CSMA/CA Based Protocol

A Distributed Access Protocol Proposal

Supporting Time Bounded Services

By: Wim Diepstraten
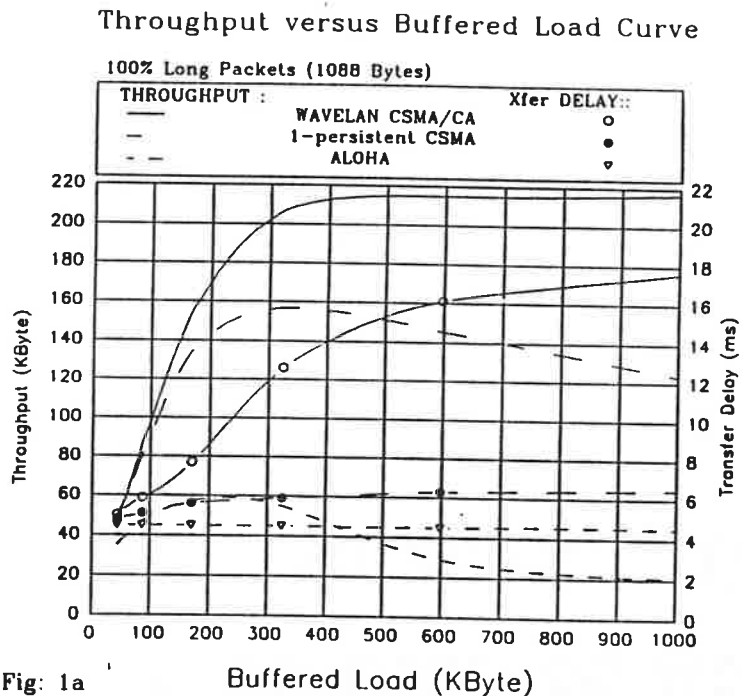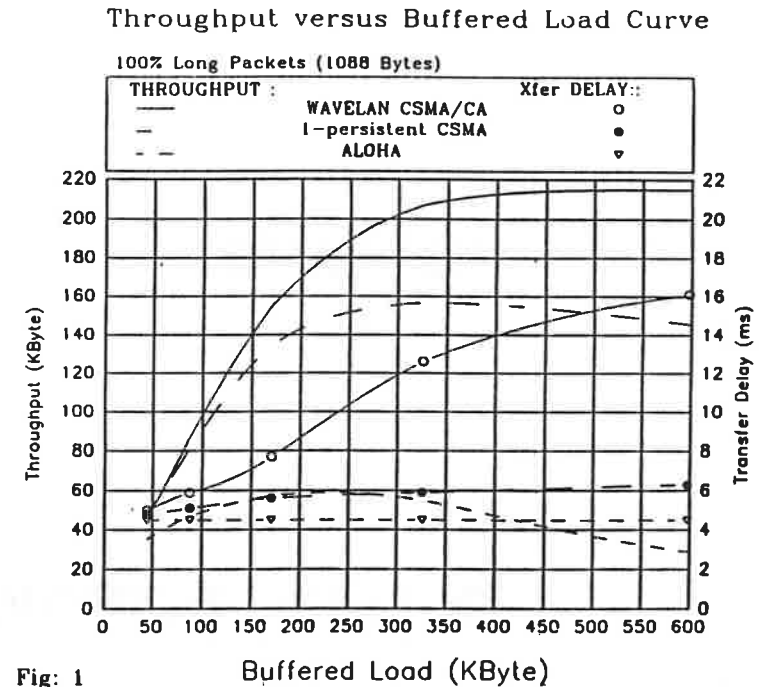
Throughput versus Buffered Load Curve

Fig: 1a   Buffered Load (KByte)

COMPARE ALOHA, CSMA and WAVELAN CSMA/CA

- WAVELAN CSMA/CA Throughput is 87% of the 2 Mbps raw bit rate.
- WAVELAN CSMA/CA is stable at high loads.
- The Delay is only calculated for those packets that get through.
- Figures include the MAC overhead.
- Load generated by 7 Stations.

