Configuration Scenario for Multi-Hop Relay Network

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE C802.16mmr-06/013

Date Submitted:

2006-01-09

Source:

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Venue:

IEEE 802.16 Session #41, New Delhi, India

Base Document:

None

Purpose:

Information

Configuration Scenario for Multi-Hop Relay Network

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January, 2006

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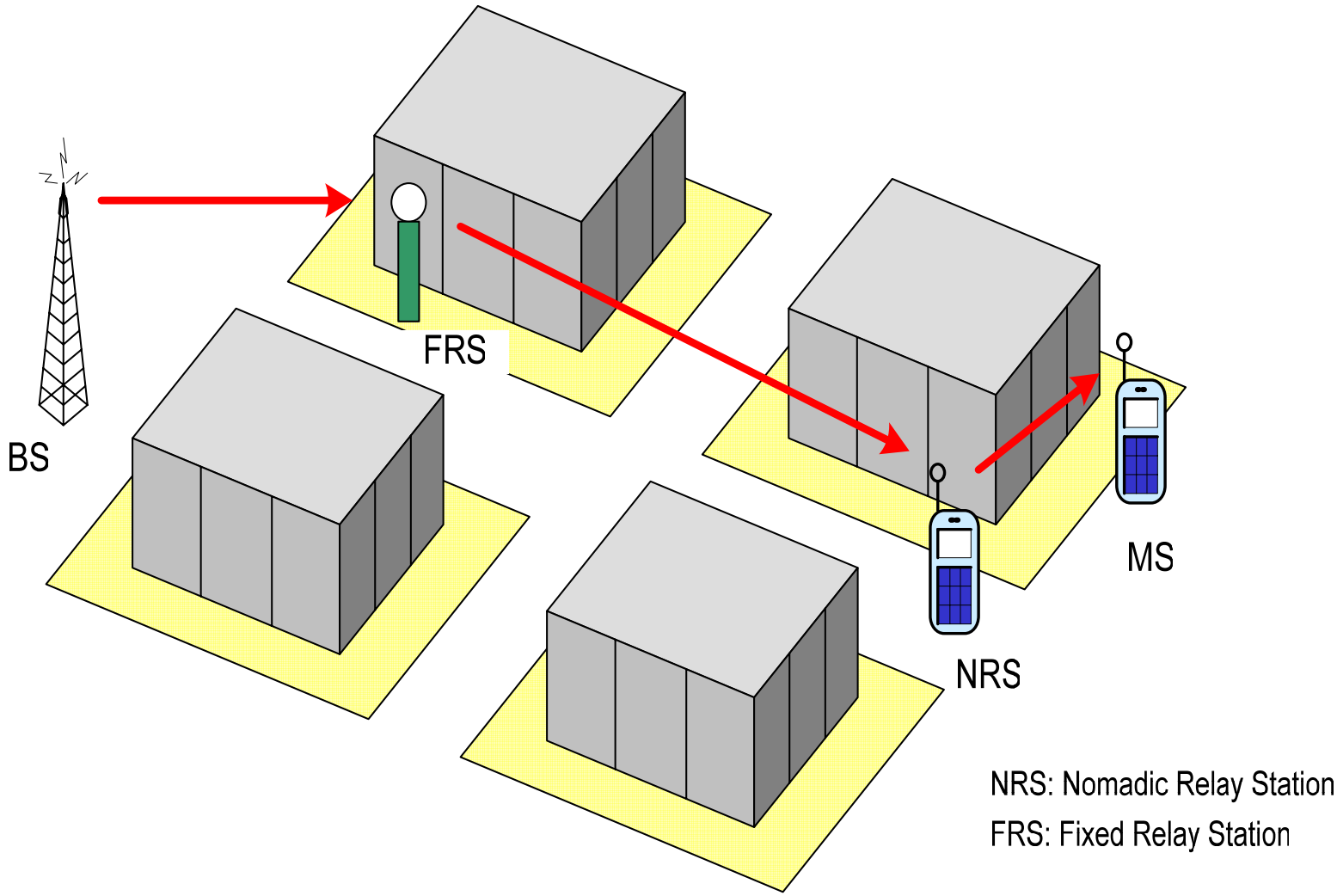
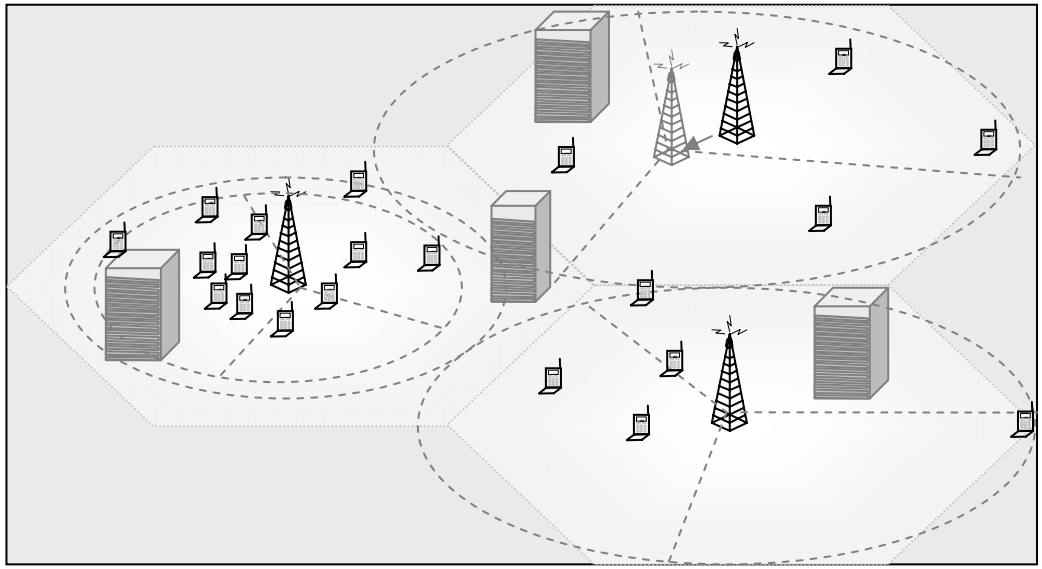
Multi-hop Relay Architecture

