A Usage Scenario and frame structure for out-of-band relay

Source:

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Purpose:

. Propose a usage scenario and frame structure for IEEE802.16j

A usage scenario and frame structure for out-of-band relay

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Outline

- Network capacity expansion scenarios
- Proposed frame structure for multi-FA operation
- Simulation results
- Text contribution
- Summary

Network Capacity Expansion Scenario (1)

• Typical relay frame structure for a single FA scenario with time division manner
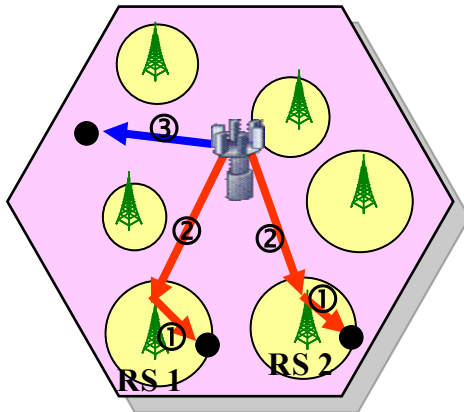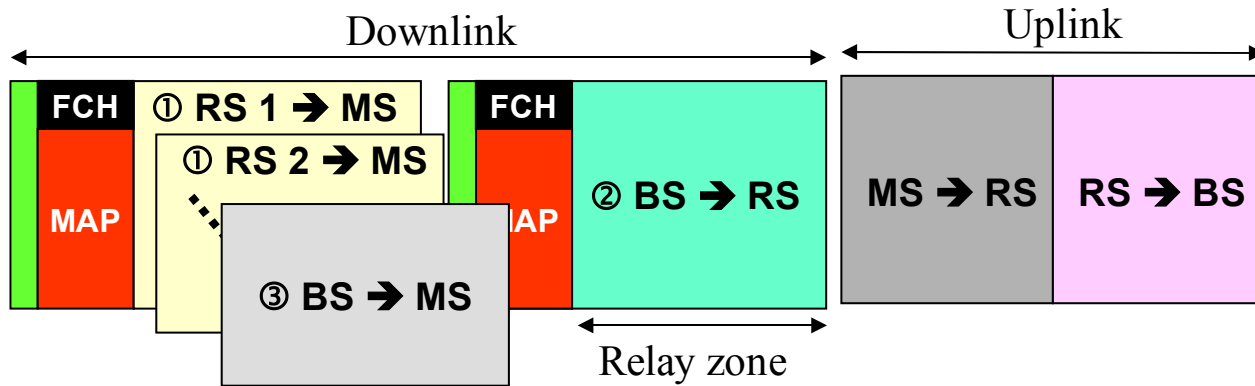
✓ RS-MS link ① interferes with BS-MS link ③
  ➔ *Inter-hop interference problem*

✓ What if we use two FA's for capacity expansion?

Network Capacity Expansion Scenario (2)