Throughput versus Buffered Load Curve

Fig: 1

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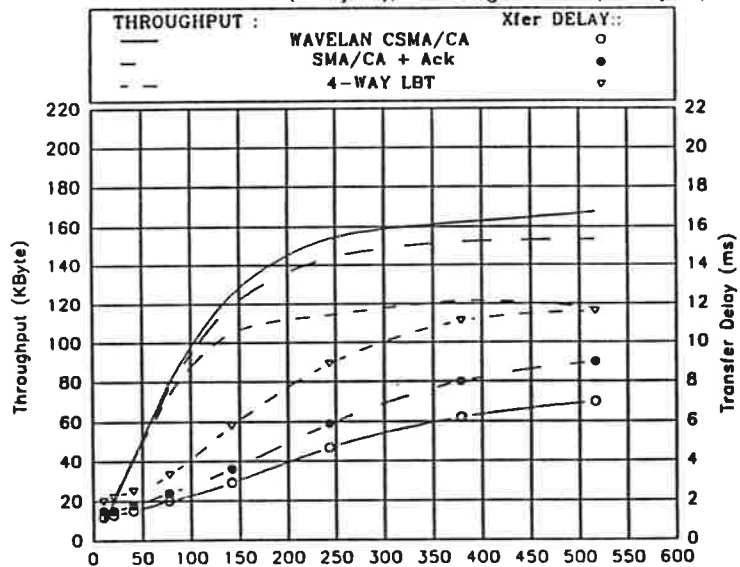60% Short Packets (64 Bytes), 40% Long Packets (576 Bytes)

THROUGHPUT :		Xfer DELAY::
—	WAVELAN CSMA/CA	o
–	SMA/CA + Ack	●
– –	4–WAY LBT	▽

Fig: 3   Buffered Load (KByte)

COMPARE CSMA/CA, CSMA/CA + Ack and 4–WAY LBT

– The Delay is only calculated for those packets that get through.

– For CSMA/CA the lost packets are not recovered so it is not included in the delay figure.

– Figures include the MAC overhead.

Throughput versus Buffered Load Curve
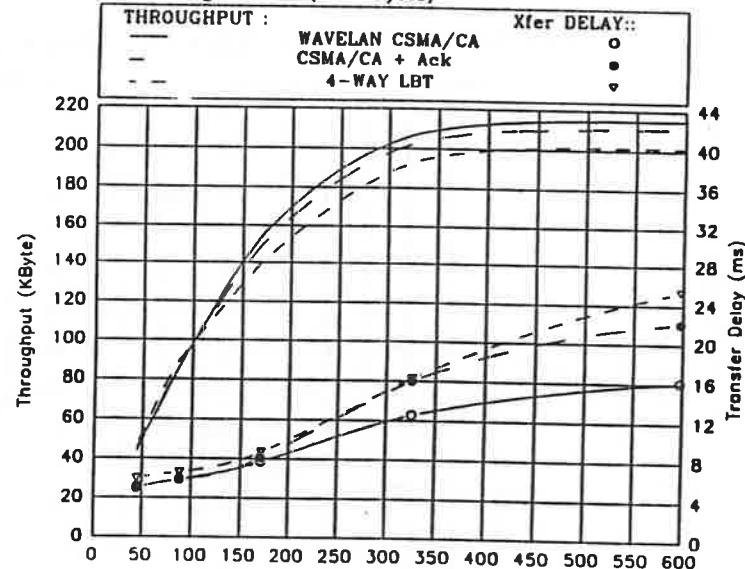
100% Long Packets (1088 Bytes)

THROUGHPUT :		Xfer DELAY::
—	WAVELAN CSMA/CA	o
–	CSMA/CA + Ack	●
– –	4–WAY LBT	▽

Fig: 2   Buffered Load (KByte)

COMPARE CSMA/CA, CSMA/CA + Ack and 4–WAY LBT

– WAVELAN CSMA/CA Throughput is 87% of the 2 Mbps raw bit rate.

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– Figures include the MAC overhead.

– Load generated by 7 Stations.