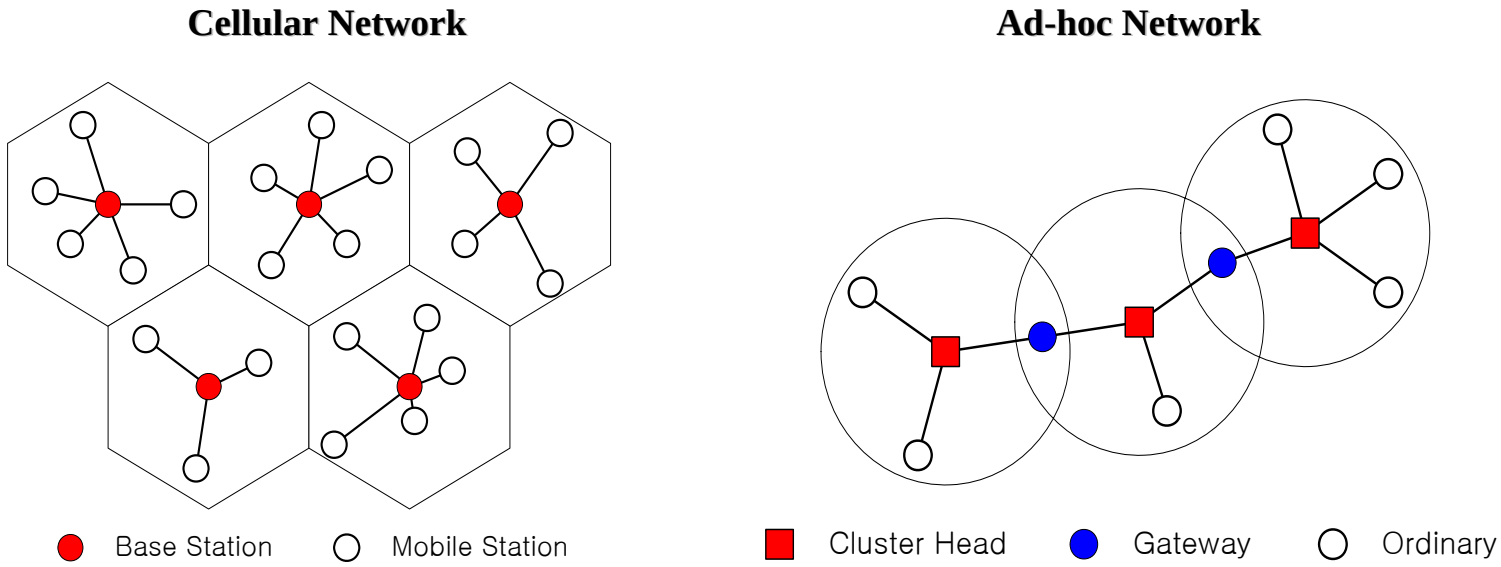


Conventional RAN



- Limitation: Fixed BS location and cell coverage (less flexible)
- In the next generation RAN,
  - Various traffic demand, ever-changing user distribution
  - Large number of small cells
- Not easy to construct such RAN in the conventional (centralized) manner

