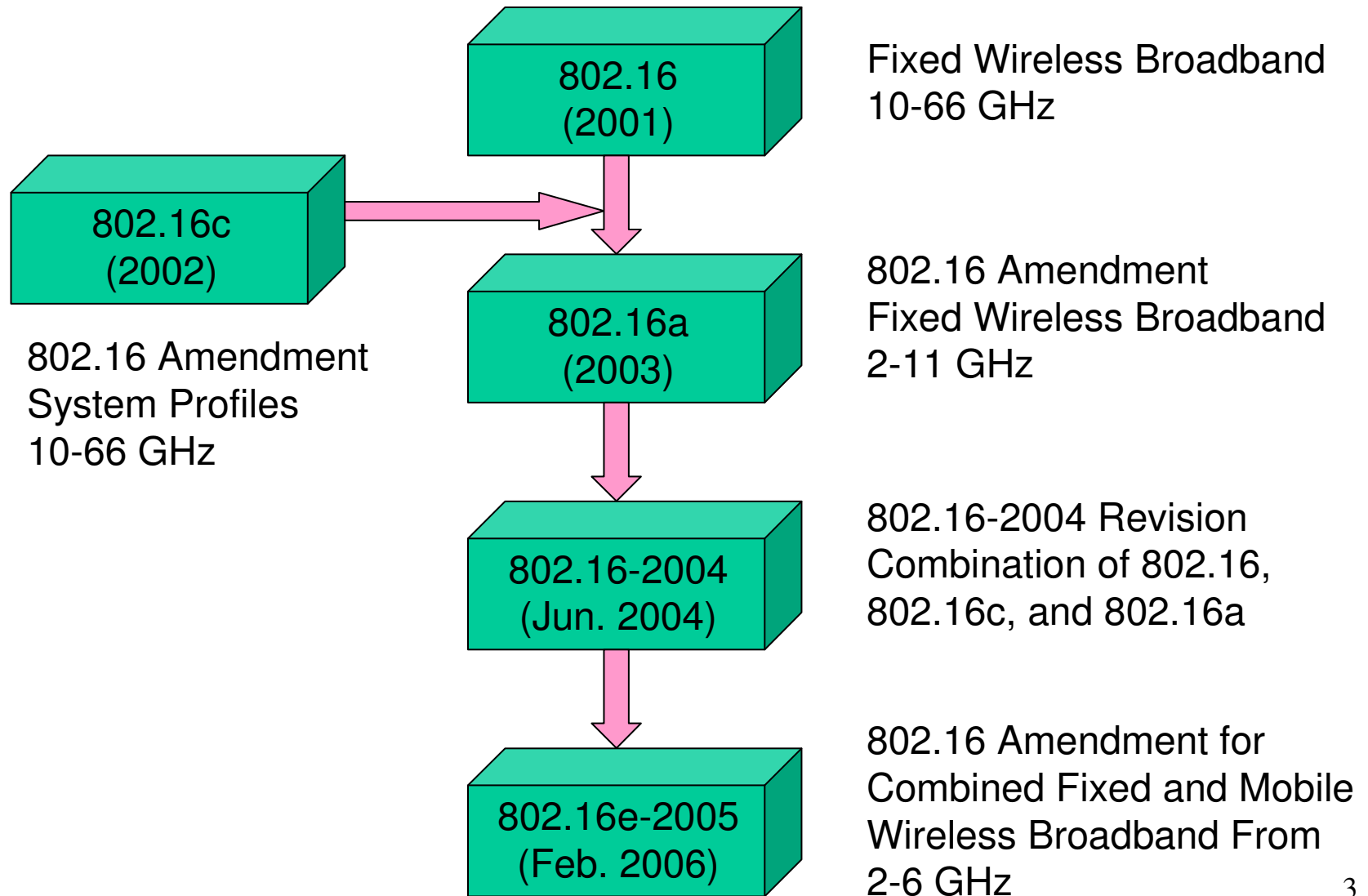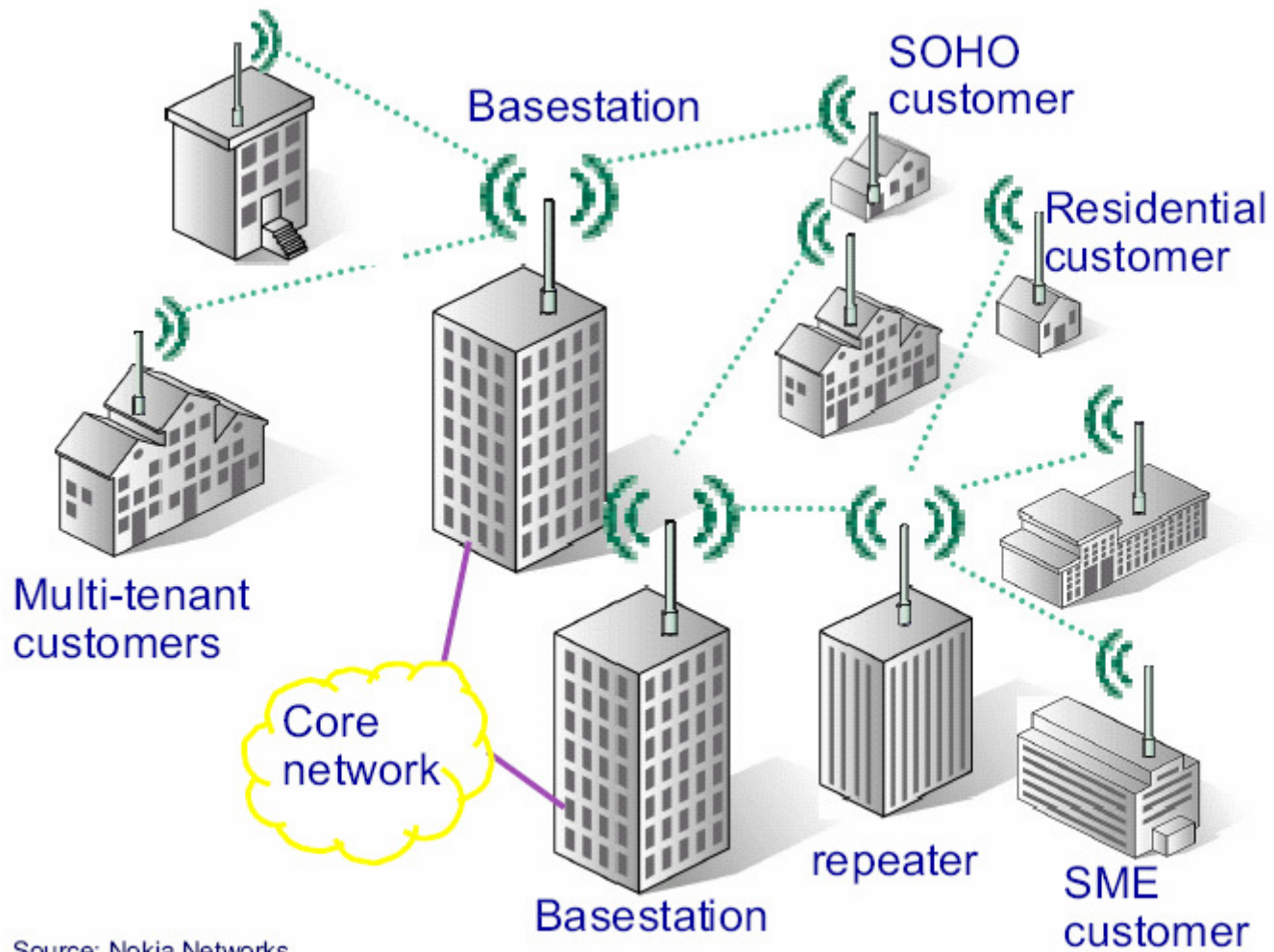
tmlin@itri.org.tw