Performance versus Number of Stations Curve

60% Short Packets (64 Bytes), 40% Long Packets (576 Bytes)

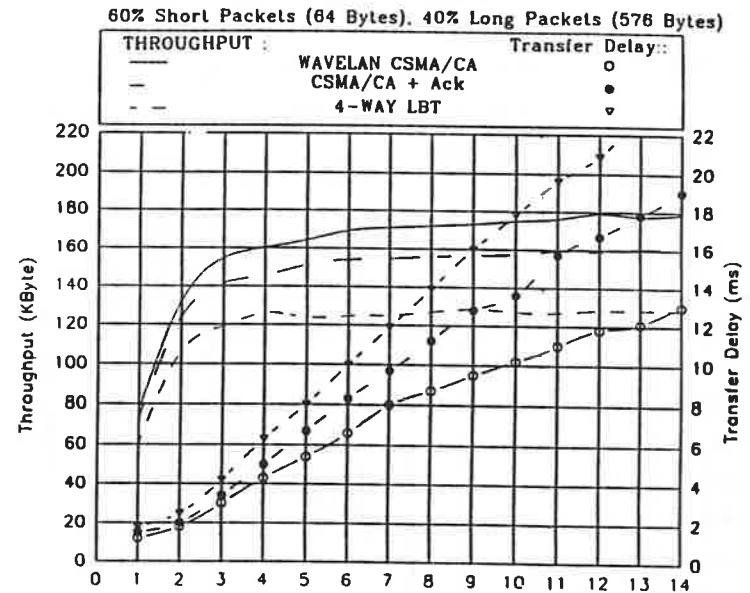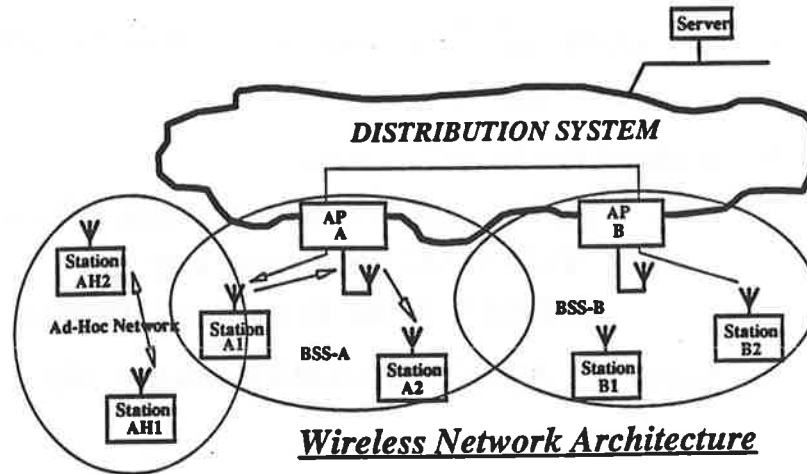Fig: 4   Number of Stations

COMPARE CSMA/CA, CSMA/CA + Ack and 4—WAY LBT

- Figures include the MAC overhead.

= Throughput remains stable for many simultaneous stations accessing the medium.

- For CSMA/CA lost packets are not recovered at MAC level

Wireless Network Architecture

Wireless Network Architecture

*   Infrastructure mode "Base Station oriented".
Default all traffic goes via the AP.

Protocol Proposal   **Slide 1**

Supported Services:

*   **Asynchronous Data Service:**
-    **Short response time with high instantaneous Throughput.**
-    **Suitable for Bursty traffic.**

*   **Time Bounded Service (Optional):**
-    **Time Bounded Service dimensioned for Voice.**
-    **Allows mixed Voice/Data.**
-    **Requires sufficient BSS isolation, (TDMA type access protocols have similar requirements).**

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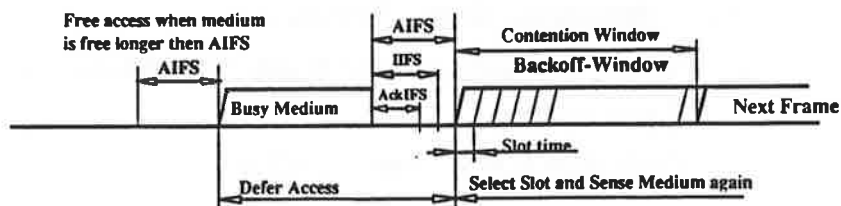
Basic Access Protocol:

*   **Use Distributed Access Protocol for efficient medium sharing.**

*   **Robust for interference.**
-    **CSMA/CA + Ack for unicast frames.**
-    **With MAC level recovery**
-    **CSMA/CA for Broadcast frames.**

*   **Supports Ad-Hoc operation seamlessly**

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CSMA/CA explained:

