VoIP-Kapazität im Relay erweiterten IEEE 802.16 System

21. ComNets-Workshop Mobil- und Telekommunikation

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Outline

Benefits

- Coverage of heavily shadowed areas
- Serving low performing MSs at the edge of the cell
- Trunking gain on back-haul link
- SDM operation of relay stations $\rightarrow$ capacity gain

Potential Challenges

- Increased packet delay over single-hop system
- Load balancing among relay stations
- Resource partitioning UL/DL

Single-hop TDD Frame

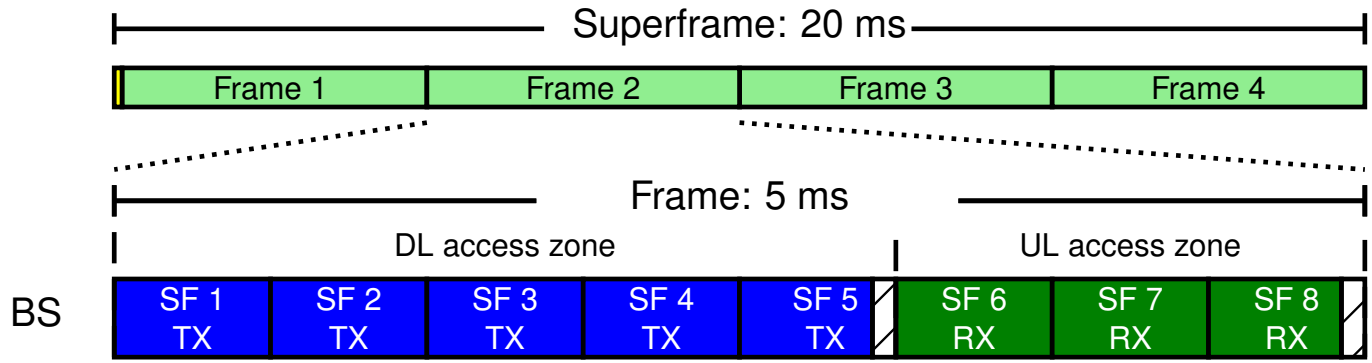


Figure: Single-hop Frame Structure

- 20 ms periodic superframe
- Partition of frame in downlink (DL)- and uplink (UL) access zone
- Subdivision into sub-frames (SF)
- base station (BS) performs radio resource management and signals at the beginning of a frame (not shown)

Multi-hop TDD Frame

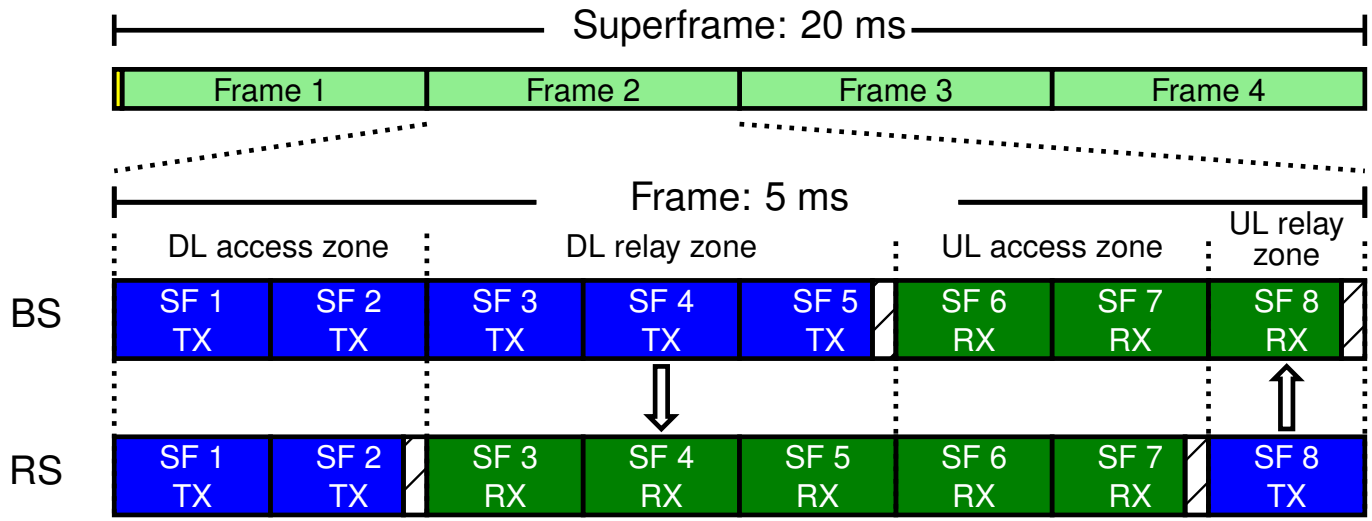


Figure: Relay Enhanced Frame

- Partition of frame in DL- and UL access and relay zone
- RS communicates with BS in relay zone
- RS performs radio resource management in relay cell

