

# When Priority Resolution Goes Way Too Far: An Experimental Evaluation in PLC Networks

Cristina Cano and David Malone

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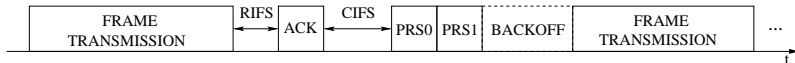
Hamilton Institute

# Motivation

- In-house Power Line Communications
- Standards: Homeplug/Homeplug AV/IEEE 1901
- Qualcomm Atheros reports 100M PLC devices shipped
- Research efforts focused on the physical layer
- PLC MAC is relatively unexplored
- MAC like IEEE 802.11, but:
  - Deferral counter
  - **Strict priority resolution scheme**
  - Negotiated tone map
  - Large aggregated frames

# Priority Resolution

- Definition of 4 CAs
- CA3/CA2 and CA1/CA0 share  $W_i$  (BO) and  $M_i$  (DC) values
- Strict prioritisation through Priority Resolution Slots (PRS)

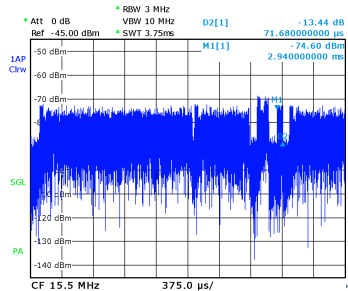
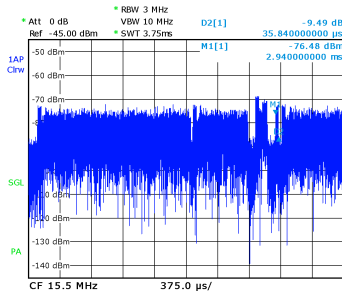
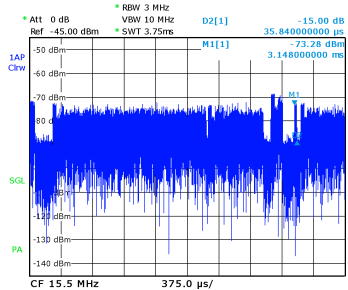
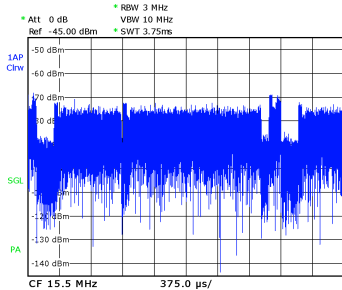


- But, only present after successful transmissions!

# Testbed Setup

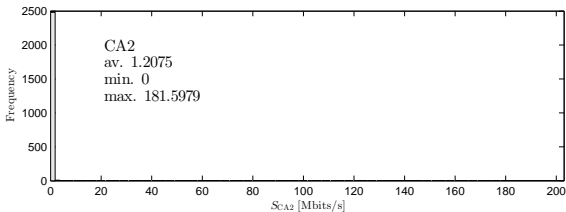
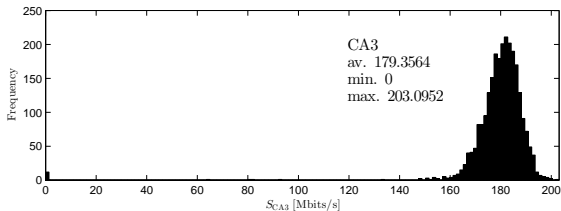
- Devices
  - Zyxel PLA4215 PLC adapters with INT7400 chipset
  - Connected via an UPS unit
  - Attached to the Gigabit Ethernet port of Soekris boxes
- Tools:
  - *Iperf*:
    - Generate traffic/measure per-second throughput
  - *Faifa*
    - Count channel accesses (Jain's Fairness Index)
  - Spectrum Analyser
    - Get more insight on the transmissions on the channel

# PRS?



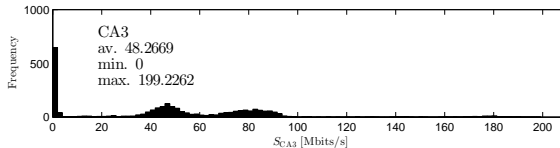
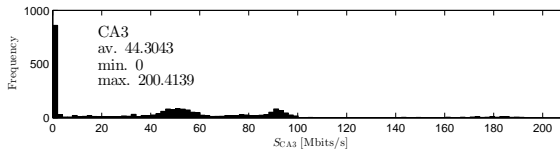
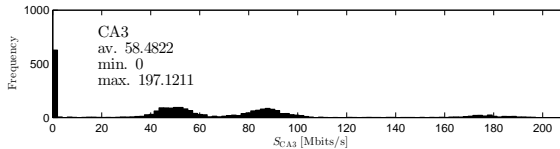
# Lower Priority Starvation

Two saturated stations in different CAs.  
How strict is the prioritisation?



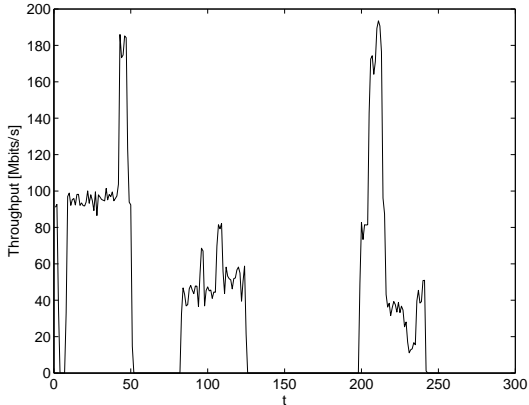
# Higher Priority Contention

3 CA3 Stations. What???!!!



# Higher Priority Contention

## Oscillatory Behaviour!



Tone map information is sent at CA2!



# Conclusions

- Outcomes
  - Lower-CA traffic
    - Suffers from starvation
    - *High variability (aggregation and buffer management)*
  - Higher-CA flows
    - Oscillatory behaviour
- Some plausible solutions
  - Reserved priority for control messages
  - Police/Shape higher classes
  - *Limit variability of aggregation*

**JSAC Issue on PLC in Networking Ecosystem: Submission  
1 July 2015.**