



Spectrum Access Scheduling among Heterogeneous Wireless Systems

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Outline

- Introduction
- Spectrum Access Scheduling
- Simulations



Problem: Spectrum Scarcity

- The radio spectrum is a precious and limited resource.
- Fixed allocation.
 - Most of the usable part of the spectrum has been divided among various radio services.
- Continuous and fast emergence of wireless standards.
- Running out of the radio spectrum?
- Actually, the currently allocated spectrum is not fully utilized.



Proposed Solution: Spectrum Access Scheduling (SAS)

- Reason: the conflict between the spectrum scarcity and underutilization.
- Proposed approach: Spectrum Access Scheduling
 - To improve the spectrum utilization efficiency.
 - The underutilized spectrum is shared among heterogeneous systems.



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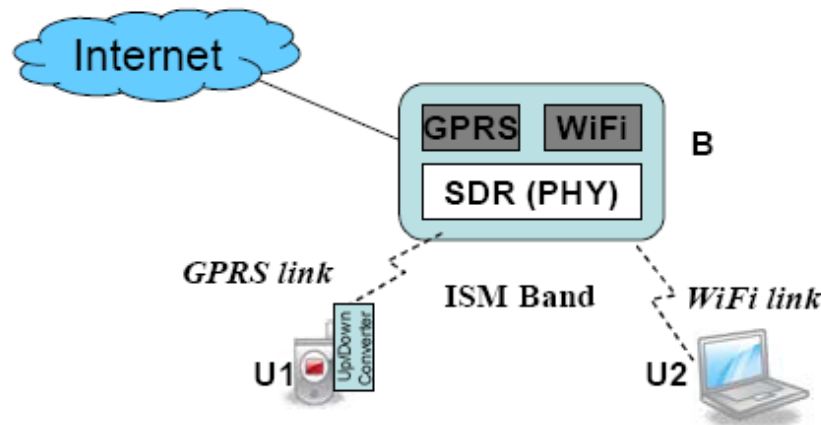


SAS System

- A centralized system.
 - Mostly affecting the base station of the overall system architecture.
 - The protocols are aware of each other at the base station, so that the spectrum is shared with minimum disruptions.
 - A cost-effective SDR-based base station.

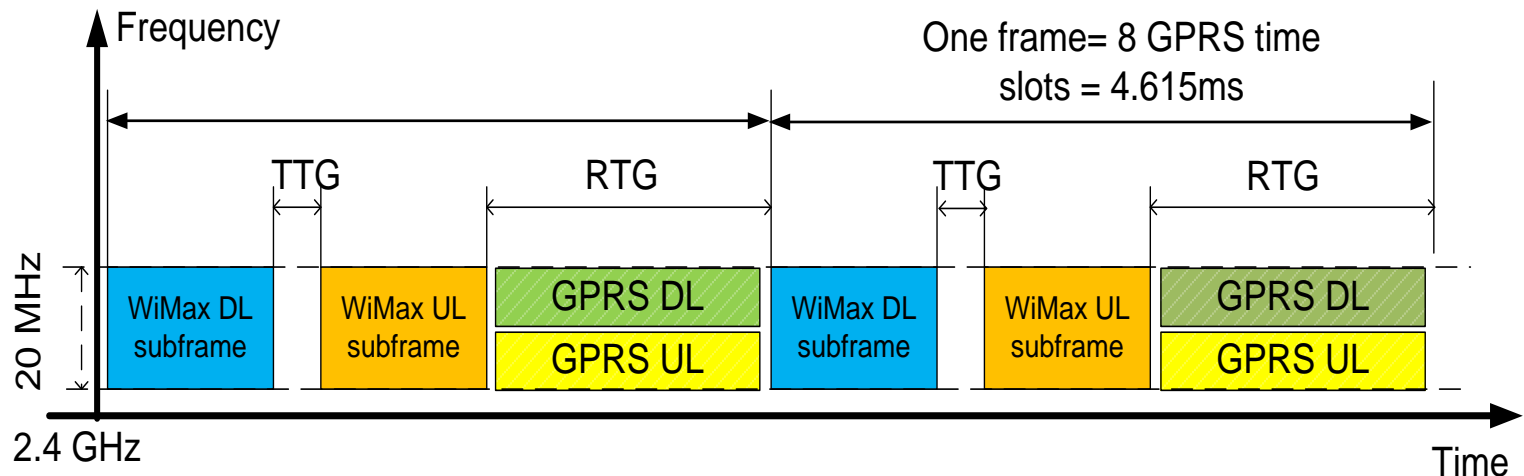
SAS System (cond't)