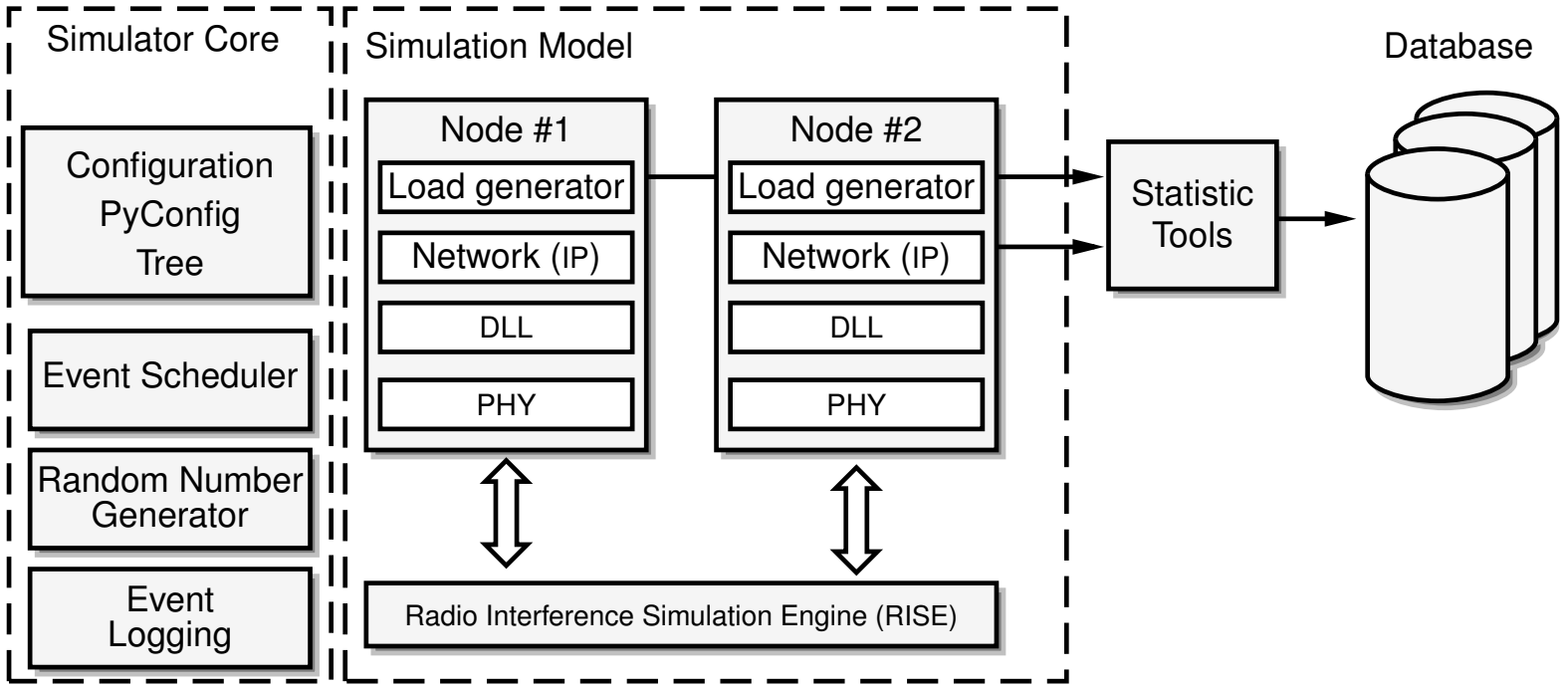


Figure: Simulator Architecture

- Simulator core provides
- Nodes contain protocol stack
- Communication between nodes via RISE

VoIP traffic model

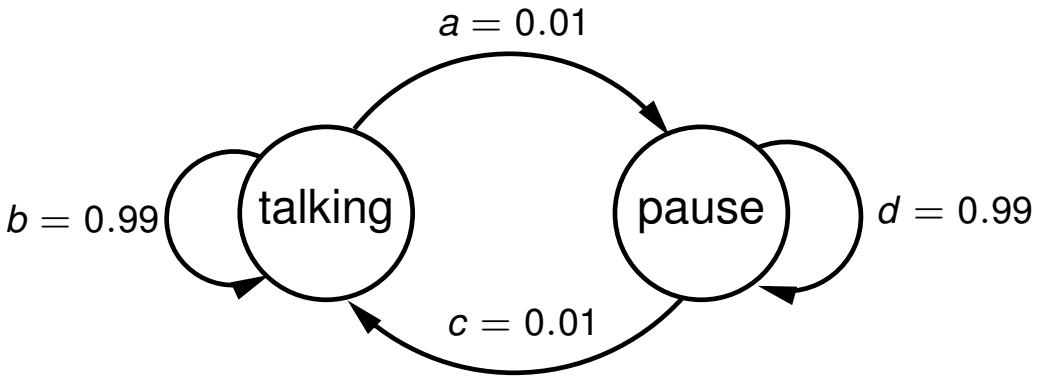


Figure: Brady VoIP model

Codec	RTP AMR 12.2 (12.2 kb/s)
Encoder frame length	20 ms
Voice frame size	320 bit
Silence indicator inter arrival time	160 ms
Silence indicator frame size	120 bit
State update interval	20 ms
Voice activity factor	50 %
Mean talk spurt length	2 s