Outline

- 802.16 working group

- 802.16j MMR overview

- MMR scenario

- Challenges

- Summary

802.16 Working Group

802.16
(2001)

Fixed Wireless Broadband
10-66 GHz

802.16c
(2002)

802.16 Amendment
System Profiles
10-66 GHz

802.16a
(2003)

802.16 Amendment
Fixed Wireless Broadband
2-11 GHz

802.16-2004
(Jun. 2004)

802.16-2004 Revision
Combination of 802.16,
802.16c, and 802.16a

802.16e-2005
(Feb. 2006)

802.16 Amendment for
Combined Fixed and Mobile
Wireless Broadband From
2-6 GHz

802.16 Network

Source: Nokia Networks

Why MMR?

- Current deployments suffer from
    - Limited spectrum
    - Low SINR at cell edge
    - Coverage hole due to shadowing
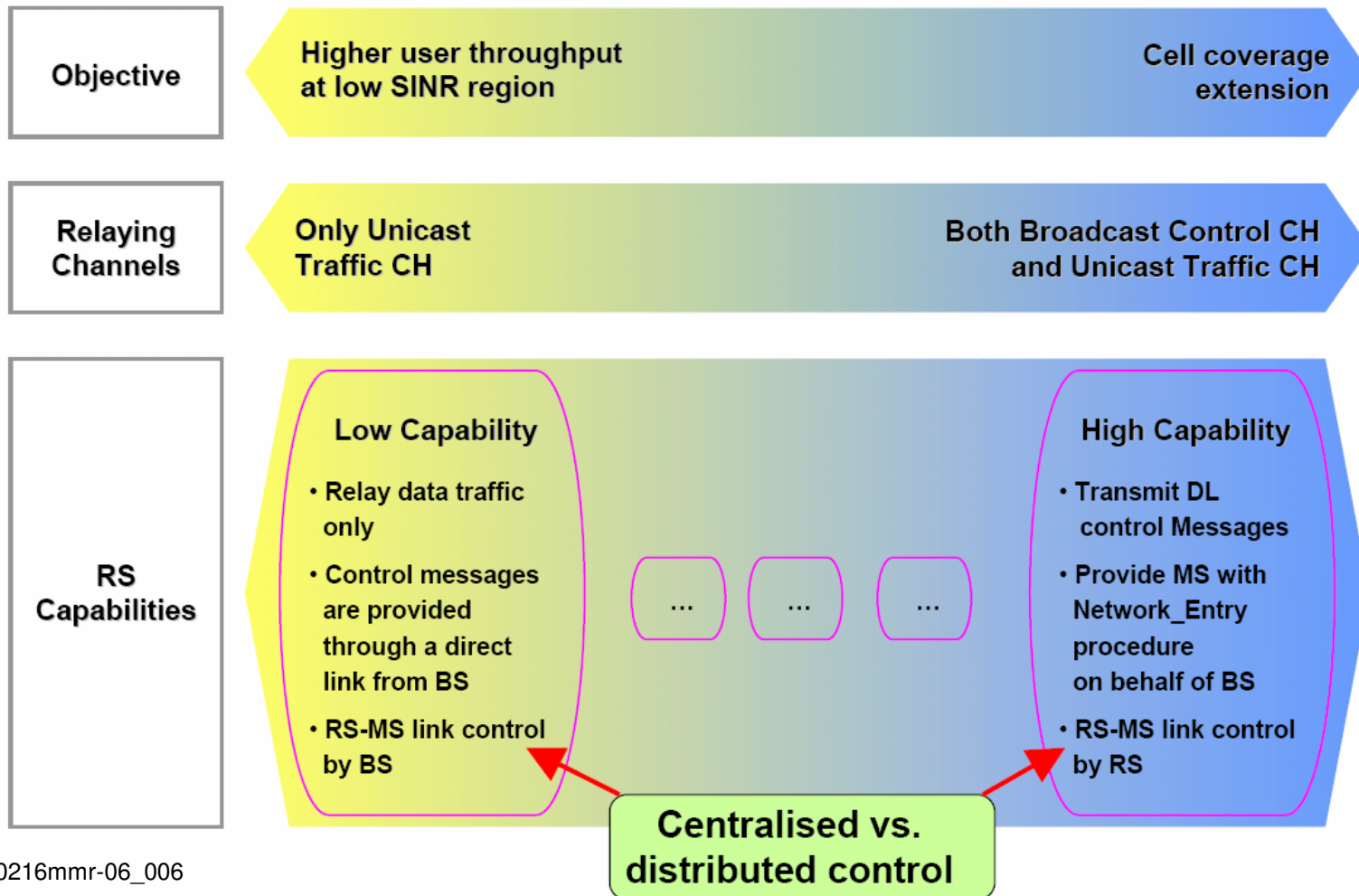   - Non-uniformly distributed traffic load