• Usage scenario for indoor coverage extension
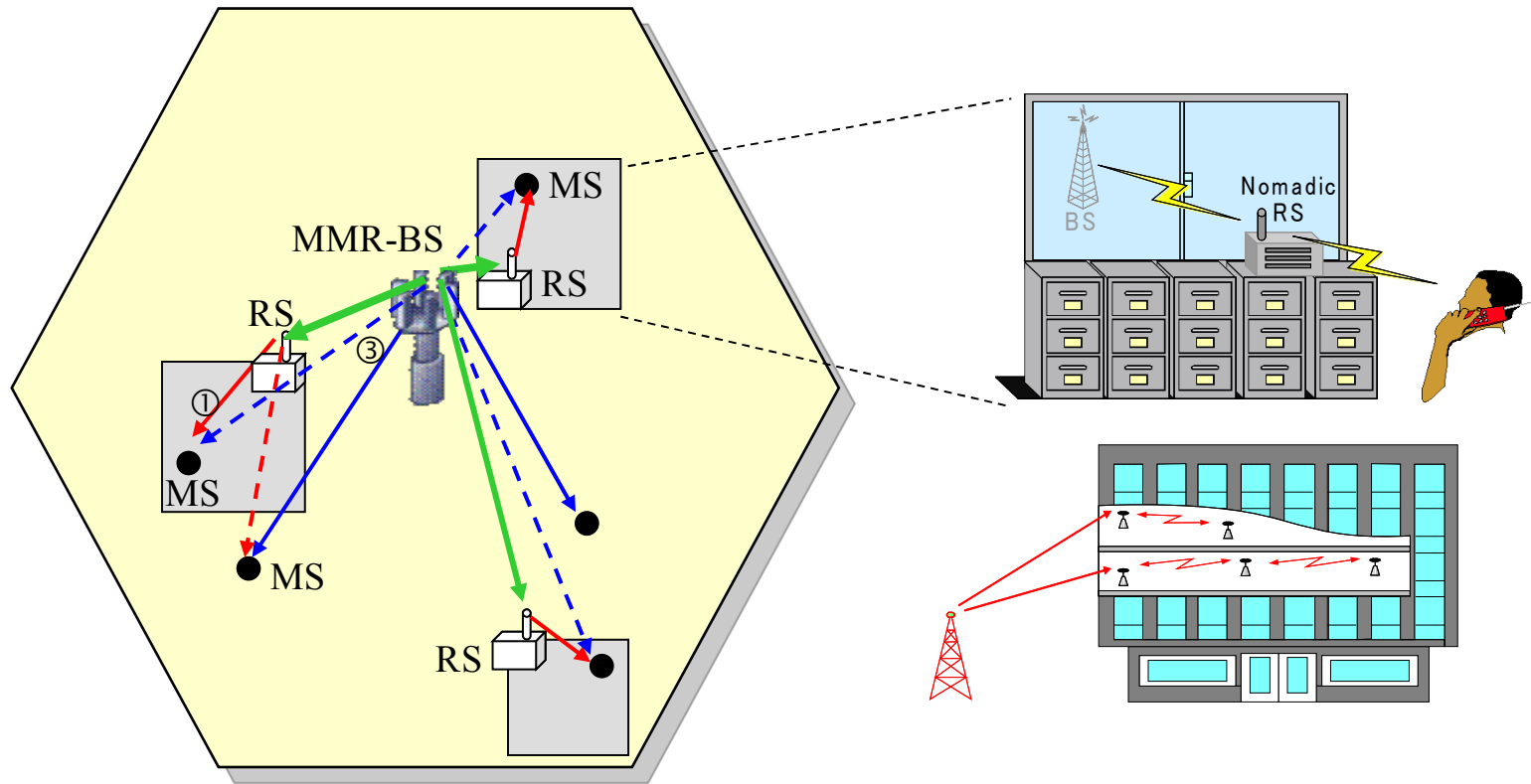
✓ Severe inter-hop interference problem expected in the indoor coverage extension scenario, especially for the buildings very close to MMR-BS

Network Capacity Expansion Scenario (3)

- Additional FA is deployed for capacity expansion as the traffic demand increases
  - ✓ Two Tx/Rx's required for each RS, one for FA 1 and the other for FA 2, incurring additional implementation cost

