Scalable Wireless Access Control

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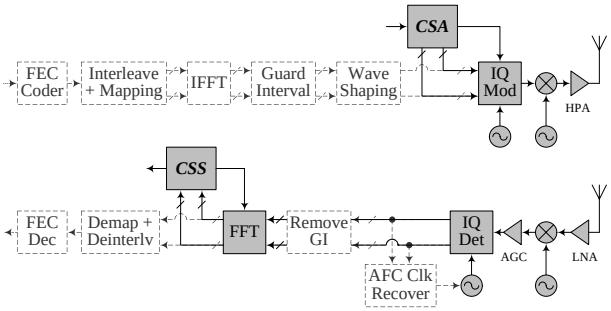
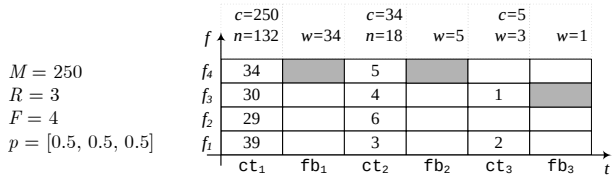
While unveiling the iPhone 4 in the summer of 2010, Steve Jobs' demo came to a halt: "**There are over 570 WiFi stations operating in this room. We can't deal with that.**" he said to an audience among which news people and bloggers were sending and streaming info on his presentation.

The number and density of wireless devices has exploded. In Manhattan, there have been reports of **over 150 WiFi Access Points visible from one flat**. APs two feet away are inaccessible due to excessive channel contention, channel capture, hidden nodes, exposed nodes and other effects. Vehicular networks are next, adding high mobility to the mix.

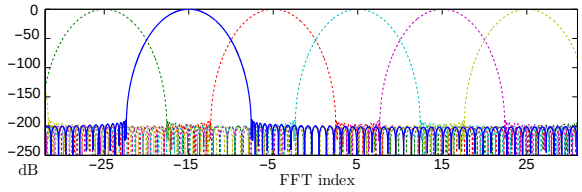
We propose a cross-layer scheme called **Multi-Carrier Burst Contention**, or **MCBC**, which strives to provide scalability, robustness and high performance in demanding scenarios.



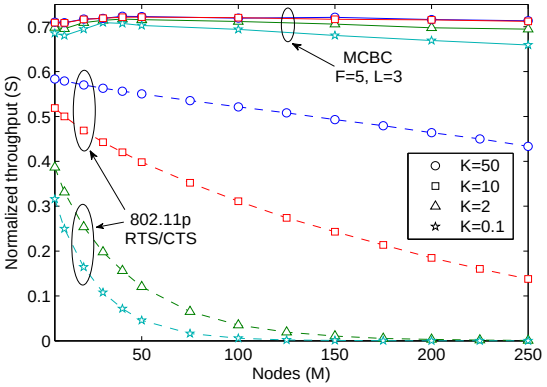
- *Augmented PHY.* With minor changes to the 802.11a PHY, a subset of OFDM subcarriers is used to send and sense *short* wave bursts during channel contention.
- *Low overhead.* No MAC data encapsulation. No PHY symbol modulation. Cached PHY waveforms.
- *Hidden nodes* are mitigated inherently owing to feedback during contention. RTS/CTS is not needed.
- *Collision probability.* Contenting nodes number decreases exponentially with respect to both time and frequency.
- *High throughput.* Close to theoretical limits owing to low overhead and low and stable collision ratio.
- *Quality of Service.* QoS and priority access by mapping traffic classes to contending OFDM subcarrier indices.
- *Fairness* is intrinsic as all nodes use the same fixed contention parameters.
- *Topology independence*. The scheme does not rely on transmission history or network state.



Contention session example with 250 nodes



Time-Frequency contention. A fast-converging round-based algorithm where nodes are eliminated by peers or *referees* by randomly bursting and sensing short ($5\ \mu s$), unmodulated and *"cached"* OFDM subcarriers.



Hardware Implementation. A multi-core testbed consisting of multiple MCBC nodes was initially implemented onto a single FPGA device, with cores independently clocked by external oscillators.

Awarded. The project was awarded by the *Microsoft Research Software Defined Radio Academic Competition 2010*. Subsequently, the FICA wireless scheme developed by Microsoft Research is using our MCBC contention scheme. We now have several Microsoft Sora SDR hardware which have been used to implement and extend MCBC.

Microsoft Research Sora SDR platform

B. Roman et al, "Cross-Layer Medium Access Control Using Multi-Carrier Burst Contention", in *IEEE Journal of Selected Areas in Communications*, vol. 28, no. 9, 2011.