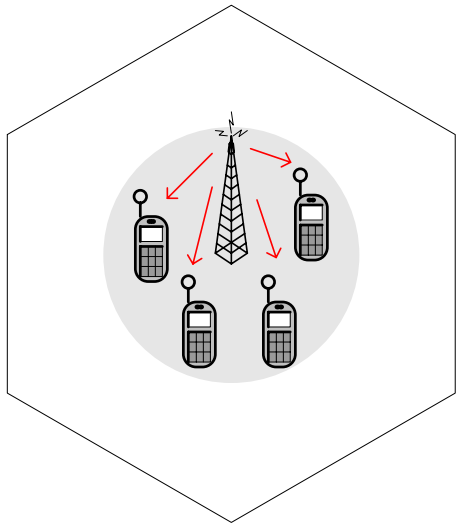
Ad-hoc Network



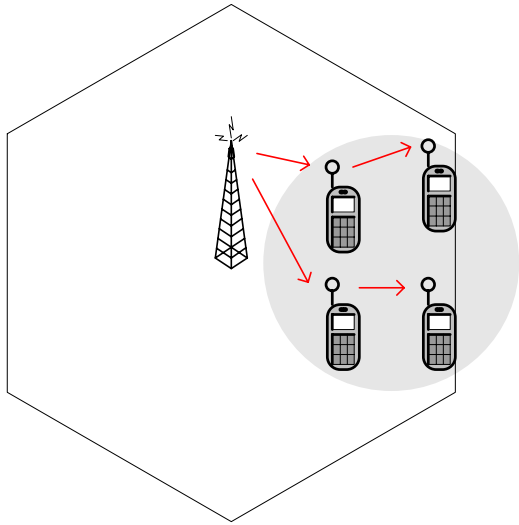
- Rapidly deployed without relying on pre-existing fixed network infrastructure
- Application
  - Military Communication, Wireless LAN, Wireless PAN, Wireless Sensor Network
- Features
  - **Self-organizing, Dynamic topology**

Multi-hop Cellular Networks

- Hybrid network of Cellular and Ad-hoc
  - Fixed BS (stability) + Multi-hop Relay (flexibility)
- Hybrid transmission mode
  - Provides flexibility in design and operation of the cellular network