WiMAC MAC Layer

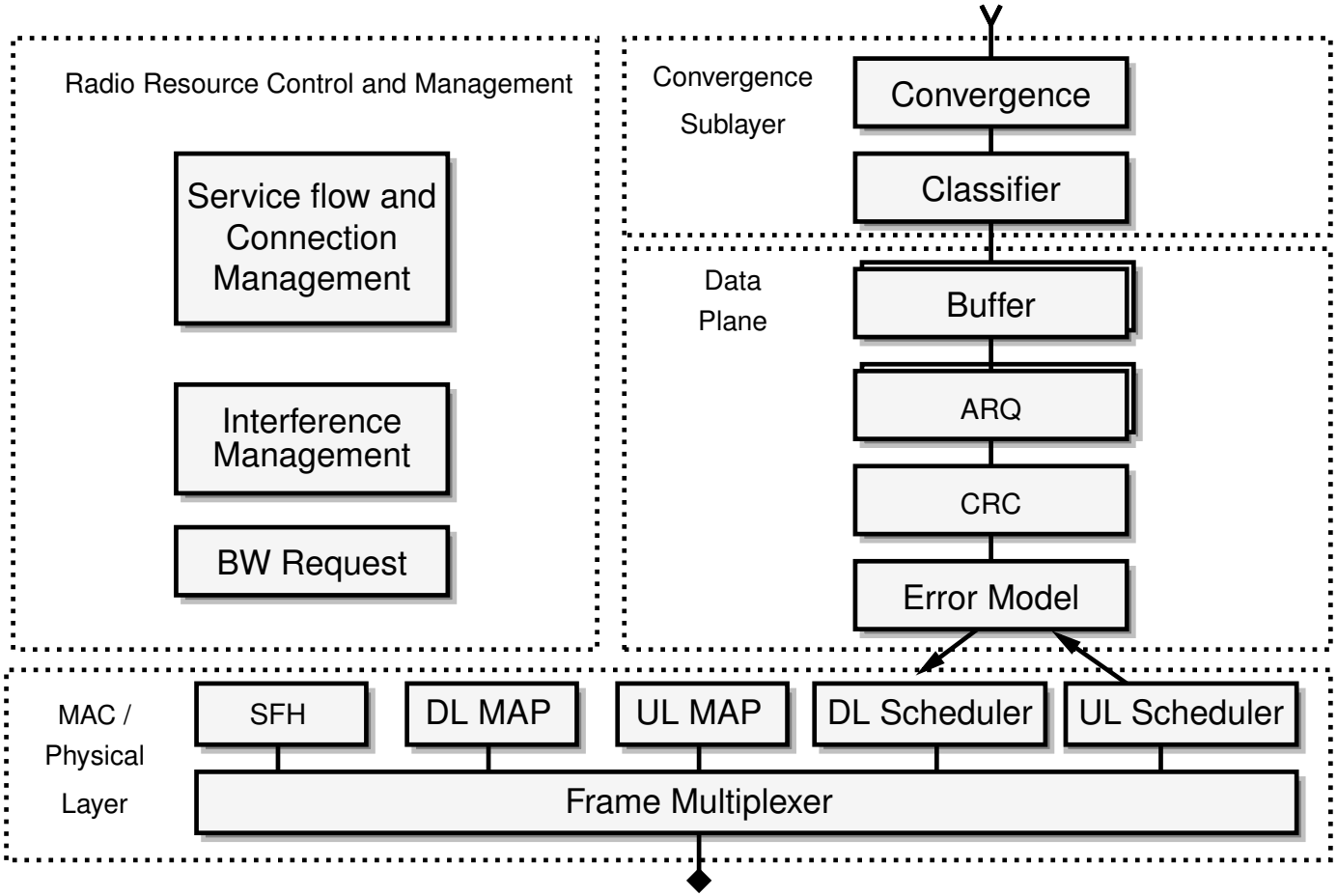


Figure: WiMAC MAC/PHY Layer

WiMAC MAC Layer of Relay Station

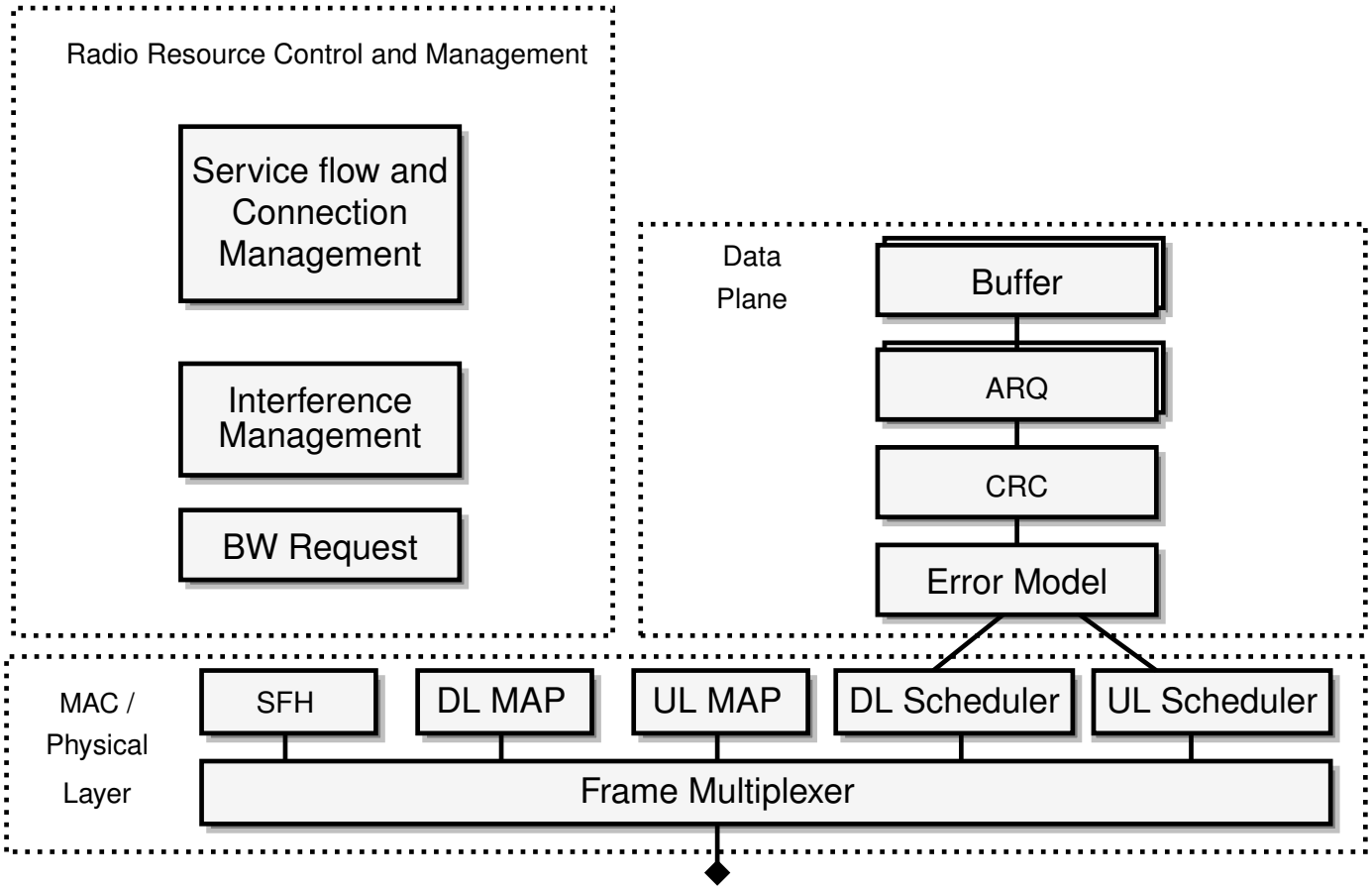
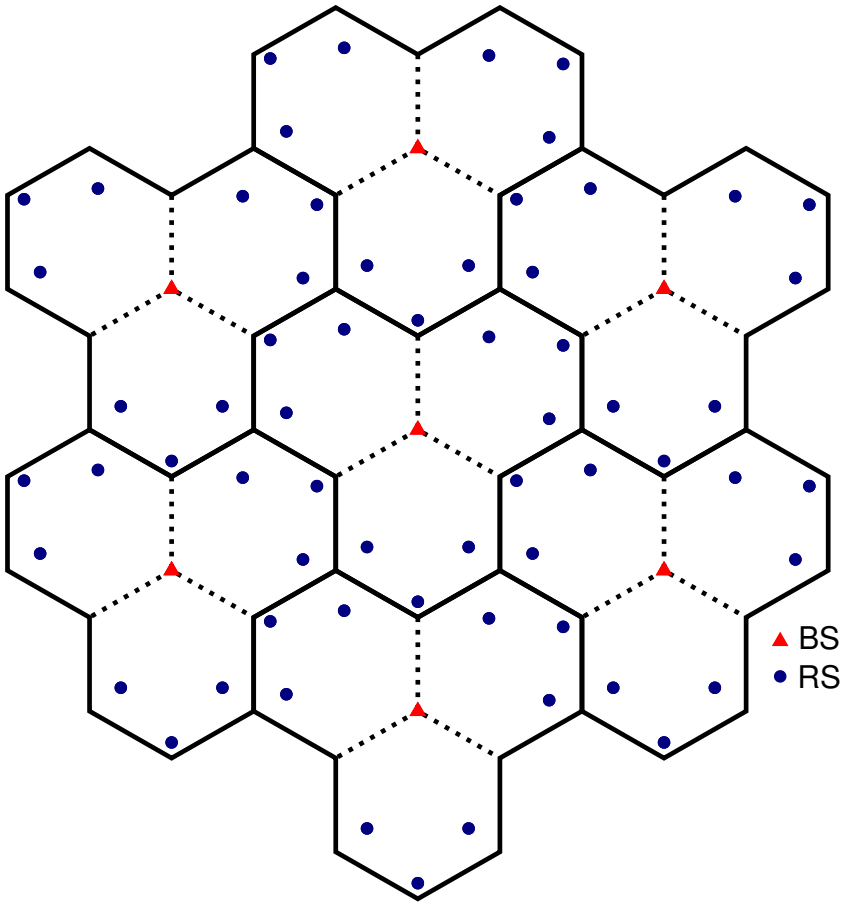


Figure: WiMAC MAC/PHY Layer

Simulation Scenario



- 3 sectors/cells each site
- 7 sites
- 500 m inter-site distance
- 3 relay stations per cell
- up to 75 mobile stations (MSs) per cell
- combined LOS/NLOS urban macro pathloss model
- LOS pathloss model for BS $\leftrightarrow$ RS link

