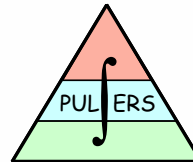


MB-OFDM UWB

The Universal Protocol Abstraction Challenge

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Software Systems Architect



Pervasive **U**ltra-wideband **L**ow **S**pectral **E**nergy **R**adio **S**ystems (Phase II)



Summary of Presentation

- Identify and describe growing requirement for UWB devices to support multiple concurrent Protocol Abstraction Layers (PALs)
 - Heterogeneous set of WPAN application profiles that abstract the convergence architecture services
- Description of Convergence Architecture (CA)
 - Multiplexing control and data services to multiple PALs
- Reveal the architectural challenges facing the 'Universal' Protocol Abstraction scenario
 - Is transferring an MP3 file to my mobile using BTv3.0 while calling a friend using VOIP or browsing the Web over WiNet simply a dream?
 - Discuss practicalities of supporting multiple concurrent application profiles and protocols
 - Propose high-level architecture

Part 1

Reveal the 'Universal' Protocol Abstraction Scenario



WiMedia MB-OFDM 'profile'

- High data rate (to 480 Mbps), low-range wireless technology
 - Uses unlicensed radio spectrum from 3.1 GHz to 10.6 GHz
 - Provides good co-existence with other radio frequency technologies
 - Low transmission power limits the communication distances to typically less than 10-15 meters
 - Low transmission power is achieved by spreading the energy across 528-MHz bandwidth
- Enables a Variety of Application Scenarios

Changing Landscape of Short-Range Wireless Communications

- WiMedia UWB seems set to emerge from the shadows in 2007
 - Tzero Technologies chipset used in several products exhibited at CES (including a high-definition TV extender from Gefen)
 - Wisair's chipset used in Belkin's WUSB hub exhibited at CES
 - HP revealed its vision for the future of mobile devices by unveiling, as a concept, a wearable wireless communications hub (ZDNet, October 2006)
 - Korean wireless carrier SK Telecom announced plans to use Staccato's chipset to deliver the first UWB personal-area-network (PAN) services via mobile phone (Mobile Radio Technology 2007)

Battle for the 'Fourth Screen'

- Next generation personal communicators much more than just a 'cell phone'
 - Music, entertainment, productivity tasks and communications from a mobile handset
- Features focus on multimedia content
 - CES '09 and the Apple iPhone
- WiMedia UWB technology likely to be at the centre of delivery of media files in WPAN
 - Local area networking--WiNet
 - Personal computer download--WUSB
 - P2P interaction with other portable devices--BTv3.0