MMR Overview

- Aiming at Developing Relay mode based on IEEE802.16e,
- To gain:
  - ➤ Coverage Extension, and
  - ➤ Throughput Enhancement,
- by introducing the Relay Stations.

Source : 80216mmr-06_006
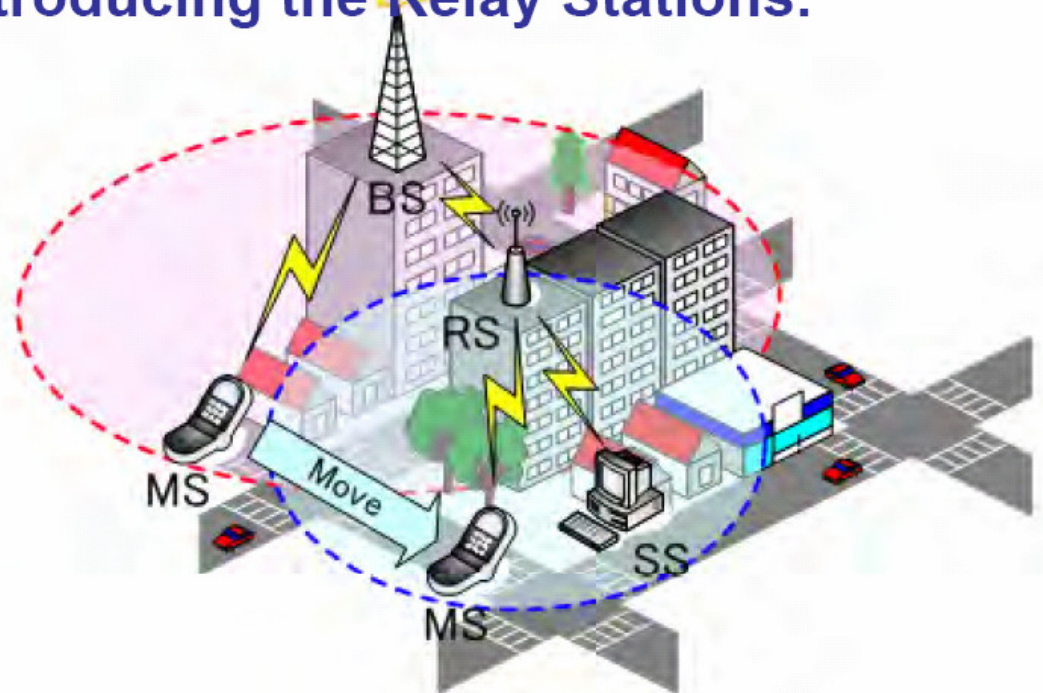
MMR System

- Tree structure for relay (not mesh nor ad hoc)
- PMP mode compatible
- 802.16e MS support
- New entities
  - MMR-BS
    - 802.16 BS with MMR functions supported
  - Relay Station (RS)
    - Fixed RS
    - Nomadic RS
    - Mobile RS
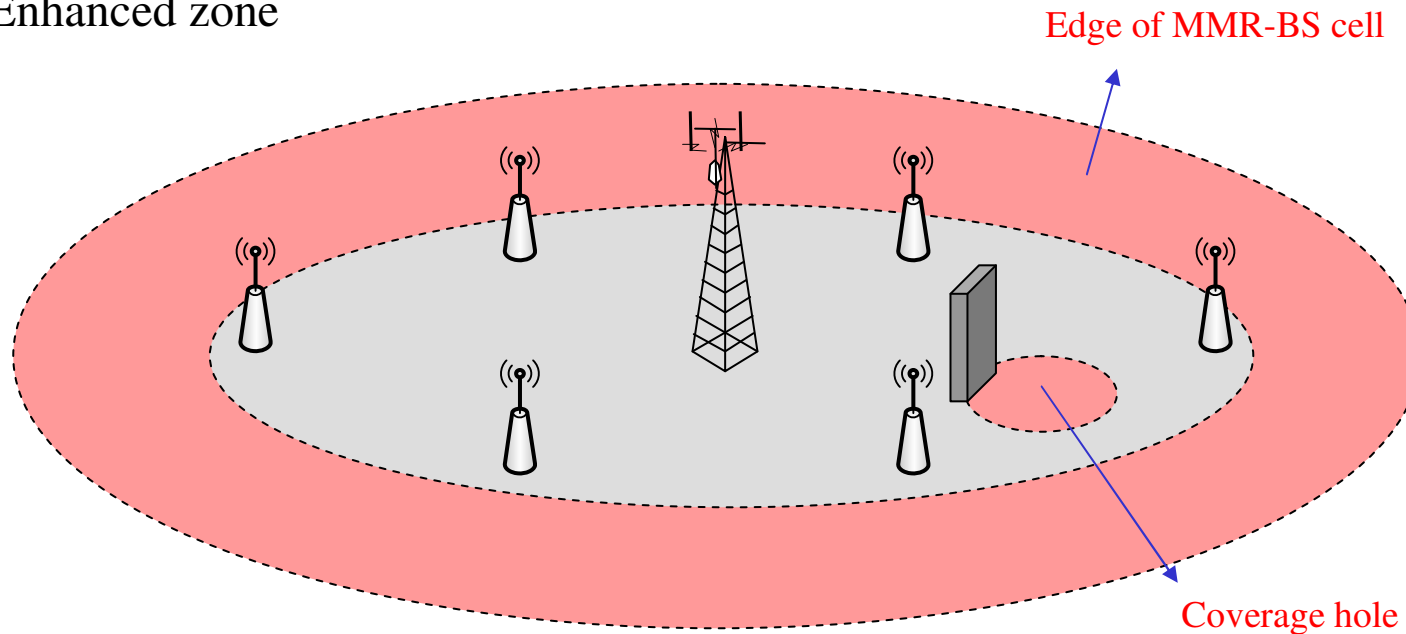
RS Type and Capabilities