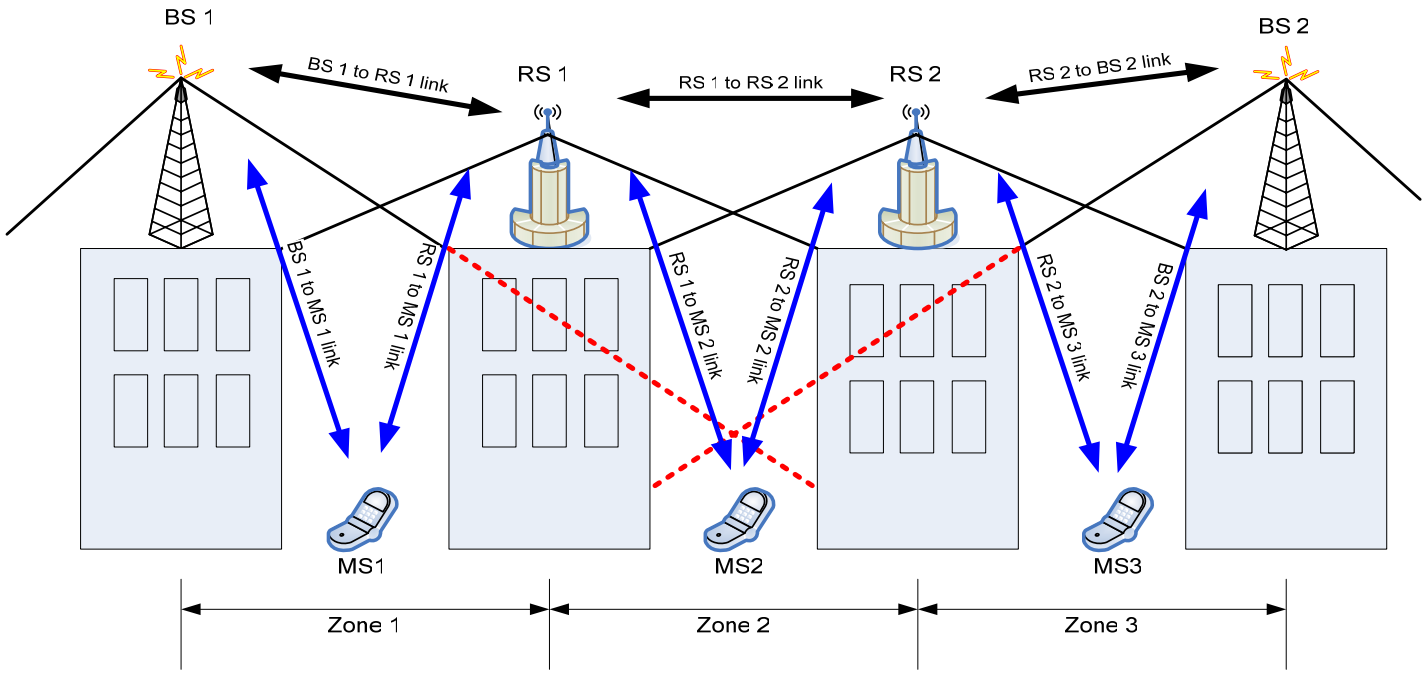
Single-hop mode



Multi-hop mode

One Example of MMR Configuration

2 BS and 1 RS configuration



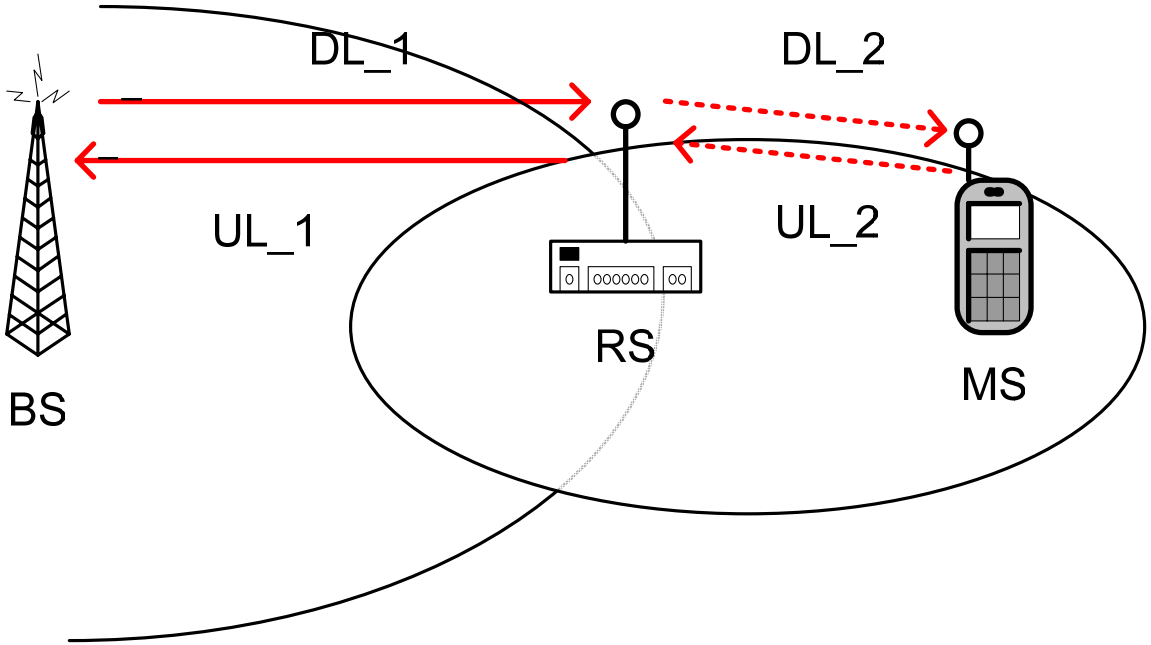
Advantages:

- **Cost Effective Cell Planning**
- **Reduction of Signaling Overhead**
- **Timely delivery of Signals**