Personal Communicators & WiMedia UWB

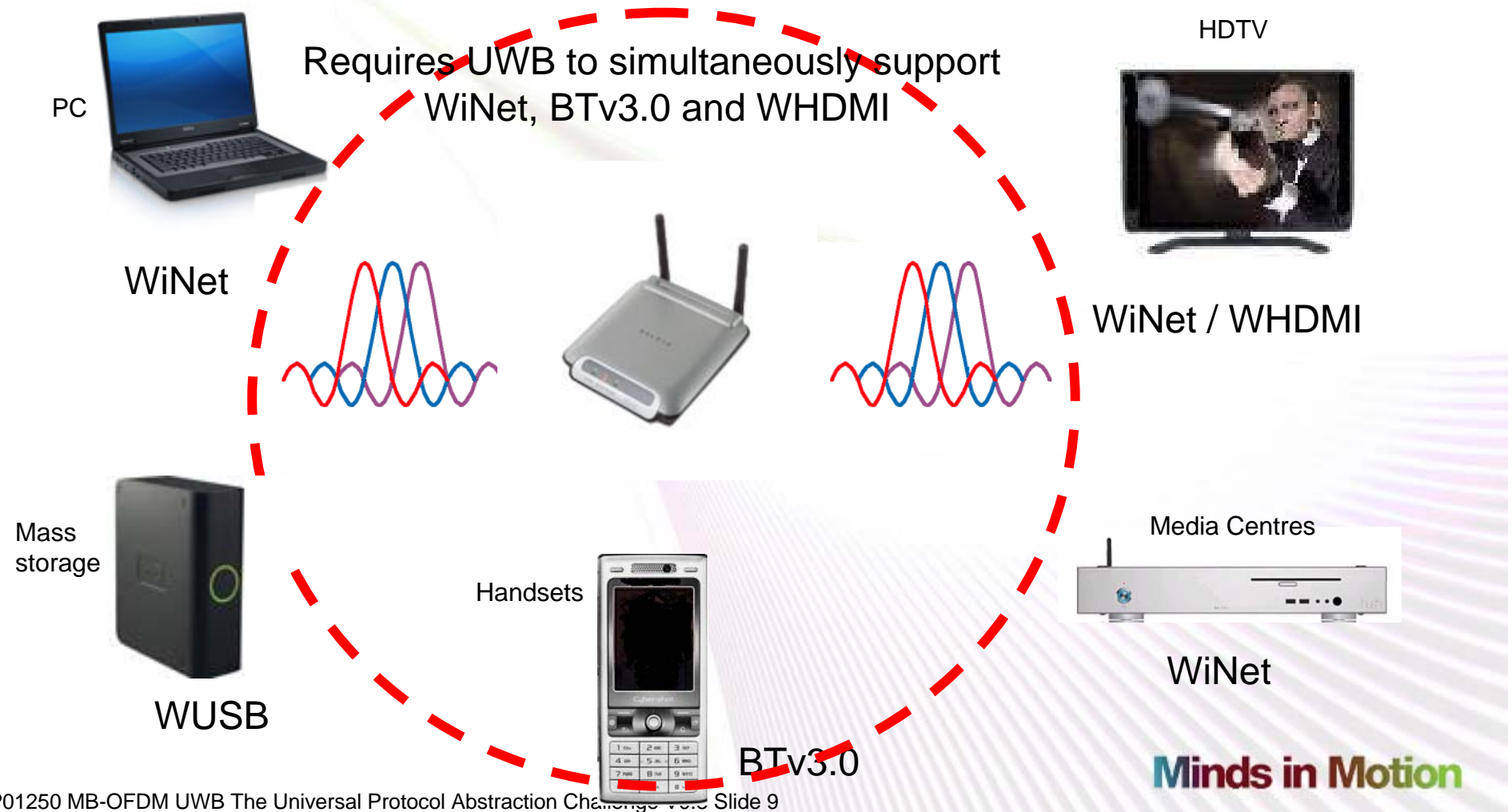


Requires device to simultaneously support WUSB, BTv3.0 and IP traffic over WiNet

WiMedia UWB & Mobile Applications

- **Mobile to PC / mass storage using WUSB**
 - Synchronise files between PCs & handsets
 - Print photos, MP3/4 files or documents
 - Wireless interface to hard drives for external storage
- **Mobile to access point using WiNet**
 - Delivery of IP-based media content to include television and music
- **Mobile to mobile using BTv3.0**
 - Sharing files, productivity tasks & media files while maximizing battery-time through hybrid radio architecture

Access Points & WiMedia UWB



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WiMedia UWB & Universal Gateway

- Access point to PC / media center using WiNet
 - Wireless DSL bridging / router
- Access point to handset using BTv3.0
 - Delivery of IP-based media content to include television and music
- Access point to HDTV using WiNET/WHDMI
 - AV streaming from multimedia center to HDTV