| Objective | Higher user throughput at low SINR region → Cell coverage extension |

| Relaying Channels | Only Unicast Traffic CH → Both Broadcast Control CH and Unicast Traffic CH |

RS Capabilities

Low Capability
- Relay data traffic only
- Control messages are provided through a direct link from BS
- RS-MS link control by BS

... ...

High Capability
- Transmit DL control Messages
- Provide MS with Network_Entry procedure on behalf of BS
- RS-MS link control by RS

Centralised vs. distributed control

8

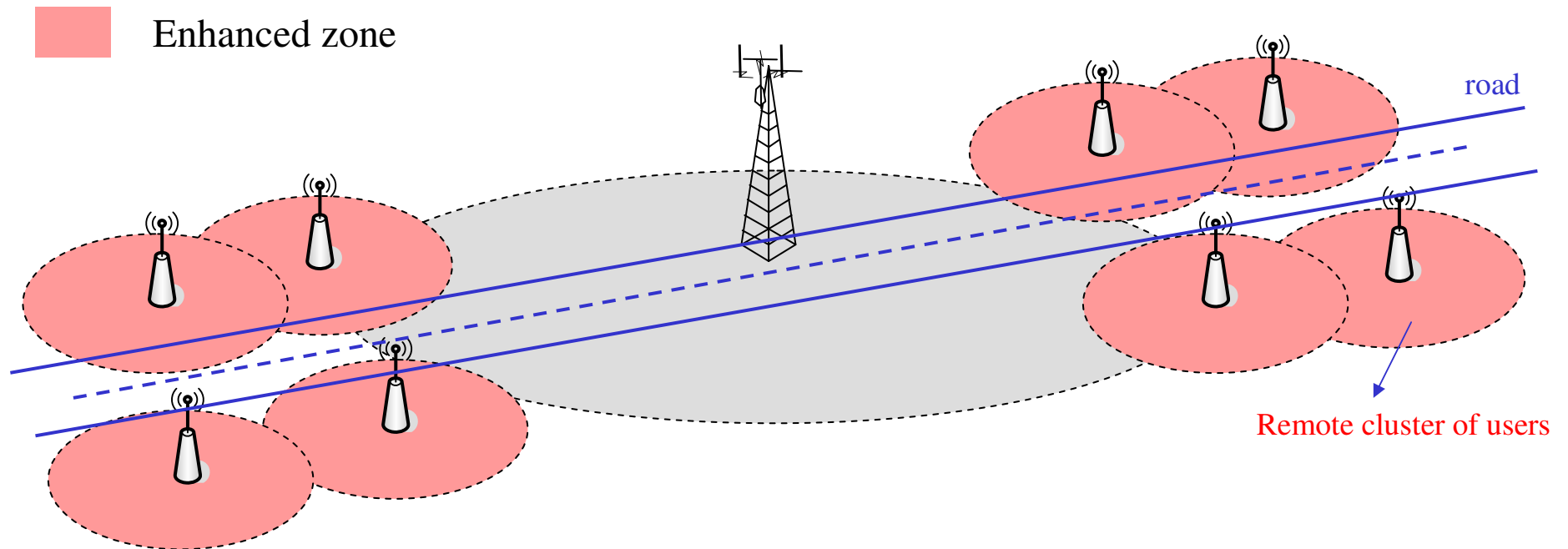# Coverage Enhancement

Enhanced zone

Edge of MMR-BS cell

Coverage hole

- Capacity is not an issue
- MMR-BS to RS link is LOS or Ricean
- RS locations are fixed
- One hop of relay (simple)
- Complex topology is require for fault tolerance

- RS ⇔ SS/MSs : PMP link
- RS ⇔ MMR-BS : MMR link
- Communication between two SS/MSs within a MMR-BS cell is rare
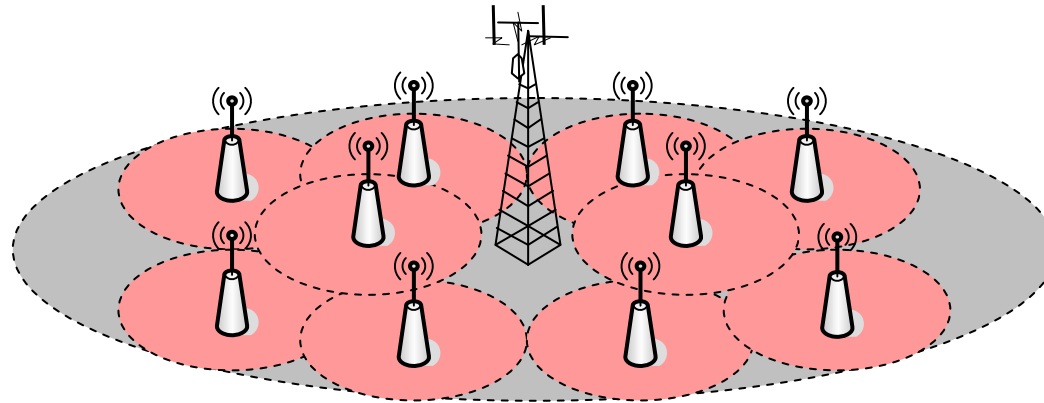- Applications
  - Web., VoIP, Peer-to-peer, Gaming, Multi-media

