

PAW

Predictable and Available Wireless

Non WG forming BoF

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Definitive information is in the documents listed below and other IETF BCPs. For advice, please talk to WG chairs or ADs:

[BCP 9](#) (Internet Standards Process)

[BCP 25](#) (Working Group processes)

[BCP 25](#) (Anti-Harassment Procedures)

[BCP 54](#) (Code of Conduct)

[BCP 78](#) (Copyright)

[BCP 79](#) (Patents, Participation)

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Reminder:

Minutes are taken *

This meeting is recorded **

Presence is logged ***

- * Contribute online to the minutes at: <https://etherpad.tools.ietf.org/p/notes-ietf-104-paw>
- ** Recordings and Minutes are public and may be subject to discovery in the event of litigation
- *** Sign the blue sheets!

Administrivia



- Minutes
 - Etherpad: <https://etherpad.tools.ietf.org/p/notes-ietf-104-paw>
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 - Meetecho: <http://www.meetecho.com/ietf104/paw>
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- Meeting materials:
 - <https://datatracker.ietf.org/meeting/104/materials.html/#paw>
 - One set of slides per presentation

Agenda [1/2]



- 13:50 Intro and Status [5mn]
 - * Note-Well, Blue Sheets, Scribes, Agenda Bashing
 - * Status on existing documents (chairs)

- 13:55 BoF presentation [15mn]
 - * scope of the work (chairs)
 - * use cases (Carlos Bernardos)

- 14:10 Related work at the IETF
 - * DetNet (Lou Berger, Janos Farkas) [10mn]
 - * CCAMP (Daniele Ceccarelli, Fatai Zhang) [5mn]
 - * 6TiSCH (Thomas Watteyne, Pascal Thubert) [5mn]

Agenda [2/2]



14:30 Technologies

- * 802.11ax and EHT (Dave Cavalcanti, remote) [10mn]
- * 5G URLLC (Bikramjit Singh) [10mn]
- * LDACS (Corinna Schmitt) [10mn]
- * IEEE 802.15.4 TSCH / 6TiSCH Tracks (Xavi Vilajosana) [10mn]

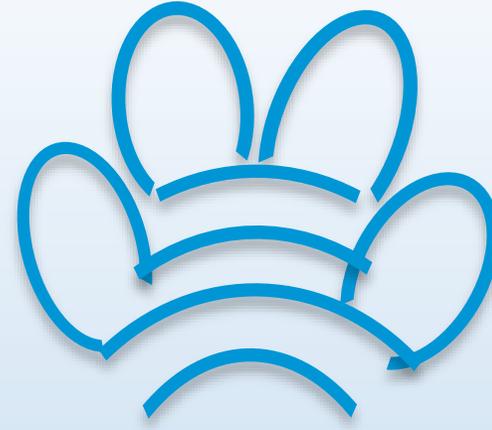
15:10 drafts and WIP

- * draft-thubert-paw-for-tisch (Pascal / Xavi) [5mn]
- * draft-papadopoulos-paw-pre-reqs (Georgios Papadopoulos) [10mn]
 - * PRE problem statement
 - * PRE recent results

15:25 Next Steps

- * going through the proposed charter (Chairs) [20mn]
- * BoF in Montreal, renaming to SPAWN, AOB [QS]

Scope of the work



PAW

Making Wireless More Predictable

Benefits of scheduling in wired networks

- Eliminate **congestion loss**
 - ⇒ Controlled amount of traffic
 - ⇒ Available Resources (bandwidth and buffers) guaranteed
- Guarantee **latency**
 - ⇒ Deterministic Progress along Scheduled path
 - ⇒ Nor ARQ: Forward Error correction, Network coding
- (Nearly) Eliminate **equipment failure losses**
 - ⇒ Frame/Packet Replication and Elimination

Benefits of scheduling in wireless

- Reduces **frame loss**
 - ⇒ Time and Frequency Diversity
 - ⇒ Reduces co-channel interference
- Optimizes **bandwidth utilization**
 - ⇒ No blanks due to IFS and CSMA-CA exponential backoff
 - ⇒ While Increasing the ratio of guaranteed critical traffic
- Saves **energy**
 - ⇒ Synchronizes sender and listener
 - ⇒ Thus optimizes sleeping periods
 - ⇒ By avoiding idle listening and long preambles