- Typical frame structure for a multiple FA scenario for capacity expansion
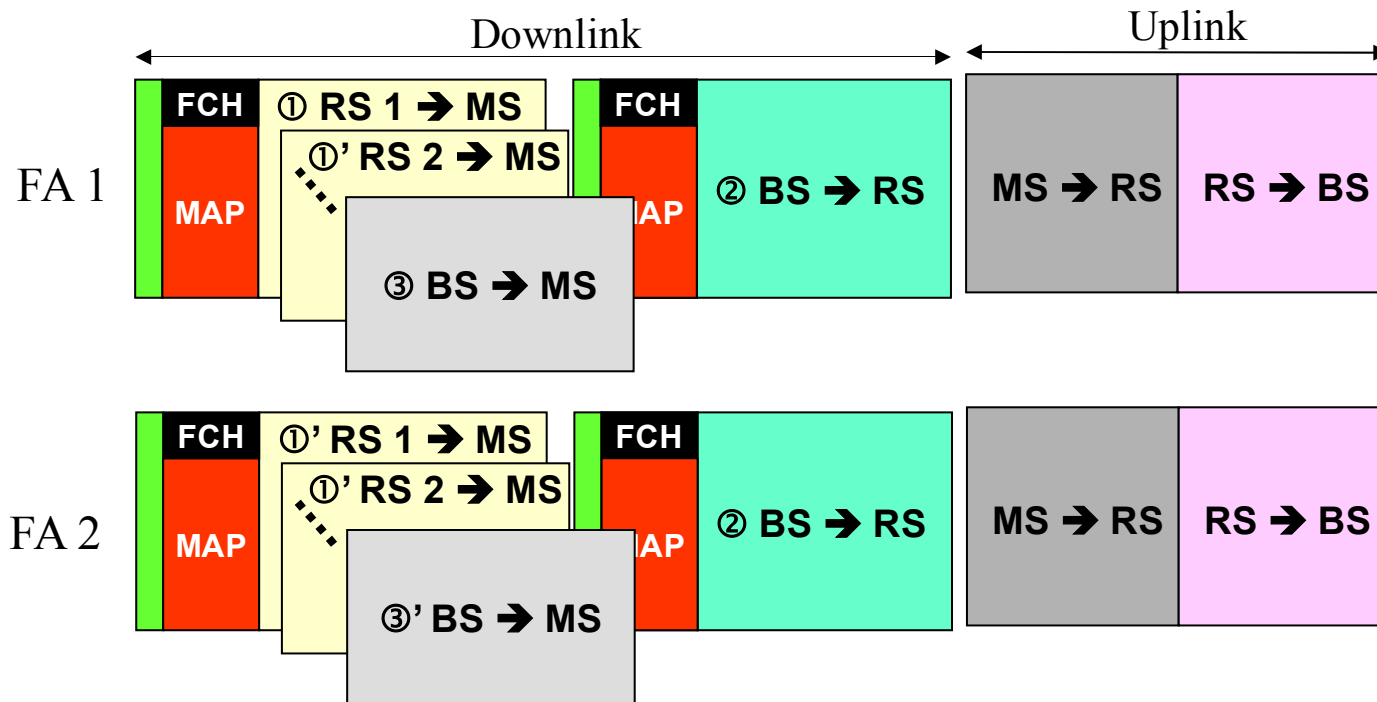
✓ The inherent inter-hop interference problem still exists in the multi-FA operation