- The underutilized spectrum is time-shared between heterogeneous systems.
 - Channels can be shifted to the same band through frequency up/down converters.
- WiFi/GPRS

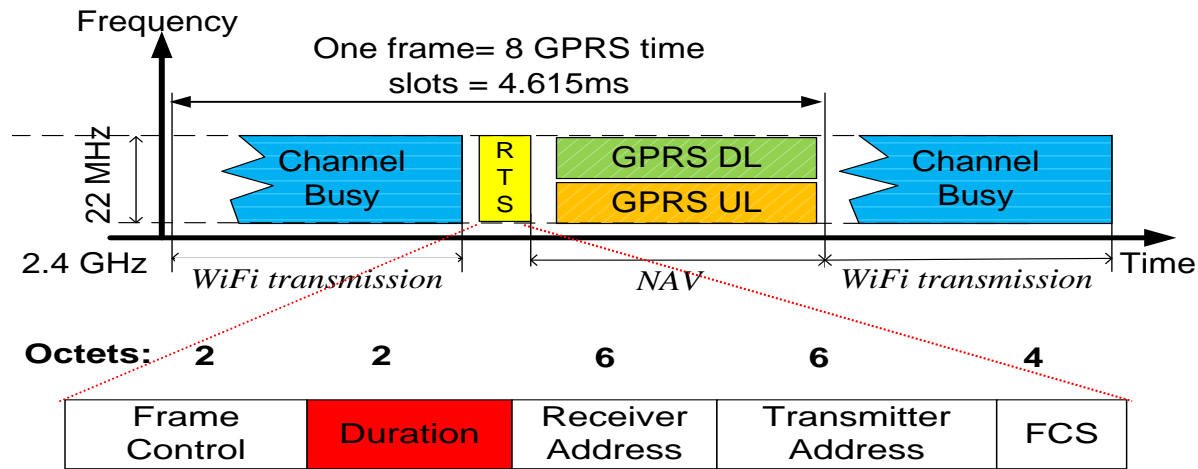


GPRS and WiMAX (802.16-2004)

- WiMAX TDD frame
 - Subframes: Downlink and uplink subframes
 - Transitions gaps: Receive/Transmit Transition Gap (RTG) and Transmit/Receive Transition Gap (TTG).
 - Adjustable.



GPRS and WiFi



RTS Frame

RTS: Request To Send

NAV: Network Allocation Vector



Outline

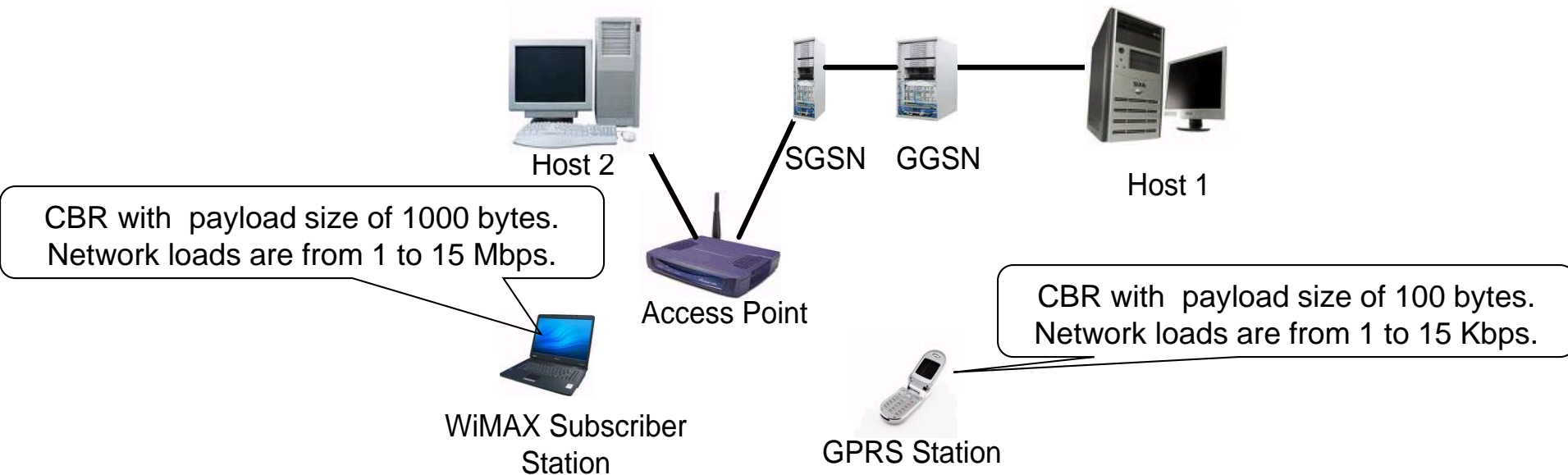
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Simulations