Range Extension

Enhanced zone

road

Remote cluster of users

- SS/MS are completely outside the coverage area of the MMR-BS
- Multiple RSs connected in a chain to an MMR-BS
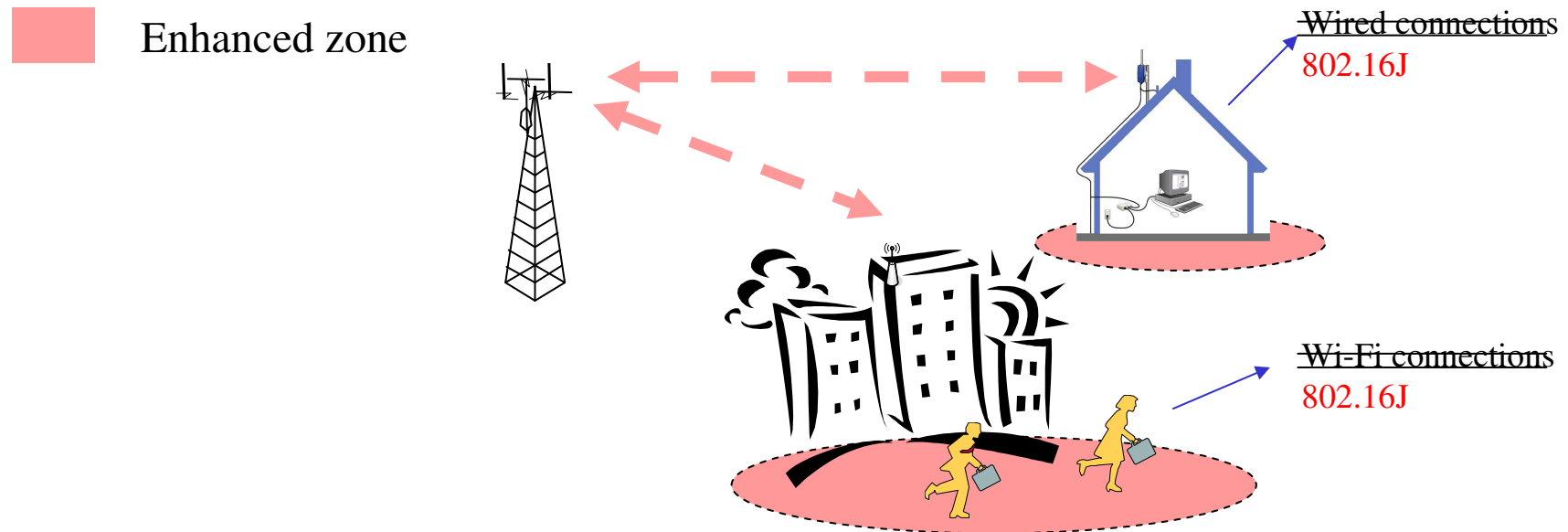- MMR-BS to RS link is LOS

Capacity Enhancement

Enhanced zone

- Multiple frequencies are used
- The entire coverage area is covered with small cells
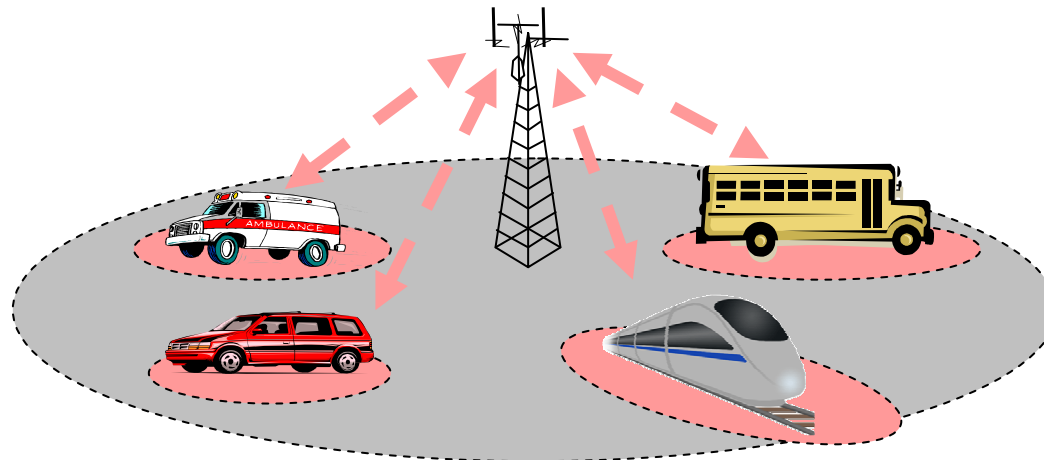- Multiple hops exist between SS/MS and MMR-BS