Proposed Frame Structure for Multi-FA Operation (1)
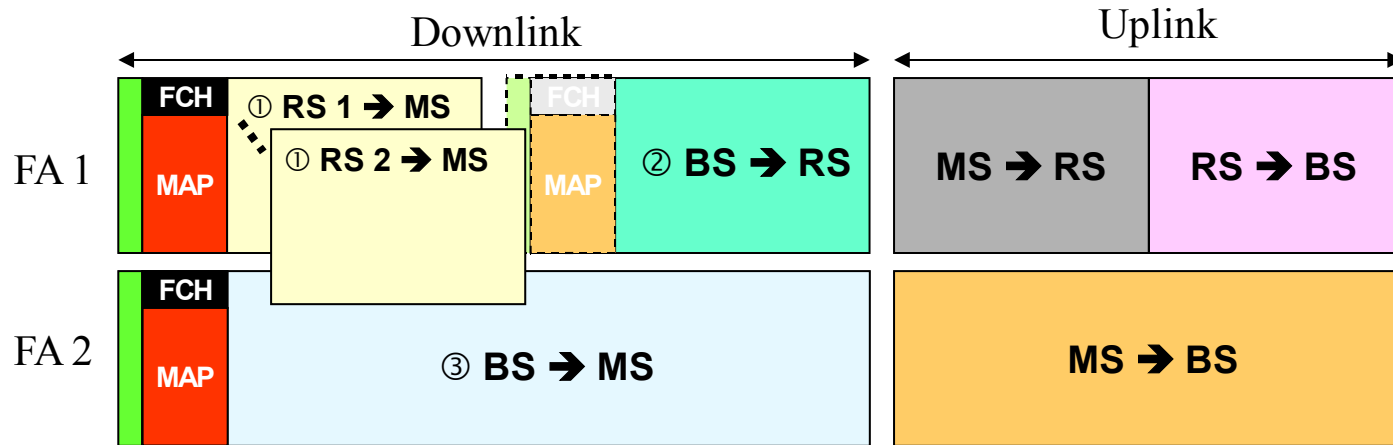
- Synchronous-broadcast MAP information
  - ✓ 1st FA: BS broadcasts MAP information to MS (in BS coverage)
  - ✓ 2nd FA: RS broadcasts it's own MAP information to MS (in RS coverage) at same time as MMR-BS
- Data burst transmission
  - ✓ 1st FA: MMR-BS schedules the relay link traffic and relay (MS Access) traffic (BS & RS share the same frame resource)
  - ✓ 2nd FA: MMR-BS schedules the relay link traffic and Relay (MS Access) traffic.

Proposed Frame Structure for Multi-FA Operation (2)

- Advantages
    - ✓ A solution to resolve BH capacity enhancement.
        - The interference might be lower than conventional usage model (frequency sharing with BS & RS)
        - BH & Relay resource control may be flexible(BS is only needed to schedule MMR link & RS Access traffic.)
    - ✓ Support a smooth migration plan
        - MMR-BS support legacy WiMAX and MMR technology at the same time.
        - FA expansion can be a way to migrate MMR system.

- Disadvantages
    - ✓ MMR-BS should support multiple FA (more costly than a simple relay)
    - ✓ Inflexibility in load balancing (e.g., what if MMR Link(RS→MS) traffic is overloaded while BS Access (BS→MS) traffic is under-loaded ?)

Simulation Scenario (1)

- Objective
  - ✓ To compare the average throughput and outage performance for two different frame structures under 2-FA operation

- Simulation Scenario
  - ✓ Indoor coverage model
 - ✓ 19 cells (wrap-around)

30m

30m

In-building coverage

MS

No mobility

120°

Mobile Speed = 3km/h

Sector Antenna:

$$A(q) = -\min\left[12\left(\frac{q}{q_{3dB}}\right)^2, A_m\right] \quad A_m = 20\ dB$$