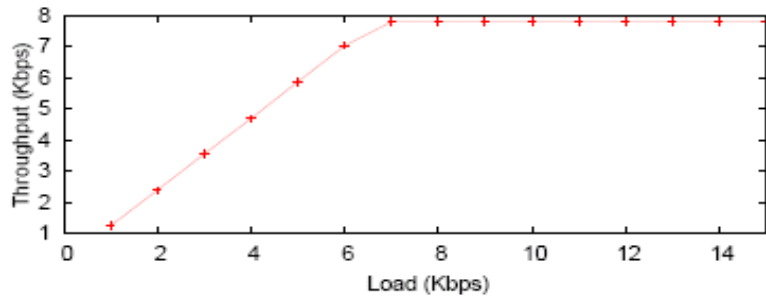
- Network simulator: NCTUns 4.0
 - Open source
 - GPRS, WiFi, and WiMAX (802.16-2004)
- Coexistence
 - GPRS and WiMAX
 - GPRS and WiFi

The Topology of the GPRS and WiMAX

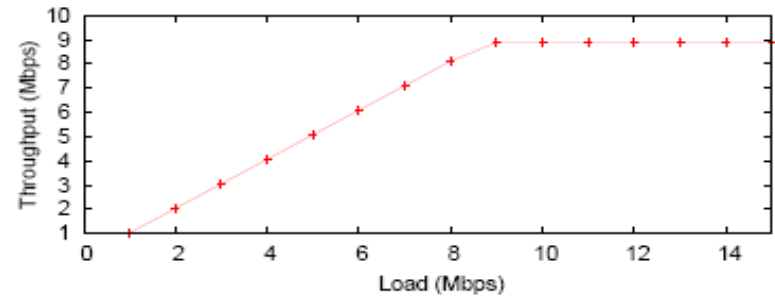


SGSN: Serving GPRS Support Node
GGSN: Gateway GPRS Support Node
CBR: Constant Bit Rate