Very High Probability Wireless



Controlling time of emission

Can achieve $\sim 10\mu\text{s}$ sync on 802.15.4

Can guarantee time of delivery

Protection the medium

ISM band crowded, no fully controlled
all sorts of interferences, including self

Can not guarantee delivery ratio

Improving the Delivery ratio

Different interferers => different mitigations

Diversity is the key

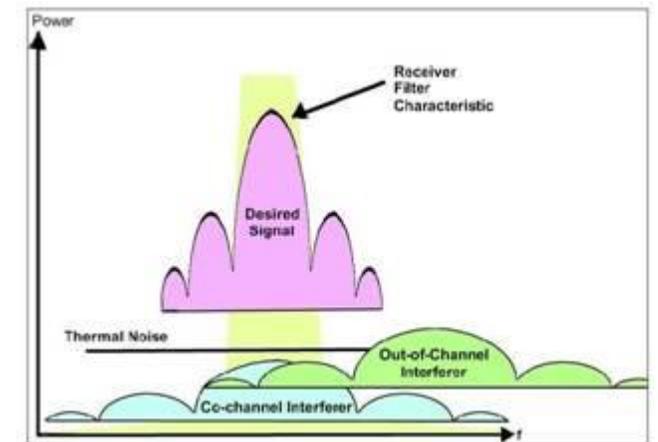
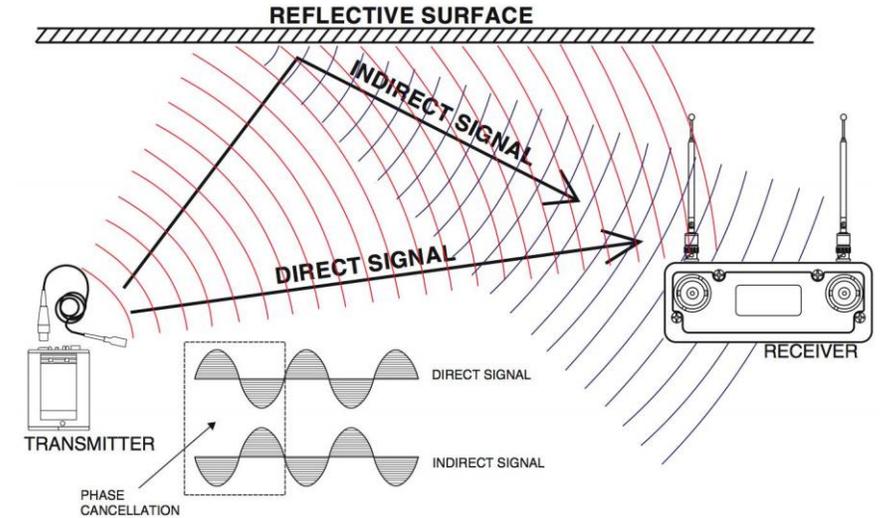


Figure 1. Co-Channel, Adjacent Interference, and Thermal Noise
All signals are referenced to zero power level.

Wireless can be made Deterministic through TDM and Scheduling

Provides **similar benefits** as wired

- ⇒ High delivery ratio through path redundancy and collision elimination
- ⇒ High ratio of critical flows
- ⇒ Bounded maximum latency (and jitter)

Centrally scheduled operations bring **additional benefits** in wireless

- ⇒ Medium usage optimization (no IFS, backoff, etc...)
- ⇒ Energy savings (wake up on scheduled transmission)

But **how that is effectively achieved is different** in wireless

- ⇒ All transmission opportunities **MUST** be scheduled (not just deterministic ones)
- ⇒ Reserved scheduled transmission opportunities for critical traffic
- ⇒ Shared scheduled transmission opportunities & dynamic allocation for best effort

What do we need to do?

Select appropriate radios

- ⇒ Meet effective use case
- ⇒ Capability to schedule resources
- ⇒ A plus: Frequency diversity

Install a PAW flow along a Track

- ⇒ Specific Data Models for indicating Time and Frequency offsets
- ⇒ Packet ARQ, Replication, Elimination and Ordering Functions (PAREO Functions)
- ⇒ Reserve scheduled transmission opportunities for critical traffic (co-existence)

Enable OAM

- ⇒ In-band and out-of-band Measurement across multiple paths
- ⇒ In-band control of Track usage to optimize energy