



# IEEE P1451.5 Wireless Sensor Interface Working Group Bluetooth Subgroup Proposal

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## Bluetooth Features for IEEE1451.5

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**Bluetooth has many features that make it a suitable wireless technology for IEEE1451.5**

- Device Discovery
  - Bluetooth Inquiry mode allows devices to be discovered
  - The Class of Device identified during inquiry allows filtering for device types
  - Bluetooth Service Discovery Profile (SDP) allows for browsing for features and services
- Connections
  - Bluetooth allows piconets with point to multipoint connections of up to 7 slaves to one master
  - More devices can be served by making fast connections (as low as 20 msec)
  - Data rates up to 723 Kbytes using asynchronous (ACL) channels
  - Bluetooth 2.0 + EDR specification using PSK modulation allows data rates to 2.1 Mbps
  - Synchronous (SCO) channels for data streaming
  - Reliable ACL channels (with retransmission)
  - L2CAP layer implements service multiplexing and fragmentation and reassembly
  - Quality of Service is negotiable to include low latency or high reliability channels
  - The Bluetooth clock can be used to implement time synchronisation across a piconet
  - Low power modes to allow battery powered devices with life in years



## Bluetooth Features for IEEE1451.5

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- Architecture
  - Bluetooth protocol stack can be implemented on two processors as a host and controller (radio) using the Host Controller Interface (HCI)
  - NCAP can implement the host on a second processor with controller on a single chip Bluetooth device for maximum performance in multipoint scenarios
  - TIM can be implement on a single chip Bluetooth device (no extra microcontroller)
  - Complete single chip TIM measurement systems possible with re-use of chips containing ADCs and DSPs designed for commercial audio applications
- Commercial
  - Many commercial PDAs, PCs and mobile phones support Bluetooth
  - Low cost re-use of commercial technology for industrial market
  - Bluetooth is shipping now in volume – over 5 M solutions per week now
  - EDR solutions shipping now in PCs, at lower cost than 1.2 devices
  - Chip prices now below \$4, falling to \$2 in 2006