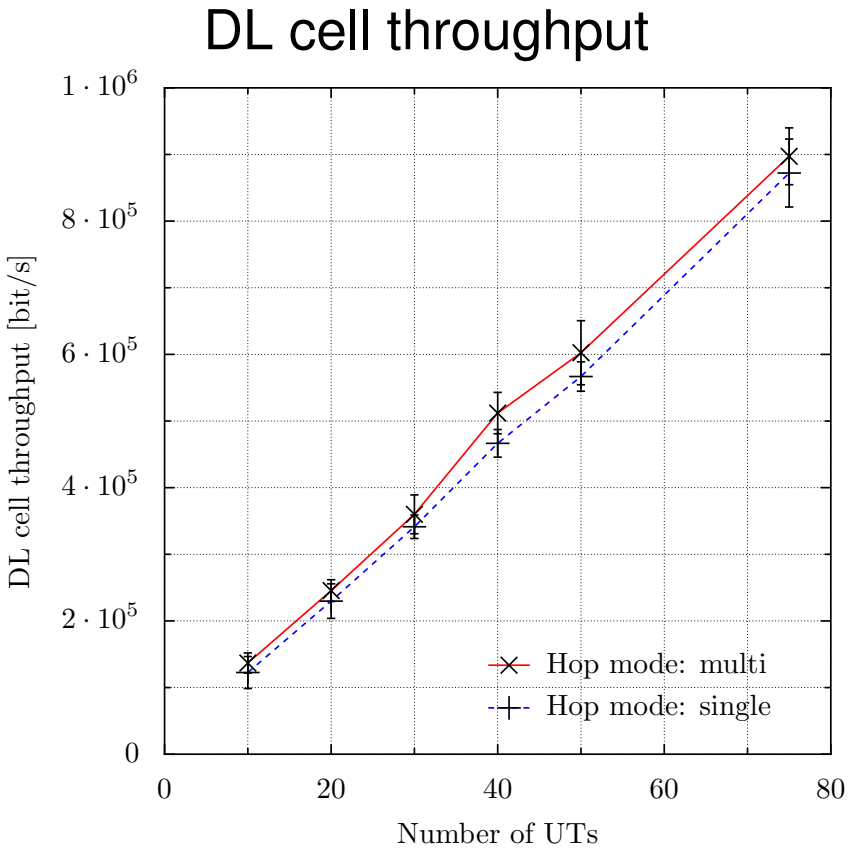
Figure: Simulation scenario

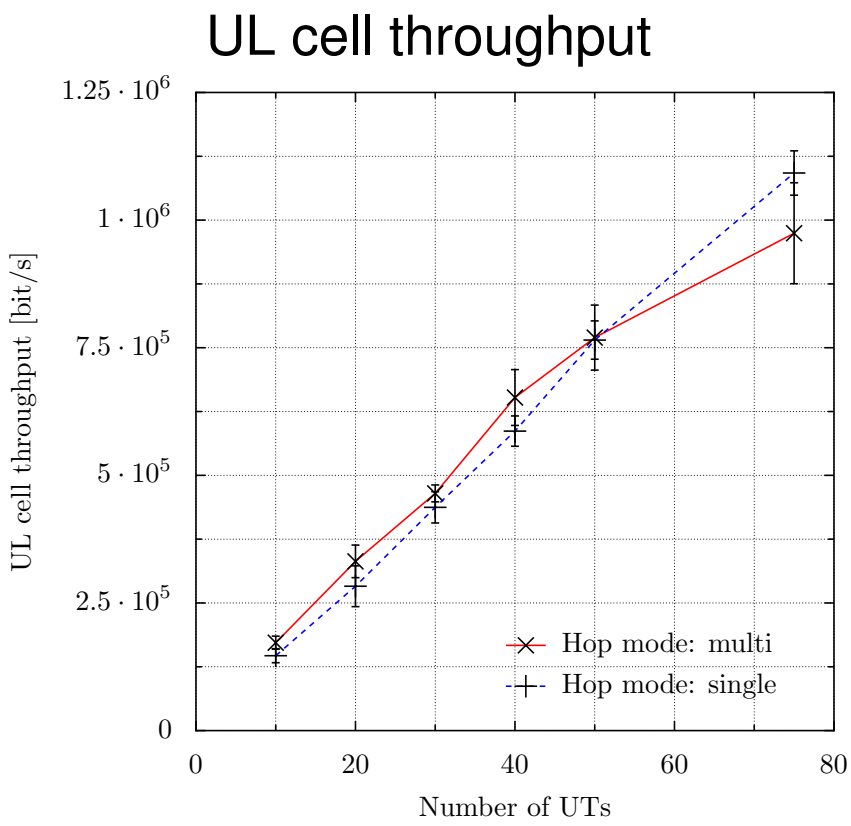
System parameters

- 5 MHz bandwidth
- DL/UL resource ratio 5:18 with RSs
- DL/UL resource ratio 12:11 without RSs
- Frequency reuse 1