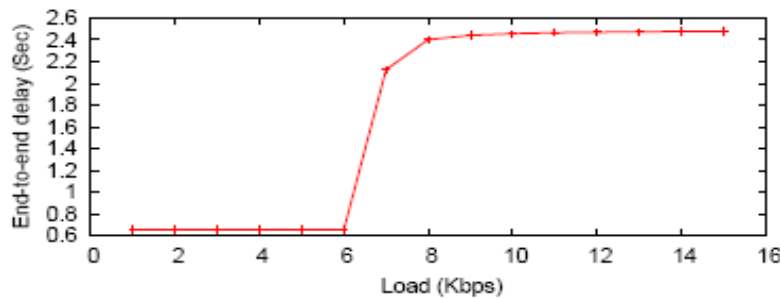
Performance



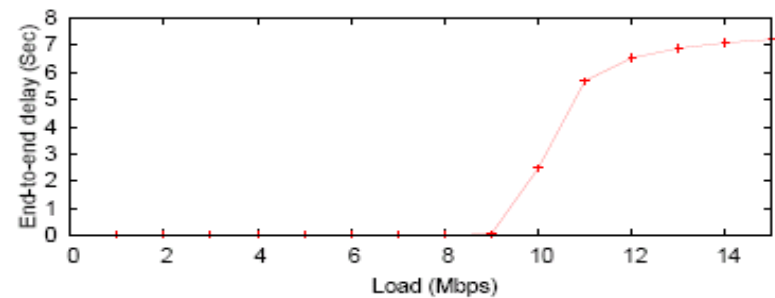
(a) GPRS Throughput



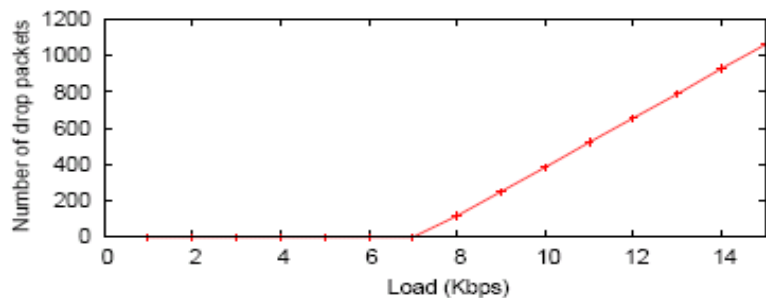
(b) WiMAX Throughput



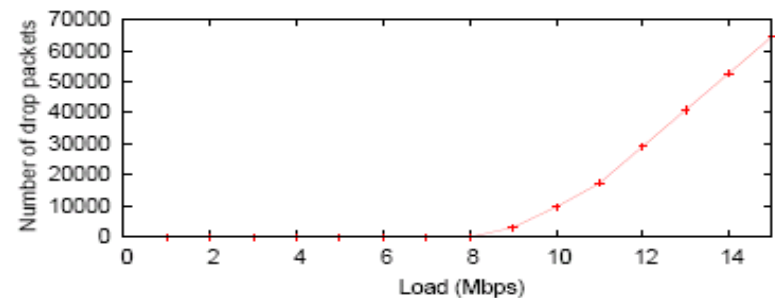
(c) GPRS End-to-End Delay



(d) WiMAX End-to-End Delay

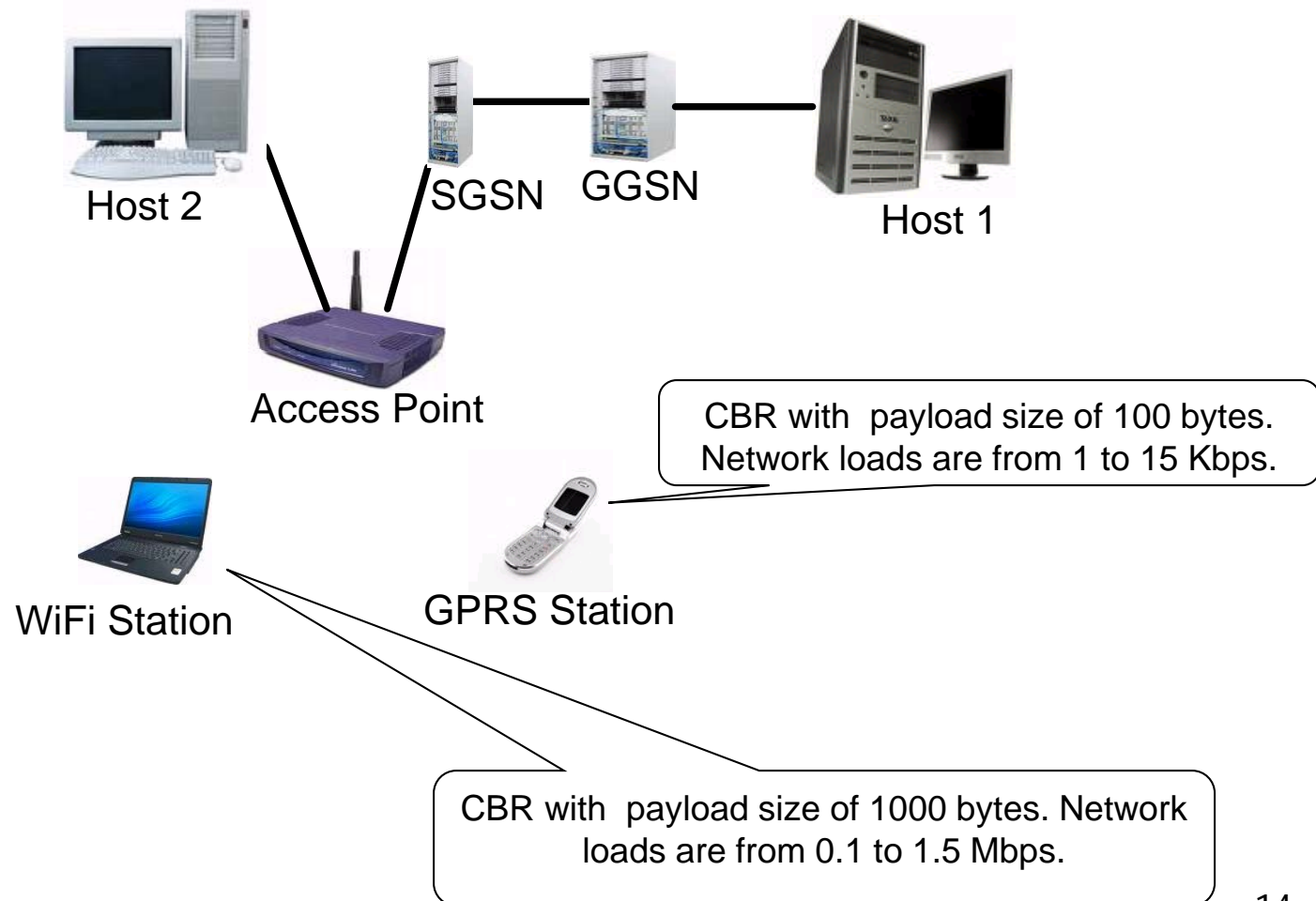


(e) GPRS Packet Loss

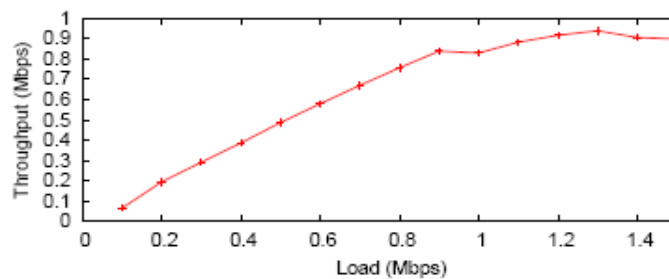


(f) WiMAX Packet Loss

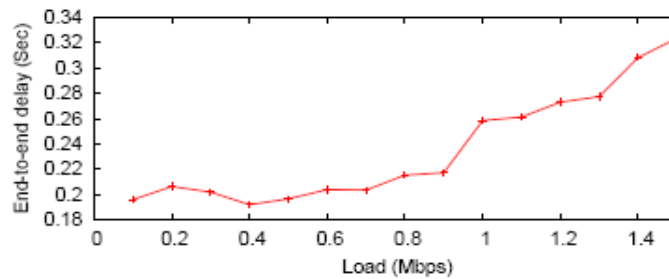
The Topology of the GPRS and WiFi



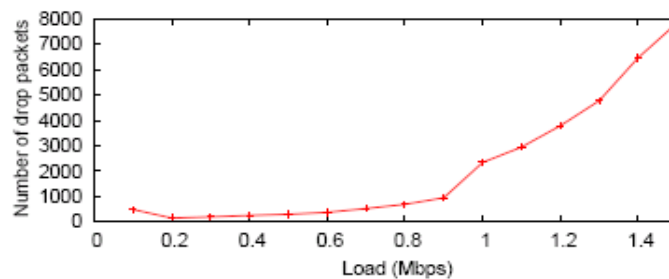
Performance



(a) WiFi Throughput



(b) WiFi End-to-End Delay



(c) WiFi Packet Loss



Conclusions

- Spectrum access scheduling has been proposed to improve the spectrum efficiency in the temporal domain .

- Cognitive Radio V.S. SAS
 - CR
 - Primary users and secondary users
 - Opportunistic
 - SAS
 - Equal spectrum share holders
 - Deterministic



Questions?

Thank you !