Multi-Hop Relay
Channel Configuration

Multi-Hop Relay Channel Configuration

- Configuration 1 of the multi-hop relay network



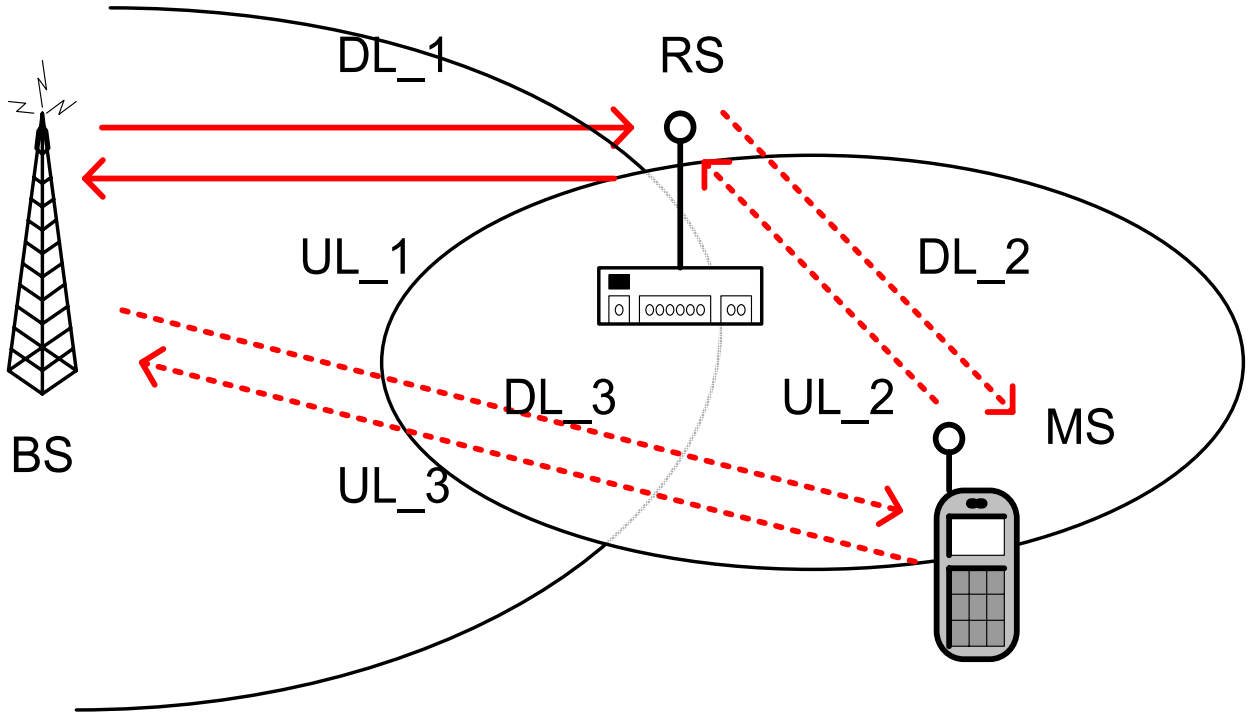
Multi-Hop Relay Channel Configuration

- Channel configuration for configuration 1

Path	Direction	Channel Allocation	BW Allocation	Available Channel	Scheduling fashion
DL_1	BS to RS	Dedicated Sub-carriers	Fixed BW	Control/Traffic channel	BS allocates particular BW to RS (No MS aware BW allocation)
		Dynamic Sub-carriers	Dynamic BW w/wo limitation		
DL_2	RS to MS	Dynamic		Control/Traffic channel	RS allocates BW to MS through the BW allocated from the BS
UL_1	RS to BS	Dedicated Sub-carrier	Fixed BW	Control/Traffic channel	With/without Contention
		Dynamic	Dynamic BW		

Multi-Hop Relay Channel Configuration

- Configuration 2 of the multi-hop relay network



Multi-Hop Relay Channel Configuration

- Channel configuration for configuration 2

Path	Direction	Channel allocation	BW allocation	Available channel	Scheduling fashion
DL_1	BS to RS	Dedicated Sub-carrier	Fixed BW	Control/Traffic channel	BS allocates particular BW to RS
		Dynamic Sub-carrier	Dynamic BW w/wo limitation		
DL_2	RS to MS	Dynamic		Traffic channel	RS allocates BW for Traffic only to MS through the BW allocated from the BS
DL_3	BS to MS	Dynamic		Control channel (Net. Entry)	BS allocates BW for Signaling only to MS
UL_1	RS to BS	Dedicated Sub-carrier	Fixed BW	Control/Traffic channel	With/without Contention
		Dynamic	Dynamic BW		
UL_2	MS to RS	Dynamic		Traffic channel	With/without contention
UL_3	MS to BS	Dynamic		Control channel (Net. Entry)	With/without contention

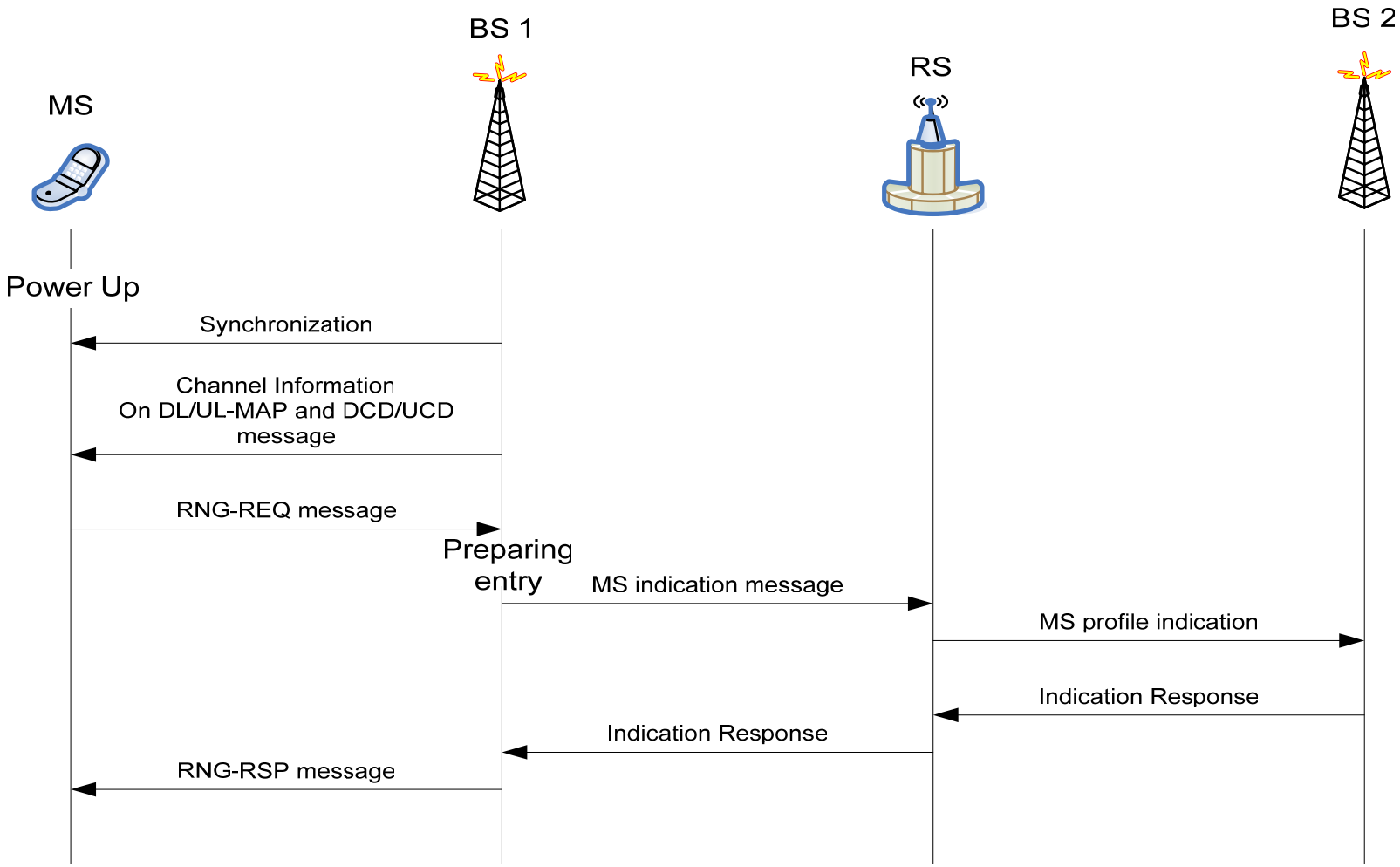
Multi-Hop Relay
Configuration Set-up Scenario