station	TX power
BS	43 dBm
RS	24 dBm
MS	24 dBm

Cell throughput

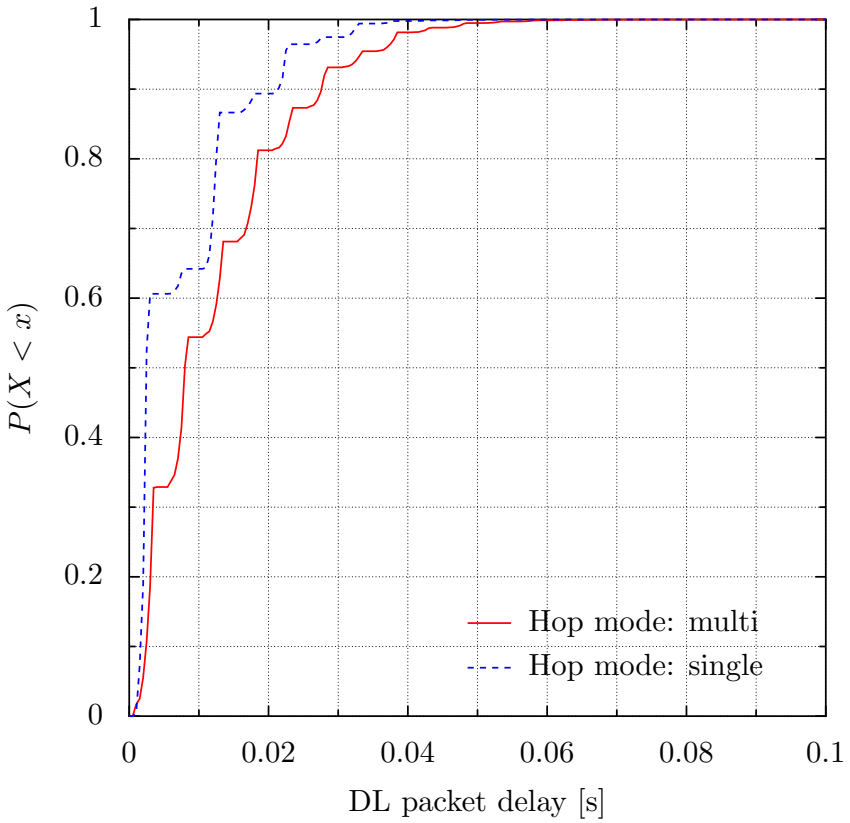




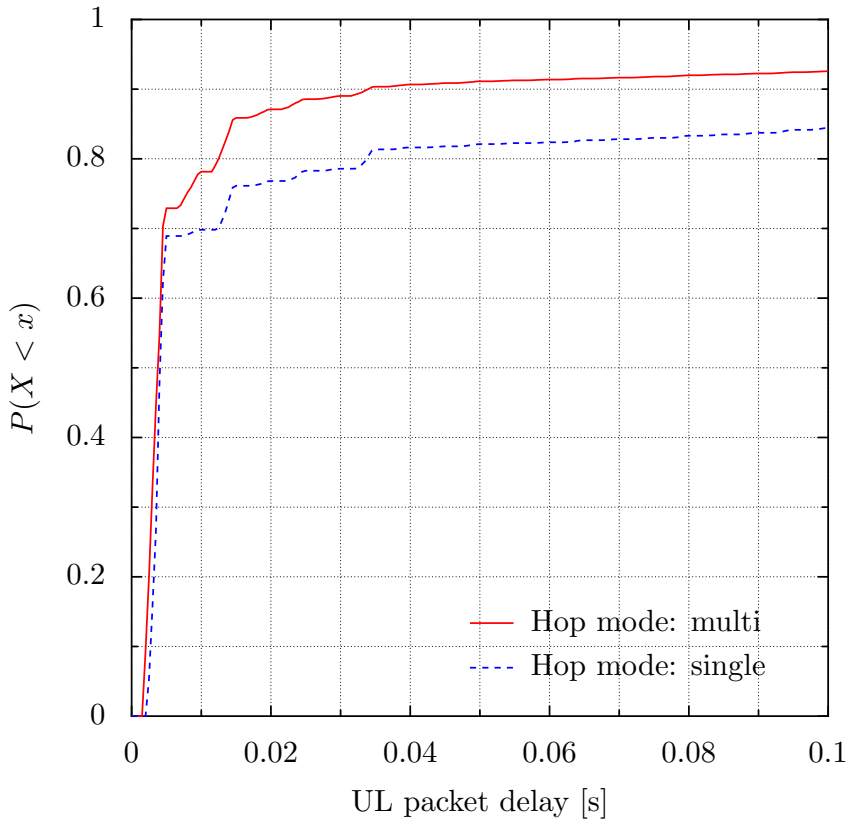
- RSs do not affect the cell capacity

Packet Delay

DL packet delay with 30 MSs



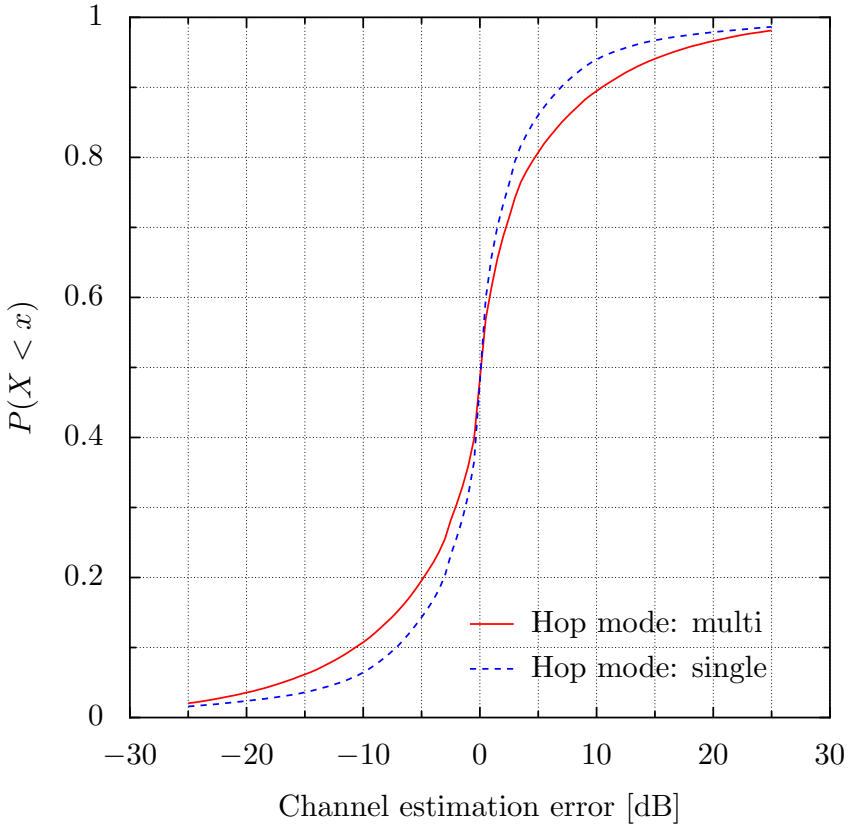
UL packet delay with 30 MSs



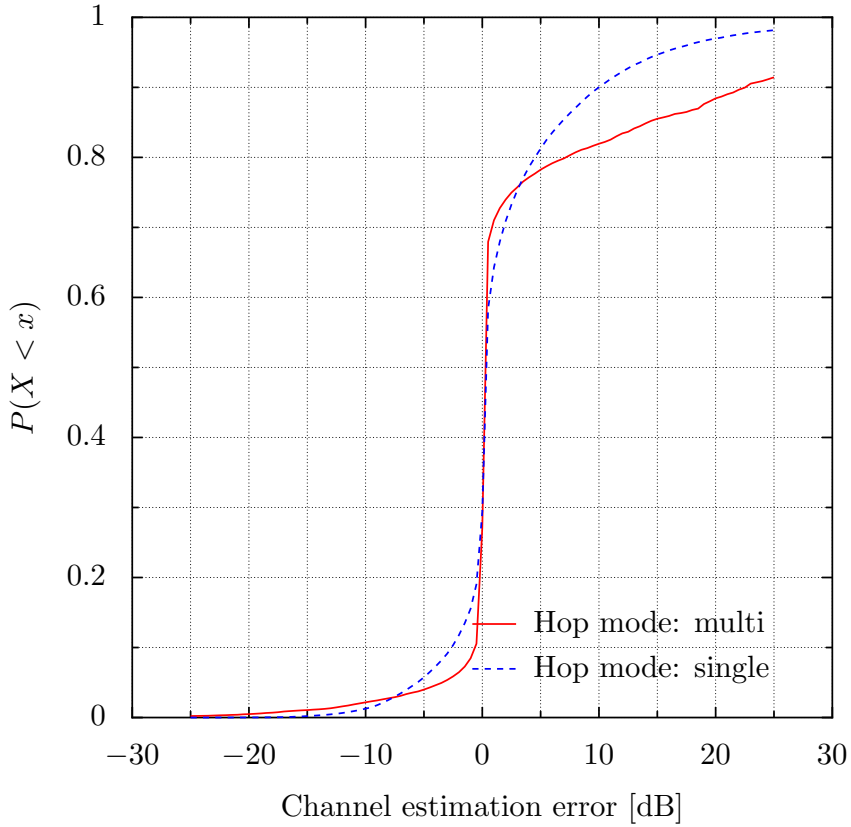
- DL packet delay is not critical
- UL packet delay shows significant decrease with RSs

