Priority Access analyses:

Analyses of Priority mechanism

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Motion adopted in March:

Motion:
To add a "Distributed Time Bounded" service functionality to the Foundation MAC and to determine by the end of the May meeting whether one or both of the TBS’s will remain in the standard.
Time Bounded Alternative:

- Foundation protocol defines optional PCF to support Time Bounded.
  - Limitation due to PCF overlap problems.
  - This limits larger installations.
  - Relevant for current and future frequency bands.
    - high speed in 1.9 GHz PCS band.
    - high speed in potential 5.2 GHz band (HIPERLAN).
- Alternative for reservation based "Time Bounded" Service needed.
- Solution: Distributed Time Bounded Service (DTBS) using priority access mechanism.

TBS voice Application:

Delay variance is less important.
- Only variable transfer delay up to a given maximum is needed.
- Timing can be restored in the receiver using a FiFo.
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Required Characteristics:

- No overlap limitations between the Asynchronous and DTBS service.
- Low transfer delay for all priority levels to support "Bursty" traffic.
- Low transfer delay probability distribution for High Priority traffic.
- Maximum delay limit for DTBS acceptable to support Voice applications.
  - 20-30 msec frame times should be acceptable.
  - longer delays acceptable for local connections.
- Low impact on "Low Priority only" delay and throughput characteristics.

Priority in CSMA/CA:

“LP traffic only” efficiency issue identified, but does not show up significantly in the simulations.
Alternative Priority scheme:

- All HP stations signal their presence by generating the “Priority request Pulse” (PrP).
- Use only a long LPIFS when High Priority traffic is there.
  - Improves delay and throughput performance.

PrP based Priority scheme:

- Lower “LP-only” delay, higher efficiency.
Other PrP method issue's:

- PrP method requires synchronization between all stations.
  - To generate and recognise the PrP.
  - Receiver antenna slotting needs to be synchronized.
  - More sensitive to Rx-Tx turnaround times, and “CCA-off detection” implementations, so more critical PHY requirements.
- More complex access algorithm.
- If not all stations see “Data and Ack”, then they generate and expect the PrP at different times, so impacting the priority scheme.

PrP may jam the Ack:

- PrP impact of the “Hidden node problem”.
  - PrP may jam the Ack consistently.
  - Pure CSMA/CA has lower jam probability.
  - Solution: HPIFS should be > SIFS+Ack
- Also shows the unsynchronized PrP case.
  - Will cause leakage between priority levels.
How to decrease Ack vulnerability:

- Prevent PrP overlap increases HPIFS about 6 slots, and decrease LPIFS with 8 (at 50% CW overlap).
- Short Ack is important.

DTBS Conclusions:

- The standard should support DTBS based on DCF priority access, as already concluded in the March meeting.
- The implementation method is still to be decided, and two alternatives have been proposed.
- The PrP based method has different characteristics compared to the original doc 58 proposal.
- Solutions of the identified problems have been found, but need further specification and simulation work.
Related issue's:

- Should we support one or both TBS methods in the draft standard.
  - Position: Only DTBS

- Should the priority mechanism be optional?
  - Position: No, the priority should be considered a fixed part of the non-optional DCF.

- Should DTBS be an optional or standard service?
  - Position: Optional

- What functions need further specification to support DTBS?
  - QoS I/F, “Time_to_Live” function, HP monitor.

Additional DTBS functions:

- QoS based interface definition.

- “Time_to_Live” parameter maintenance.

- High Priority Load monitoring function.

- Issue:
  - Do we need to standardize Queue ordering functions, or is this an implementation issue.
  - Position: Can be an implementation decision.
Possible DTBS I/F:

Source TBS-LLC
- Max. delay
- Discard
- QoS
MAC Time-to-Live

DS Forwarding
- Update Max. delay and drop if needed

Destination TBS-LLC
- Max. delay
- Discard
- QoS
MAC Time-to-Live

DTBS interface considerations
- A possible TBS-LLC could have Header containing:
  - Max. Delay parameter
  - Discard parameter (to allow drop of frame that experienced a too long delay, and allow recovery of timing in the receiver).

Average Delay performance:

Average Delay versus Load
LPIFS=16, LPcw=64, HPcw=32

Significant priority difference when load increases.
Low Priority only impact:

No difference at low loads, minor impact during higher loads, showing lower throughput.

* 20 msec max delay can be met even in high priority overload case.
More Delay Distribution:

- Both Low and High Priority traffic load increases in this simulation.

Throughput:

High priority traffic gets higher throughput.