CSMA/CA Access Methodology with Isochronous capability
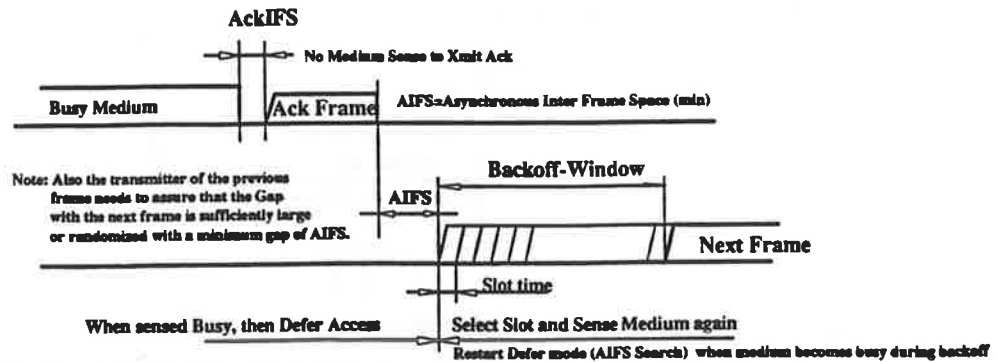
*   **Reduce collision probability where mostly needed.**

*   **Implement different priority levels.**
   (to allow immediate Ack and Isochronous coexistence)

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CSMA/CA+Ack Access Protocol

CSMA/CA + Ack Asynchronous Access Methodology

* **Exponential Backoff with Access Retry limit.**
* **Retransmission after Random delay when no Ack received.**
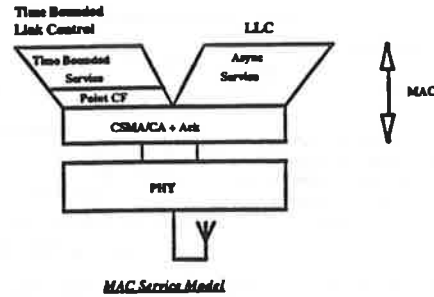

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Async service Characteristics:

* **Short response time, and high throughput efficiency similar to 802.3 CSMA/CD.**

* **Lost packets due to collisions and/or interference are recovered at the MAC level.**

* **Stable under high Load conditions.**

* **Efficient Medium sharing without added control overhead.**

* **Includes Coexistence Provisions for Time Bounded Services.**

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Async/Time Bounded model:

MAC Service Model

*   **Data, Voice or mixed implementations possible.**

*   **Time Bounded Service uses Point Coordination Function.**

*   **Time Bounded capability does not burden the Async service implementation.**

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Time Bounded Characteristics:

*   **Built on Asynchronous Access method.**

*   **Uses CSMA/CA + (Ack) with highest priority.**
   -    **With limited Asynchronous recovery.**

*   **Dimensioned to support mixed Voice/Data.**

*   **Video support possible at higher PHY rates.**

*   **Isochronous Framing Period is PHY speed dependent IFP= 20-25 msec for a 2 Mbps PHY.**

*   **Unused reserved Isochronous Bandwidth can be used for Asynchronous traffic.**
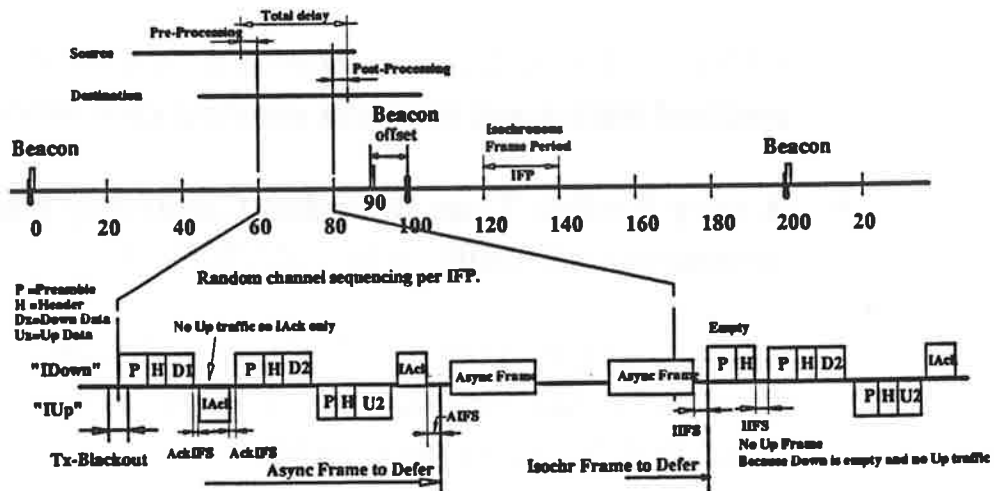
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Time Bounded Characteristics:

* Can support different PHY speeds (1-20 Mbps)

* Support variable packet size on a per frame basis, without control overhead.
  - Can take full advantage of "Talk Spurt" characteristics of Voice.
  - Allows flexible congestion control.