Channel estimation error

Channel estimation error at MSs



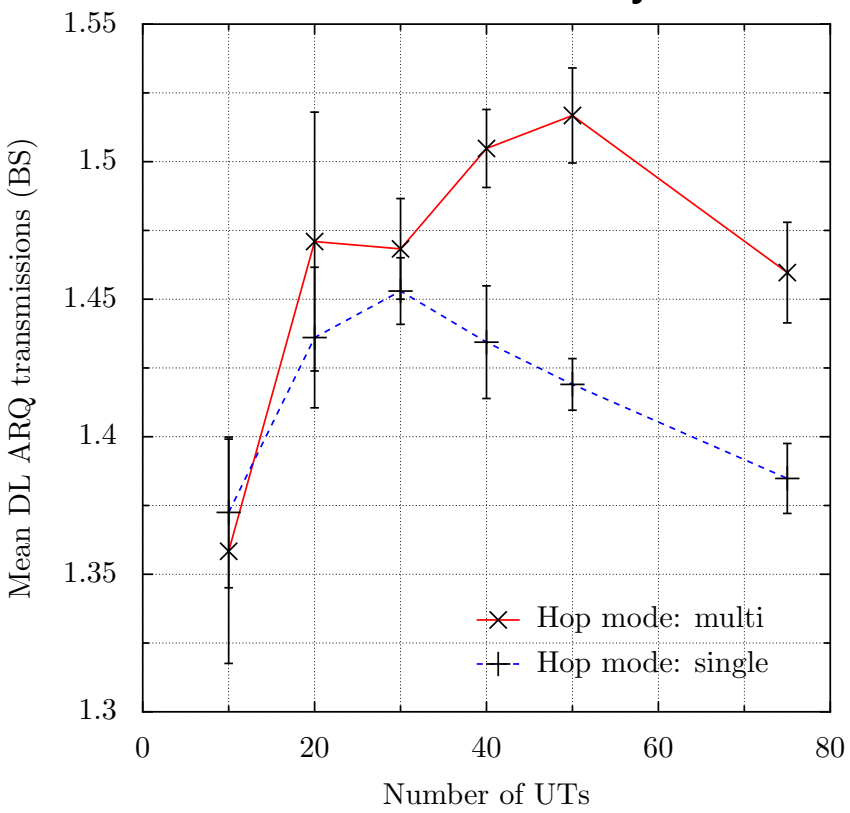
Channel estimation error at BSs



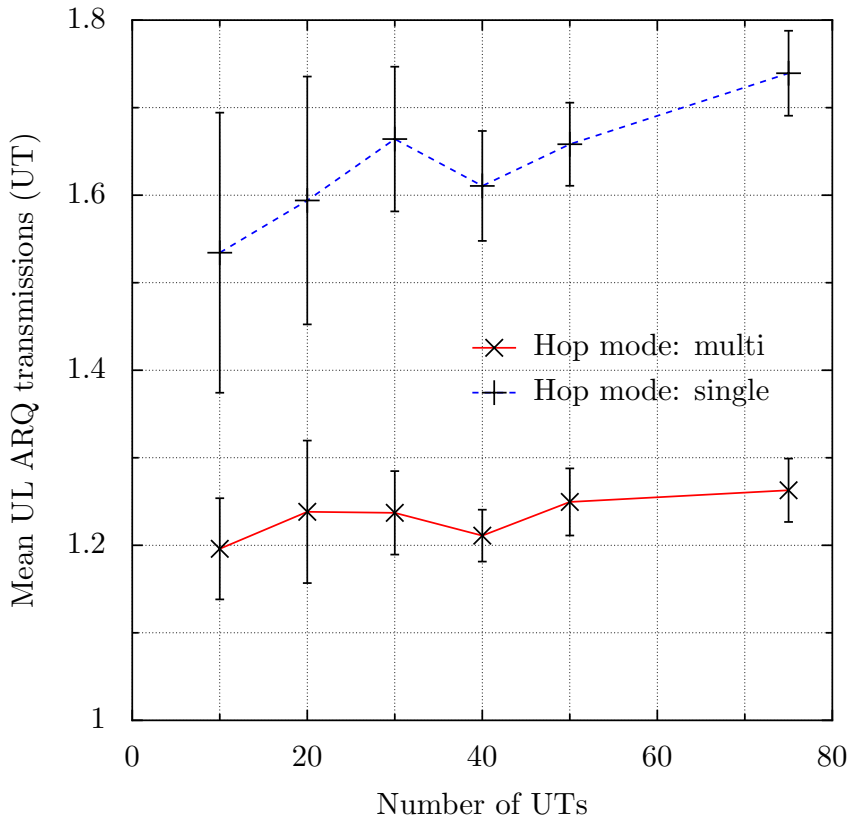
- Channel estimation error is unaffected by RSs