$$q_{3dB} = 70°$$

$$-180 \le q \le 180$$
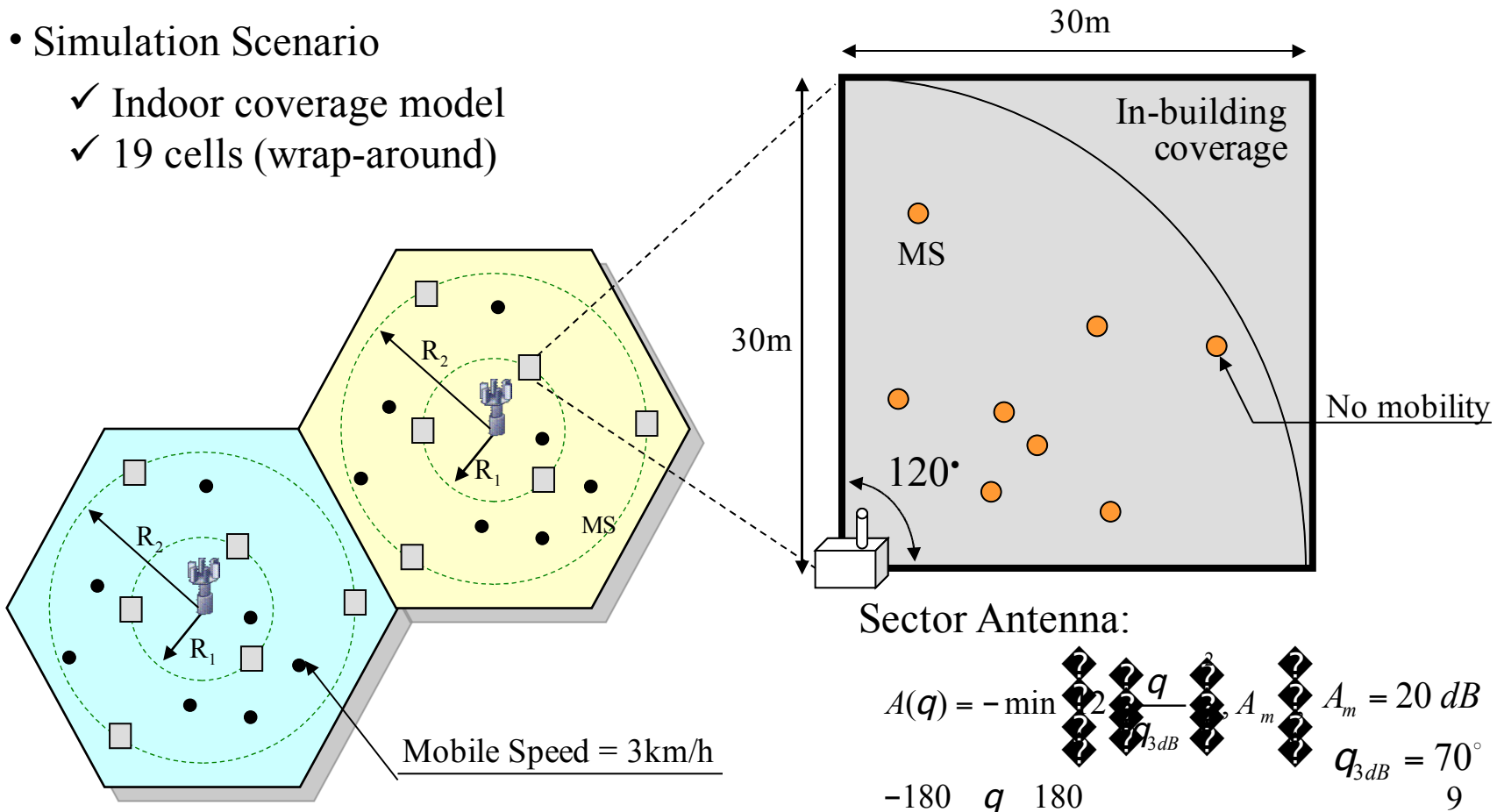
Simulation Scenario (2)

- Simulation Parameters

| Model		Parameters
Cell Layout		• 19 cells – wrap around
RS Configuration		• 6 FRS per cell • 3 RS's located on a circle with radius of R_1 • 3 RS's located on a circle with radius of R_2
Transmit Power		• BS Power: 20W • RS Power: 1W
Channel Model	**BS-RS Link**	• LOS for 64-QAM with R = 5/6
	BS-MS Link (outdoor MS)	• Path-loss: NLOS • Shadow fading: 9.6dB
	BS-MS Link (indoor MS)	• Path-loss: NLOS • Shadow fading: 9.6dB • Additional loss of 10~20dB for building wall
	RS-MS Link (indoor MS)	• Path-loss: NLOS • Shadow fading: 12dB
Mobile speed		• Outdoor MS: 3km/h • Indoor MS: 0km/h
Packet Scheduling		Round robin
Traffic model		Full buffer