Fixed / Portable Gateway RS

Enhanced zone

Wired connections
802.16J

Wi-Fi connections
802.16J

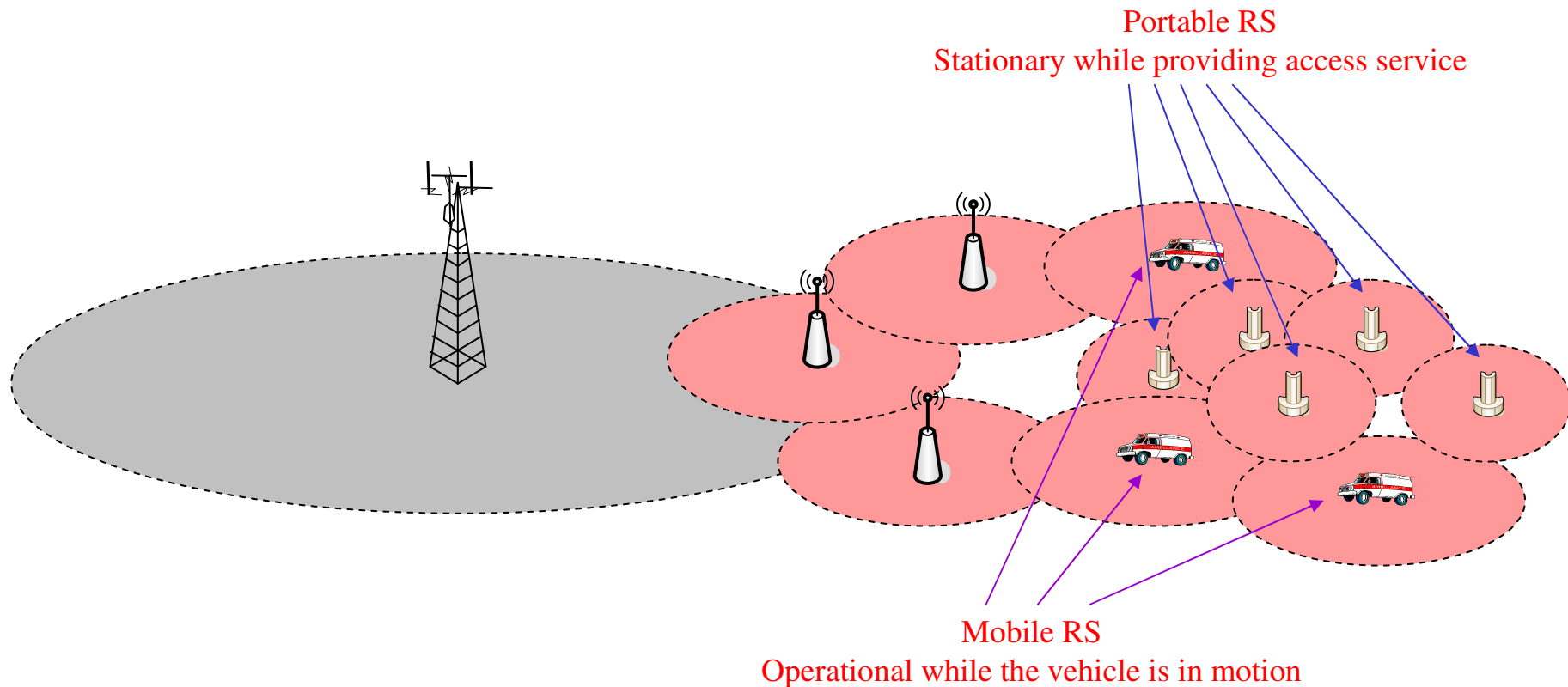- Alternative to deploying a gateway

Mobile Gateway RS

Enhanced zone

- Provides access to the SS/MSs moving with the vehicle

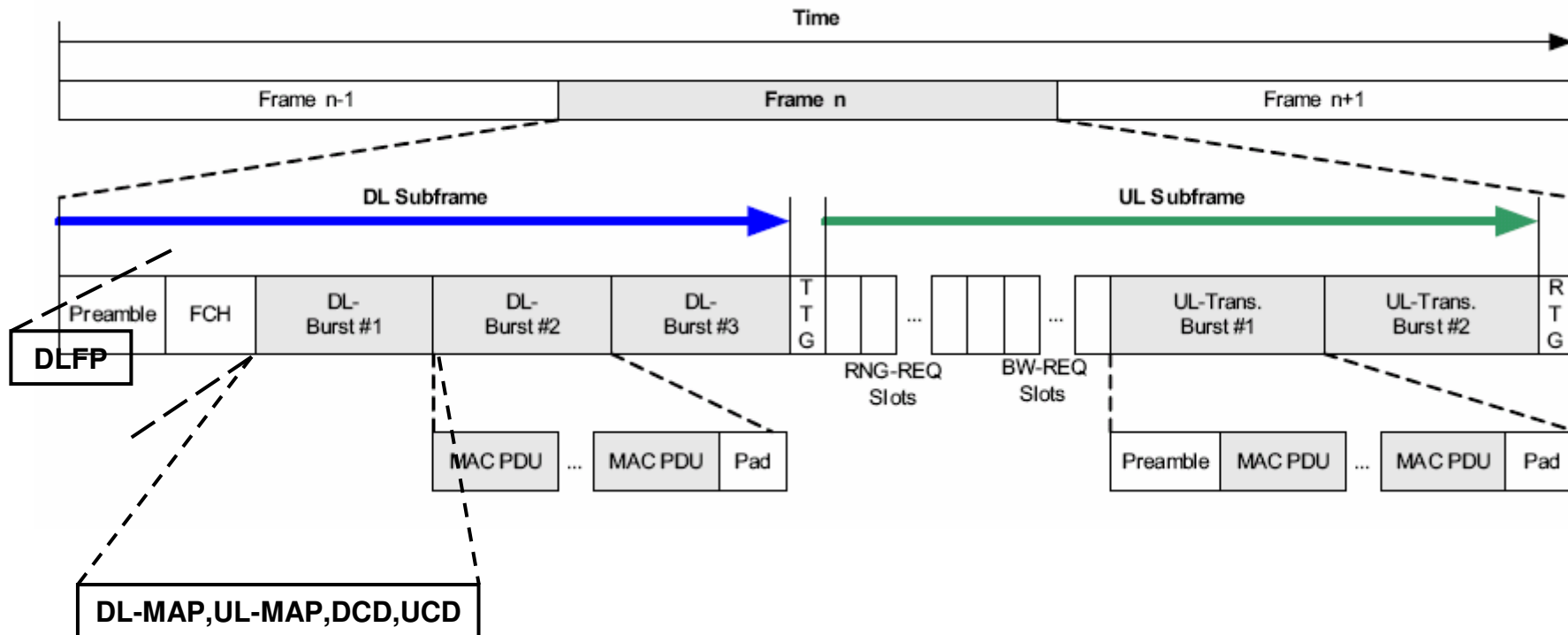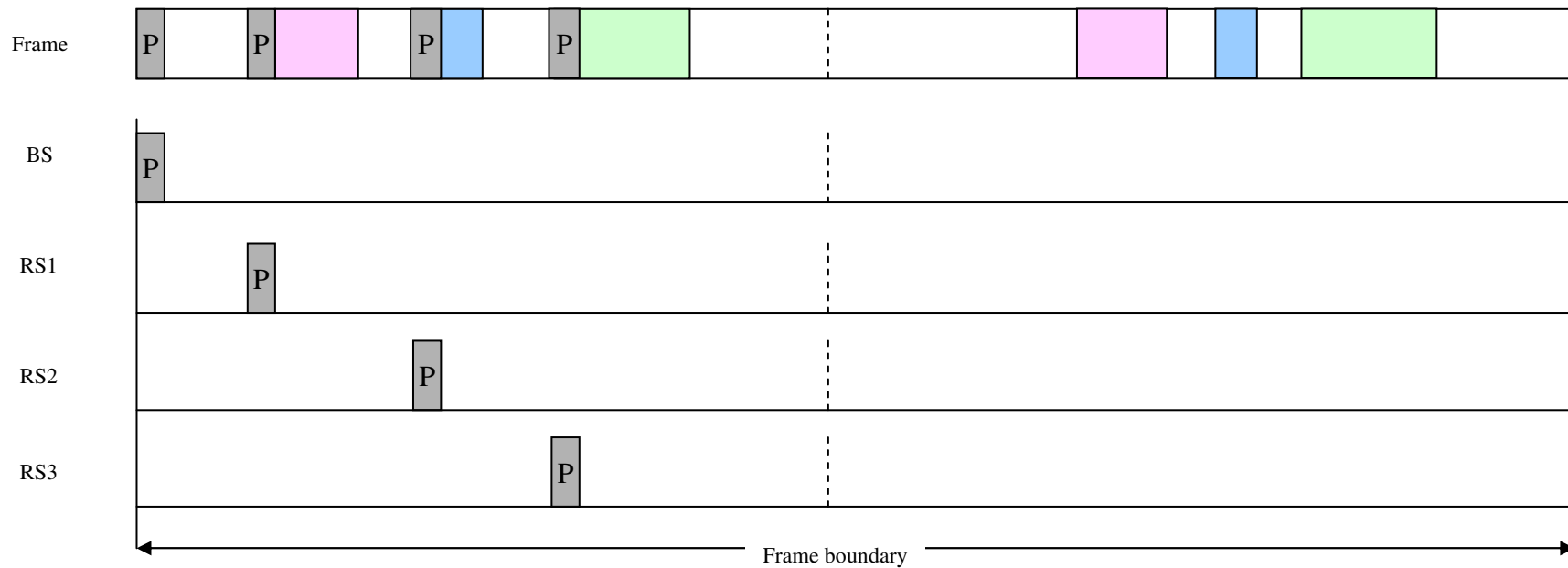# Public Safety / Disaster Recovery Deployment

Portable RS
Stationary while providing access service
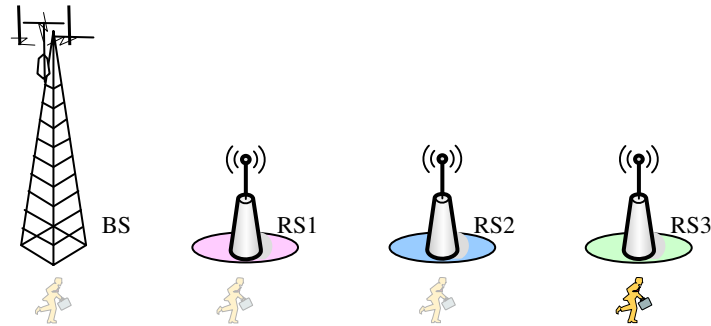
Mobile RS
Operational while the vehicle is in motion

- A network is pieced together from existing operational MMR-BSs and fixed RSs, and portable and mobile RSs

14

802.16 Frame Structure

TTG : Transmission Transition Gap
RTG : Receive Transition Gap
FCH : Frame Control Header
DLFP: Downlink Frame Prefix

Time

| Frame n-1 | Frame n | Frame n+1 |

DL Subframe

UL Subframe

| Preamble | FCH | DL-Burst #1 | DL-Burst #2 | DL-Burst #3 | T T G | | ... | | ... | | UL-Trans. Burst #1 | UL-Trans. Burst #2 | R T G |