MMR Configuration Set-up Scenario

- Multi-hop cellular networks provides an alternative path to the single hop direct link. It also obtains a path gain in the condition of free space propagation and as a result of which there is an added capacity and coverage to the network.
- The RS can also have multiple connections to the BS and at the same time, communicate with the MS in the cell boundary of 2 BS.
- Hence, a framework of communication link is needed between the multiple base stations, mobile station and relay station, for effective operation of the multi-hop relay network.
- The present contribution describes the framework for the communication between the different entities in the multi-hop relay network.

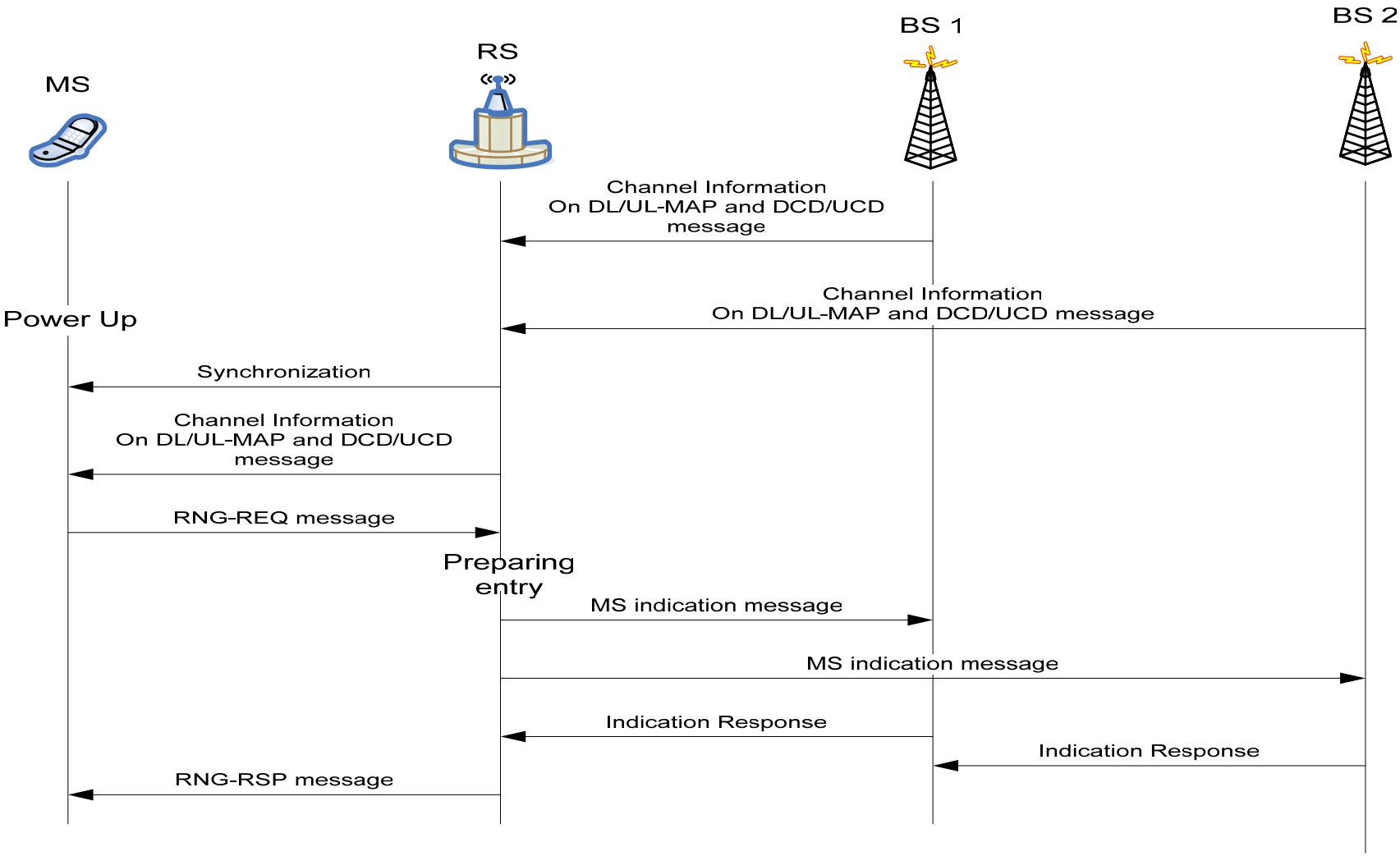
MMR Configuration Set-up Scenario

- Call Flow for MS initiated Case in BS



MMR Configuration Set-up Scenario