Simulation Result (1)

- Overall System Performance
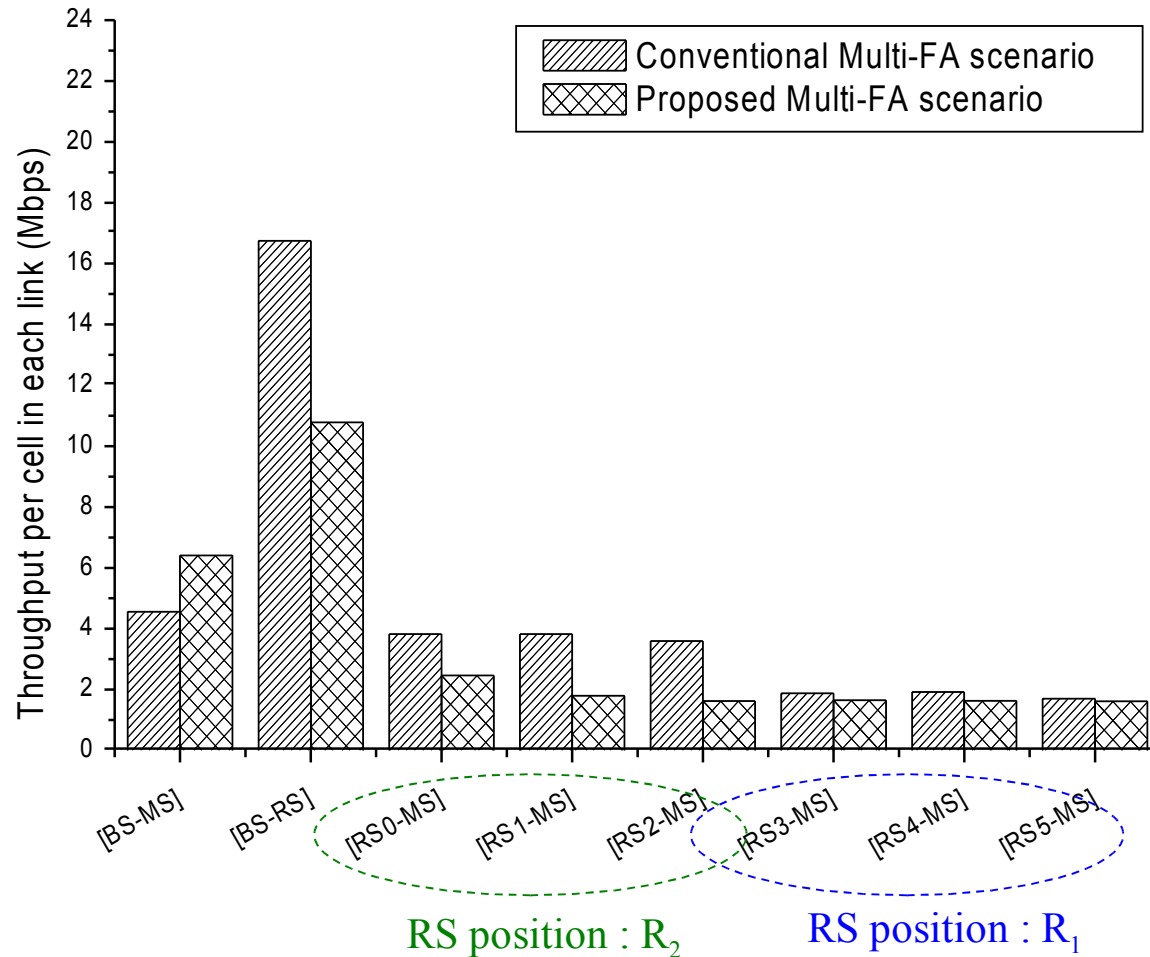
  ✓ Average cell throughput