Number of transmissions

Number of DL transmissions for successful delivery

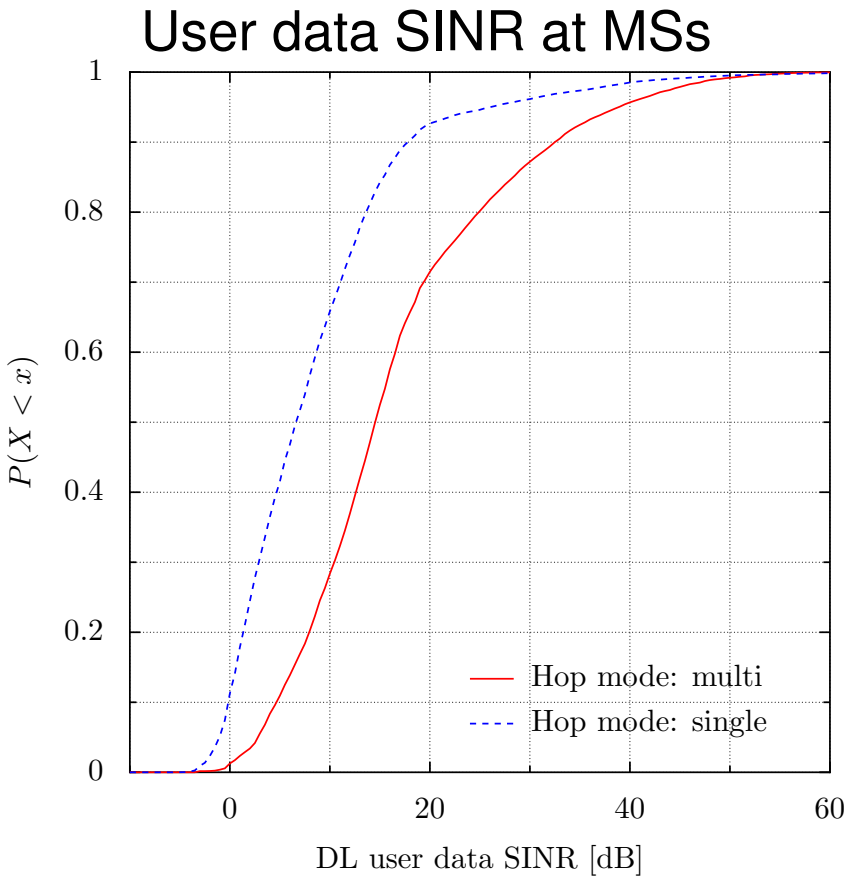


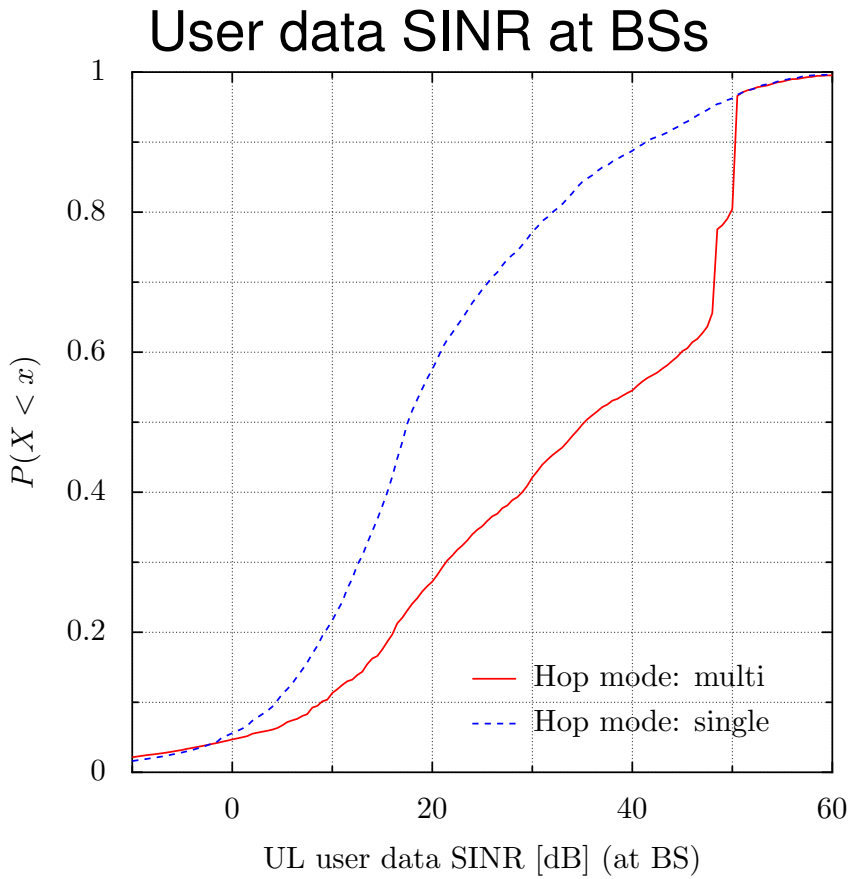
Number of UL transmissions for successful delivery



- RSs reduce the amount of retransmissions

User Data SINR distribution





- RS provide a significant gain in user data SINR for UL and DL

Conclusion

Benefits of relay stations

- Relays improve channel knowledge for UL transmissions
- Relays provide same DL quality of service with less resources
- Even low-powered relay stations improve system performance

Open issues

- Packet delay must be limited by packet prioritization
- Load balancing among RSs is not possible

Thank you

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