- Call Flow for MS initiated case in RS



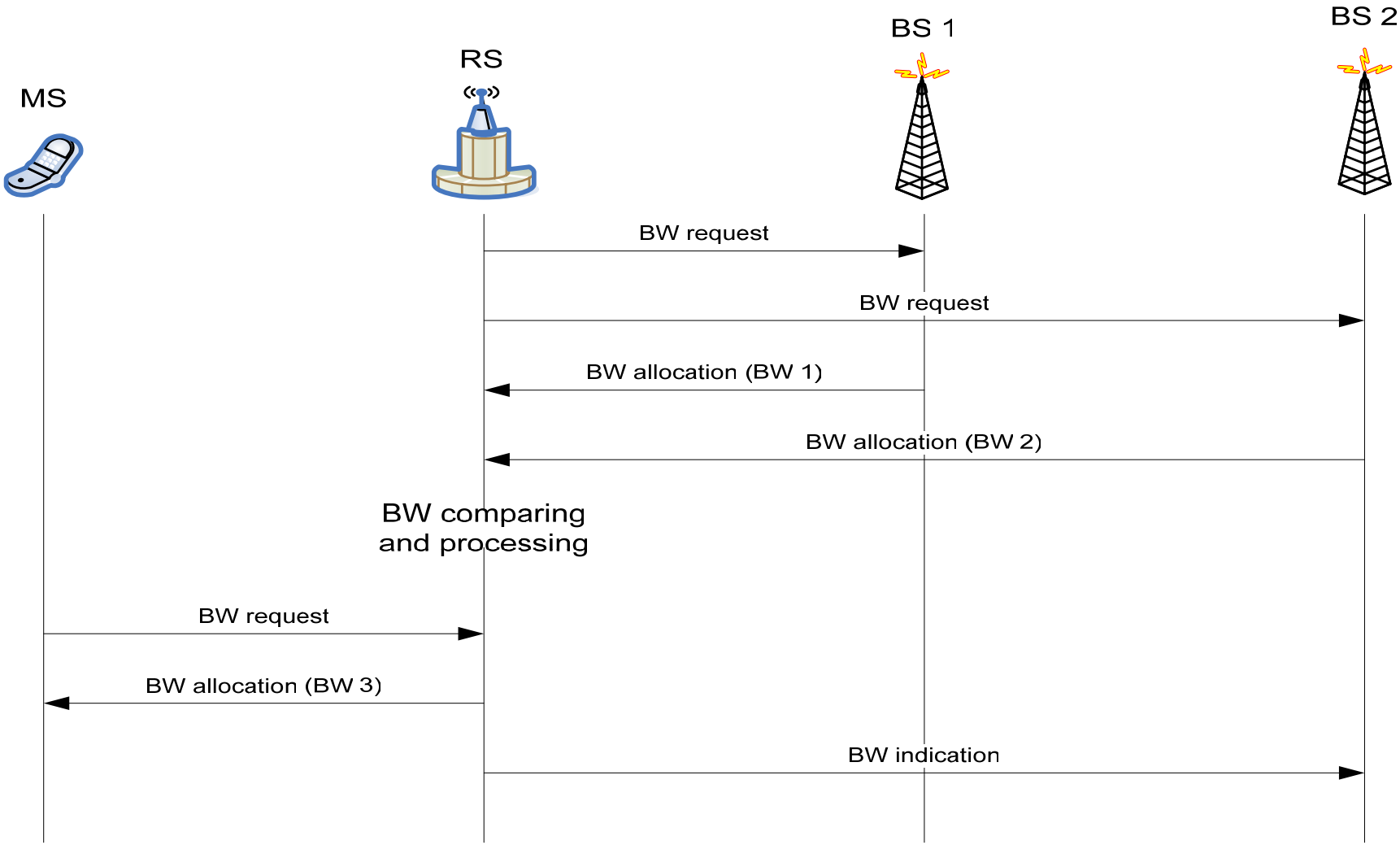
Multi-Hop Relay
Bandwidth Allocation Mechanism

Multi-Hop Relay Bandwidth Allocation Mechanism

- Bandwidth Allocation in the MMR architecture is tricky and critical.
- Bandwidth should be allocated in the cell configuration in which the RS is connected to the multiple base stations.
- MS connected to the RS having different paths may have different capacity because of the link going thru' the different multipath effect.
- If the RS allocates the higher bandwidth to the MS, but not supported by the BS, then the effective bandwidth is reduced, as the link between the RS and the BS would serve as a bottleneck.
- The contribution suggests the effective mechanism to quickly vary the total available bandwidth and resulting in effective bandwidth allocation.