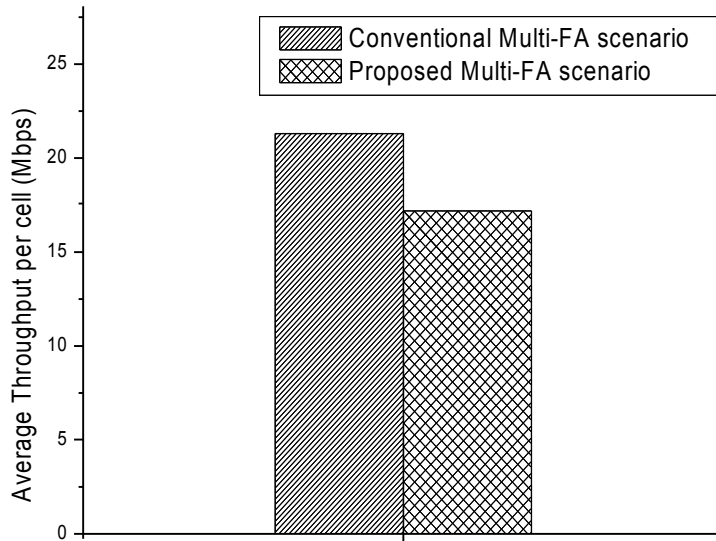
  ✓ Distribution of AMC levels
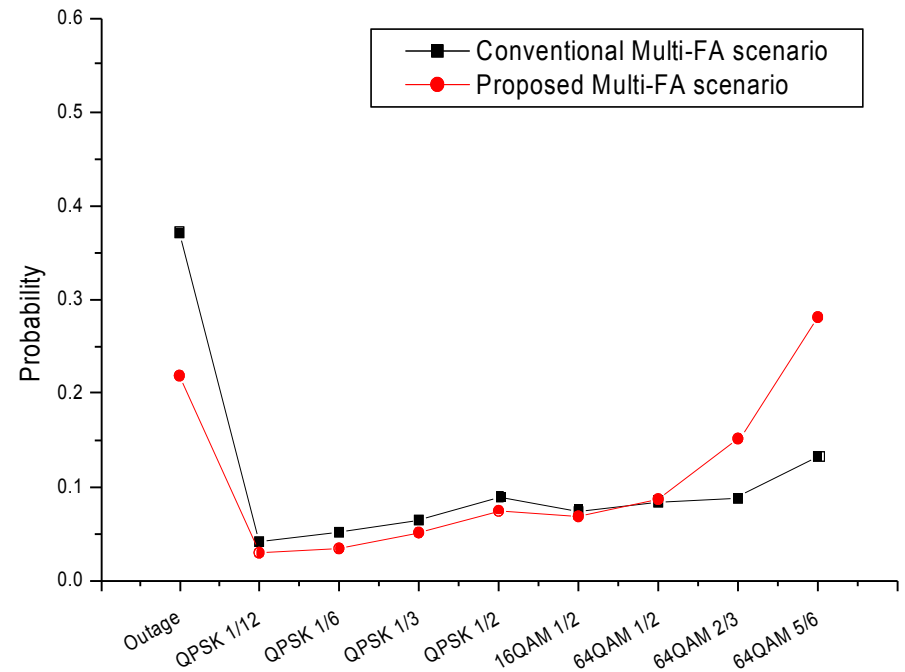
Simulation Result (2)