DLFP

RNG-REQ Slots

BW-REQ Slots

| MAC PDU | ... | MAC PDU | Pad |

| Preamble | MAC PDU | ... | MAC PDU | Pad |

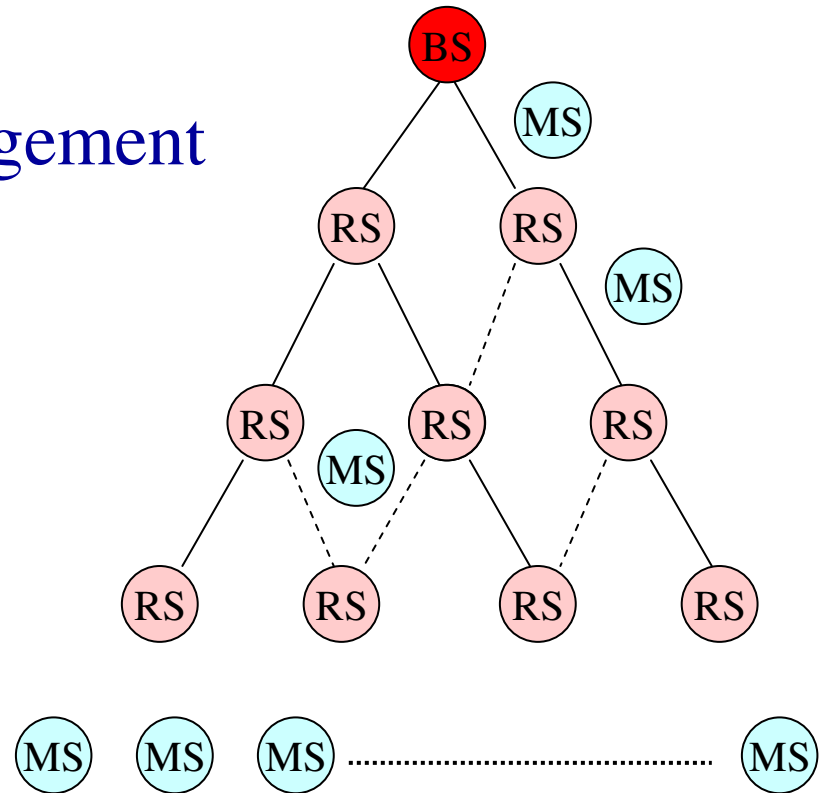DL-MAP,UL-MAP,DCD,UCD
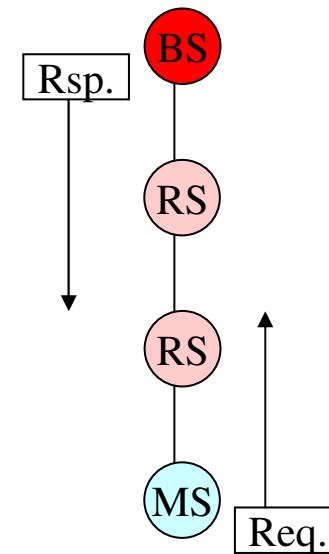
15

MMR Frame Structure

Challenges - 1

- **System configuration/management**
  - Network topology
  - Neighbor detection
  - Relay path management
    - Path selection algorithm
    - Path recovery
  - Congestion control
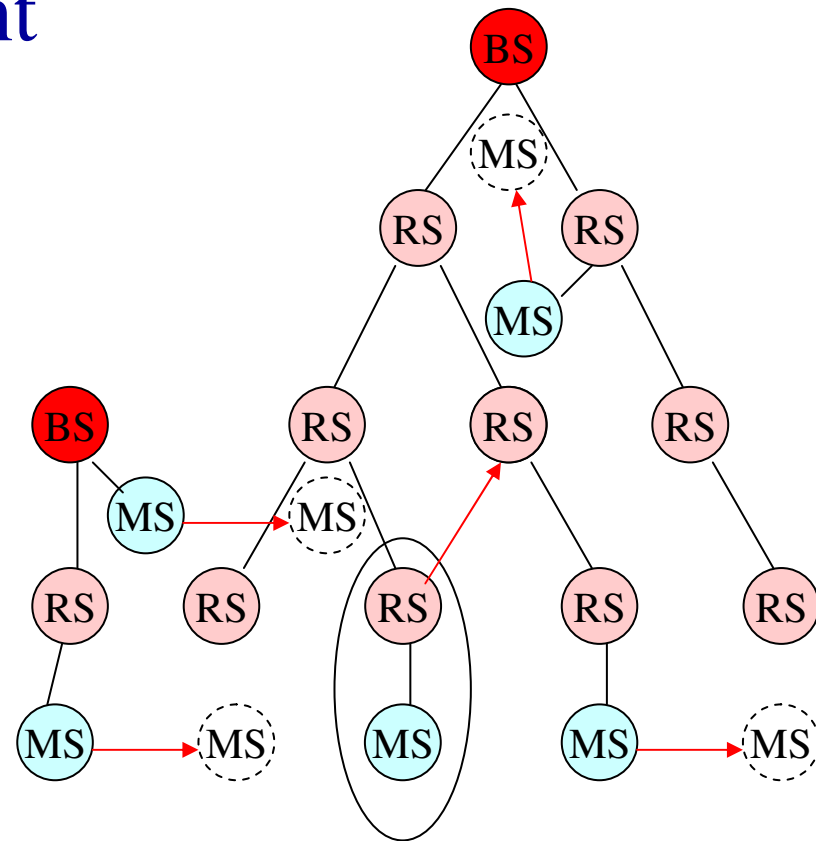 - Connection management
  - QoS provision

Challenge - 2

- ## Network Entry
  - Synchronization, ranging, authorization, and etc.

- ## Bandwidth management
  - Bandwidth request
  - Bandwidth allocation

- ## Scheduling
  - Centralized scheduling
  - Distributed scheduling

Rsp.

BS

RS

RS

MS

Req.

Challenge - 3

- Data Delivery
  - MAC PDU processing
  - Unicast/multicast/broadcast data
  - (H)ARQ processes
  - Cooperative relay

Challenge - 4

- ## Mobility Management
  - – MS handover
  - – MRS handover
  - – Handover decision

Summary

- 802.16j is under cooking for
  - Coverage extension
  - Throughput enhancement
- There are lots issues for MMR system
  - System configuration and management
  - Network entry
  - Bandwidth management
  - Scheduling
  - Data delivery
  - Mobility management