Multi-Hop Relay Bandwidth Allocation Mechanism

- Bandwidth Allocation Mechanism



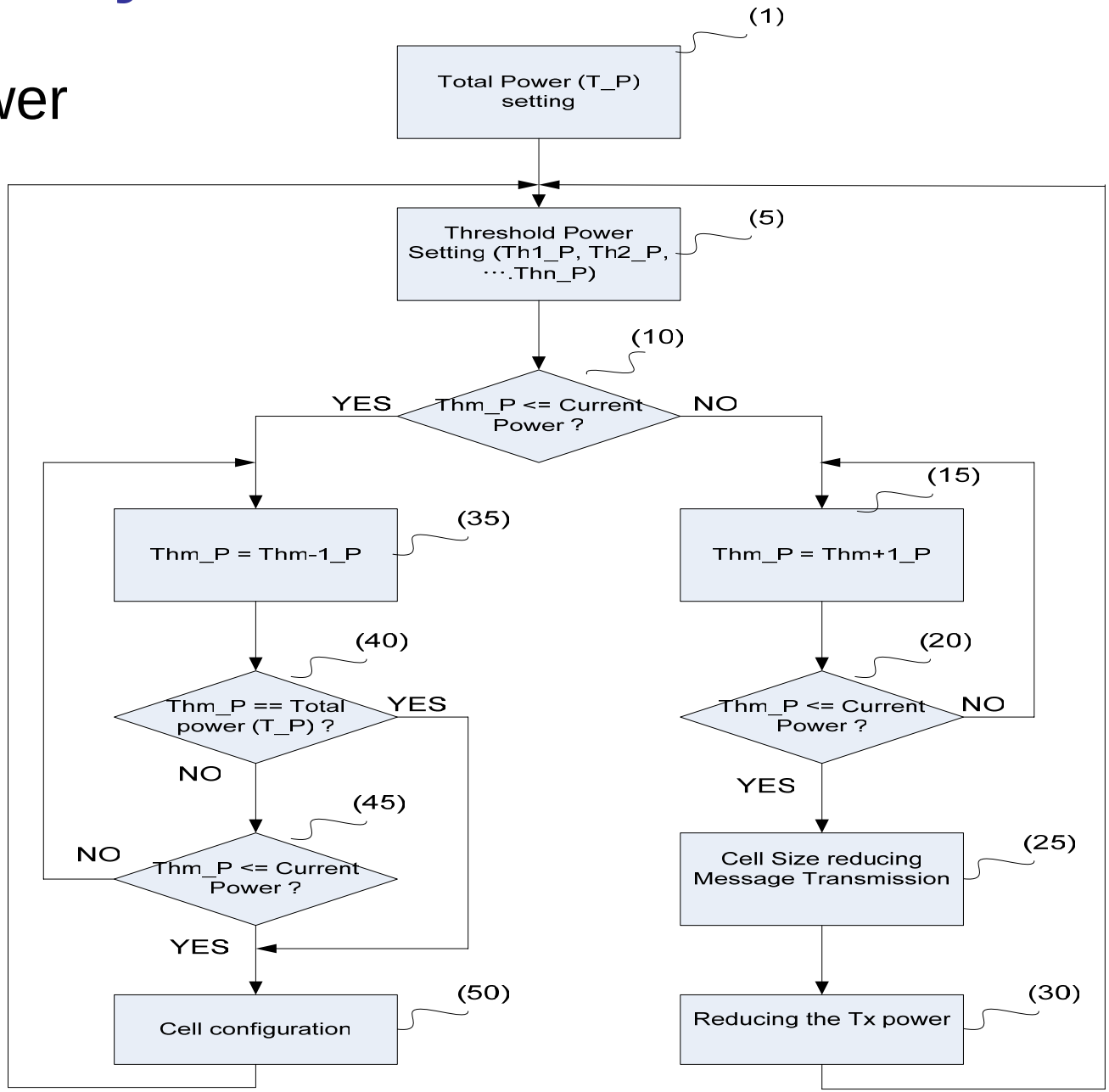
Multi-Hop Relay Power Control and Load Control Mechanism

Multi-Hop Relay Power Control Mechanism

- The base station coverage is limited by a combination of the range from the Base station, terrain blockage and building penetration loss.
- The communication between the Base station and the mobile station can be extended by the RS, which may be fixed or mobile.
- However the coverage extension or user data rates of the cell using the above means is limited by the available power at the RS.
- In this proposal, the effective technique for providing the coverage extension is provided with minimal usage of power.

Multi-Hop Relay Power Control Mechanism

- Available Power lower at the RS



Multi-Hop Relay Load Control Mechanism

- The base station coverage is limited by a combination of the range from the Base station, terrain blockage and building penetration loss.
- The communication between the Base station and the mobile station can be extended by the RS, which may be fixed or mobile.
- However the coverage extension or user data rates of the cell using the above means is limited by the loading of the RS.
- In this proposal, the effective technique for providing the coverage extension is provided taking into consideration the load at the RS.

Multi-Hop Relay Load Control Mechanism

- Available Load reaches the threshold at RS