• Throughput per cell in each link

Simulation Result (3)

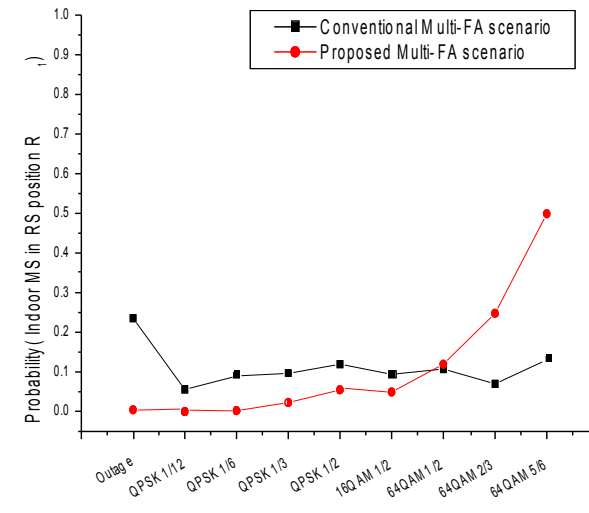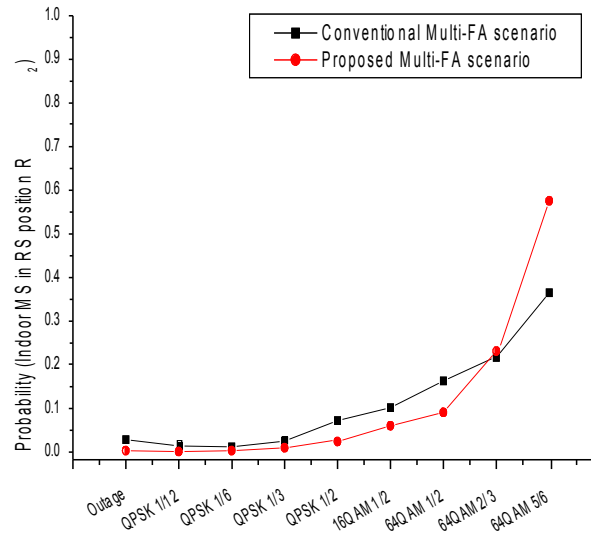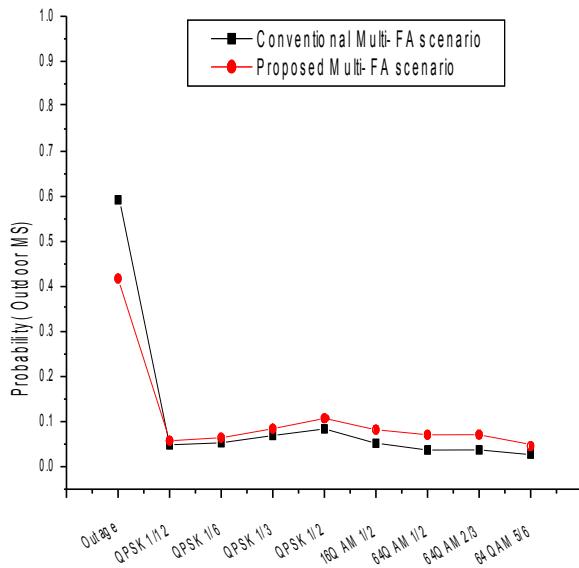• Distribution of AMC Levels: $R_1 = 289$ m & $R_2 = 866$ m

✓ Outdoor MS

✓ Indoor MS
in RS at $R_2 = 866$m

✓ Indoor MS
in RS at $R_1 = 289$ m

Text Contribution

8.4.4.8 Relaying frame structure

…………………………..

Insert the following text in the subclause:

When a multiple number of FA's are employed for capacity expansion, two different frame structures, the relaying frame structure and the conventional frame structure, can be used at the same time, each of which is using the different FA so as to isolate the interference between RS-MS link from BS-MS link. It is always operating in a pair with the MMR frame structure over the different FA.

…………………………..

Summary

- A new frame configuration is introduced for a multiple number of FA's as a network capacity is expanded.
  - ✓ To allow a more economical migration toward MMR-based network
  - ✓ To provide a reliable and effective means of indoor coverage extension (more effective as there are a large number of buildings to be covered by RS, especially those close to BS)

- Additional MAC management procedure might be required to for multi-FA operation under consideration
  - ✓ To be further discussed