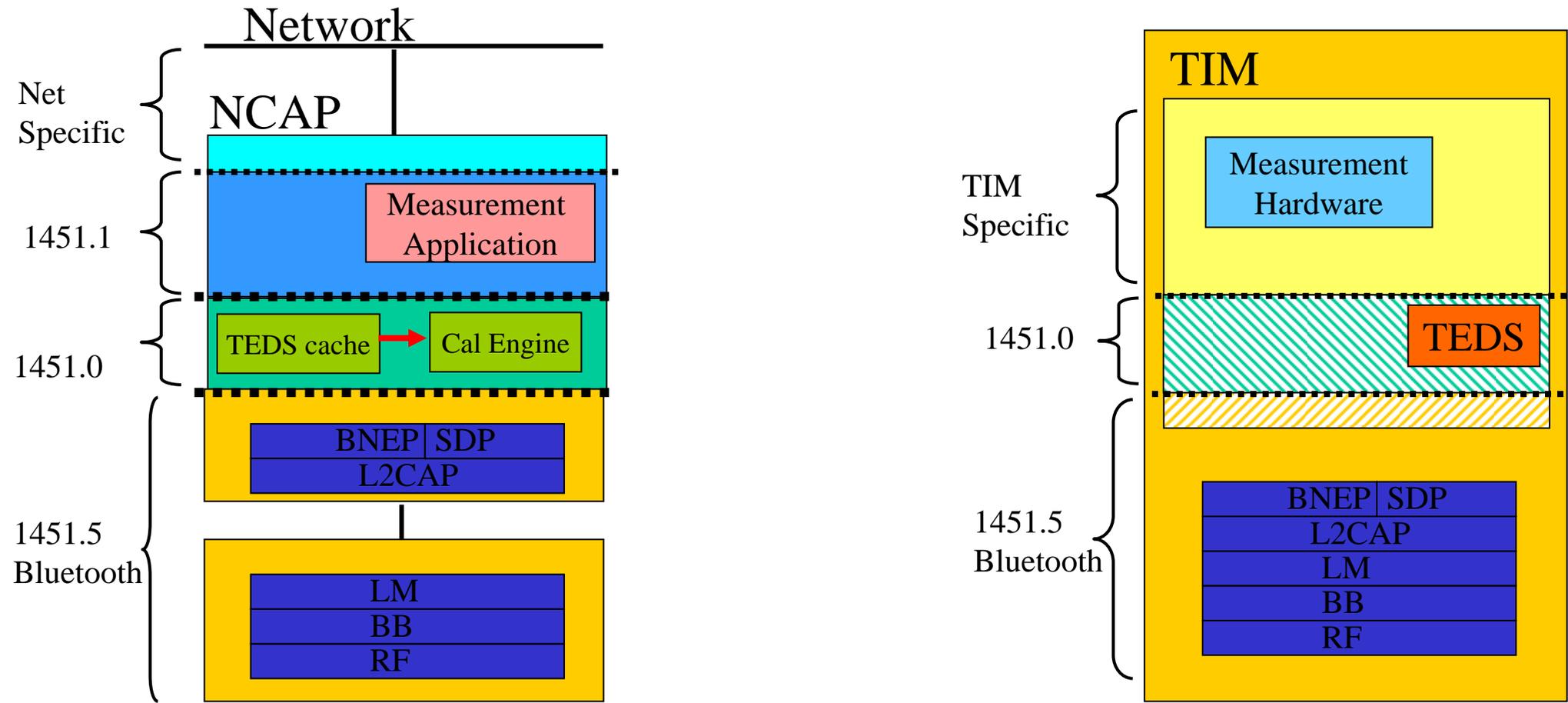


## Bluetooth Proposal for IEEE1451.5

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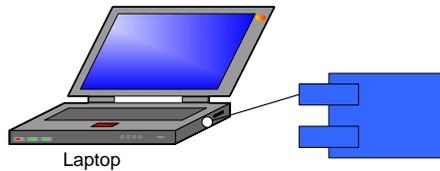
- Architecture
  - IEEE1451.5 implemented using Bluetooth Network Encapsulation Protocol (BNEP) transport
  - BNEP is lightweight protocol with as low as a single byte overhead
  - Allows re-use of Bluetooth address (MAC address) to reduce protocol overhead in point to point links
  - BNEP can also transport IP packets, so alternative implementations or extensions to include routing are possible.
  - High level API for BNEP and stack implementation is not a standard interface, so the Dot5 specification describes Bluetooth functionality, not a formal interface.
  - NCAP to TIM interoperability at the upper Dot0 application interface is proposed as the means of testing.
- Channels
  - Use ACL channels for datagram triggering and streaming services
  - Use Bluetooth clock for synchronisation
  - Use QoS interface to configure data channels
- Device Discovery
  - Using Bluetooth Inquiry and Paging modes
- TEDS
  - Single chip TIMs can use SDP database to store TEDS
  - SDP protocol allows for efficient TEDS browsing and retrieval from NCAP
- Performance
  - Proposed IEEE1451.0 datagram could be carried by the smallest Bluetooth packet (17 byte payload) so single readings can be transported in a single data packet for maximum throughput and minimum latency.

# Bluetooth IEEE1451.5 Example





# Development Roadmap



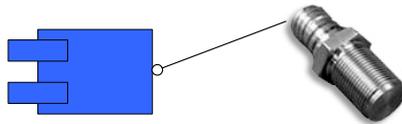
Laptop  
Laptop based NCAP  
Development Kit with plug  
in Bluetooth radio



Laptop  
Laptop NCAP with  
integrated Bluetooth radio



Access Point Bluetooth  
NCAP



TIM Development Kit  
based on processor with  
integrated Bluetooth radio  
and interface to sensor



Fully integrated Bluetooth  
Smart Sensor with TIM  
implemented on single  
chip Bluetooth radio



## Summary

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- Bluetooth offers industrial users a low cost, high performance and secure wireless technology that is mature and in mass commercial production.
- The proposal can take advantage of developments in Bluetooth, including Enhanced Data Rate (EDR) which increases data rate to over 2 Mbps, but also offers lower power consumption and chip prices.
- The proposal will make use of existing Bluetooth protocols and profiles so only thin dot0/dot 5 applications will have to be implemented.
- Bluetooth radios have been supplied to the dot0/dot5 development teams for specification prototyping.
- Bluetooth TIM and NCAP development kits are in development and will be available later this year.
- Work is starting on interoperability type test specifications as used by Bluetooth profiles to build on Bluetooth Qualification.