* Includes provisions for Power Consumption Management.

* Includes basic re-association provisions.

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Time Bounded Services (Cont.):

Isochronous Access Protocol

* Time Synchronization assumed by regular Beacon.

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Performance Example:

*   Assumption: 32Kbps ADPCM Voice
                             15 Byte MAC + Wavelan PHY Overhead

*   Example: @ 2 Mbps Modem speed:

Voice only: 28 FDX (using talkspurt)
Voice/Data   576 Byte: 23 FDX (using talkspurt)
Voice/Data 1500 Byte: 18 FDX (using talkspurt)
Voice/Data 1500 Byte: 9 FDX (100% load)

Async Data throughput: > 75 KByte/sec (assuming max Isoc load)
Async Data throughput: >130 KByte/sec (assuming 9 FDX Talkspurt channels)
Async Data throughput: >200 KByte/sec (no Isoc connection active)

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Conclusion:

*   CSMA/CA + Ack is an efficient distributed access
  method with good medium sharing characteristics.

*   A very flexible Time Bounded Capability has been
  demonstrated, built on top of CSMA/CA.

*   Added advantage over TDMA is its frame size
  flexability and optimum Asynchronous and Time
  Bounded sharing characteristic.

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Service required from the PHY
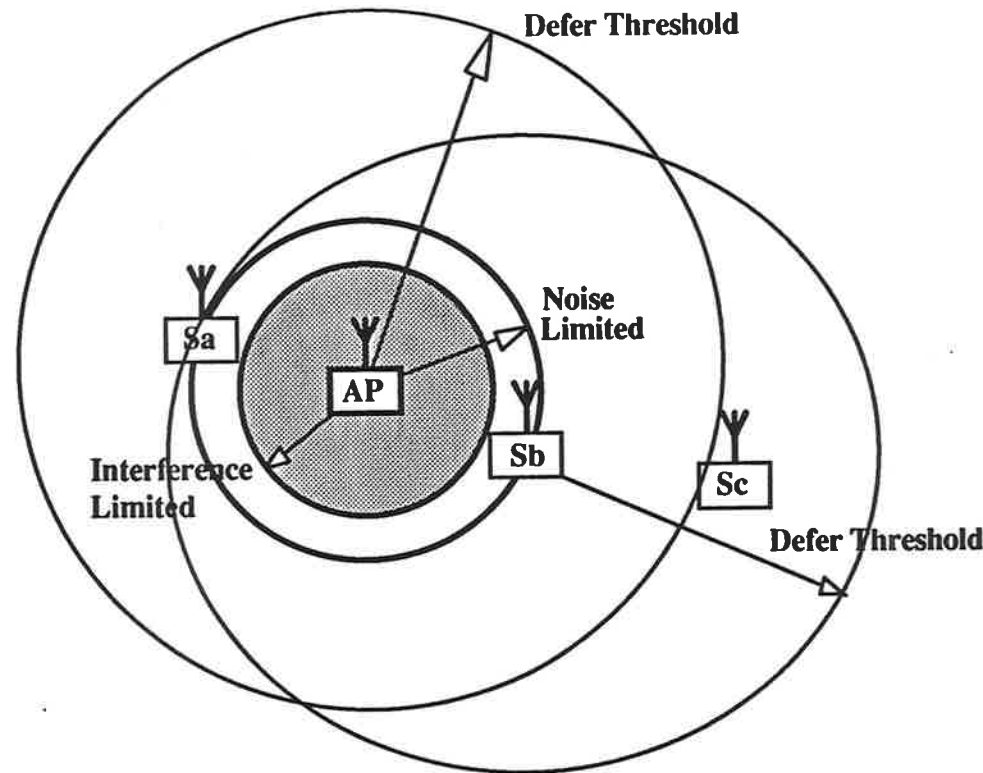
*   **Fast CS function with approx. 10 dB more sensitivity than the acceptable Data quality level.**
*   **Fast Rx-to-Tx Turnaround time.**

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