Part 2

Description of Convergence Architecture

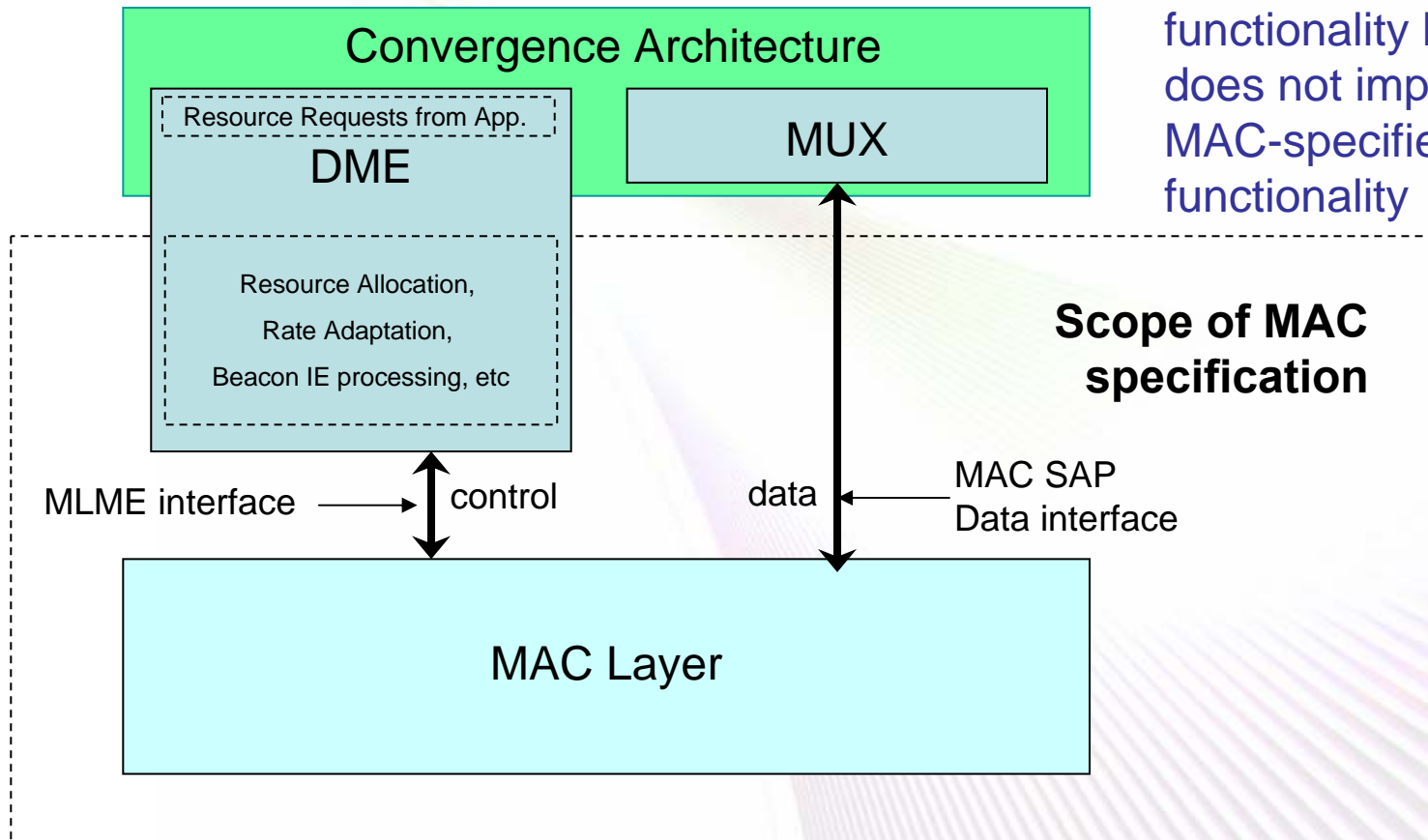


Convergence Architecture

- ECMA 368 Specification defines two entities required to support concurrent higher layers
 - DME: Device Management Entity
 - General system management entity that provides standard management services
 - MUX: Data Multiplexing Interface
 - Enables the coexistence of concurrently active higher layer protocols within a single device by providing data path multiplexing services
- Convergence architecture layer provides:
 - Data [de]multiplexing services into the single MAC data port
 - Control and arbitration of system-wide resources between multiple PALs
- Convergence architecture also contains:
 - High-level MAC layer functions to provide full normative WiMedia implementation

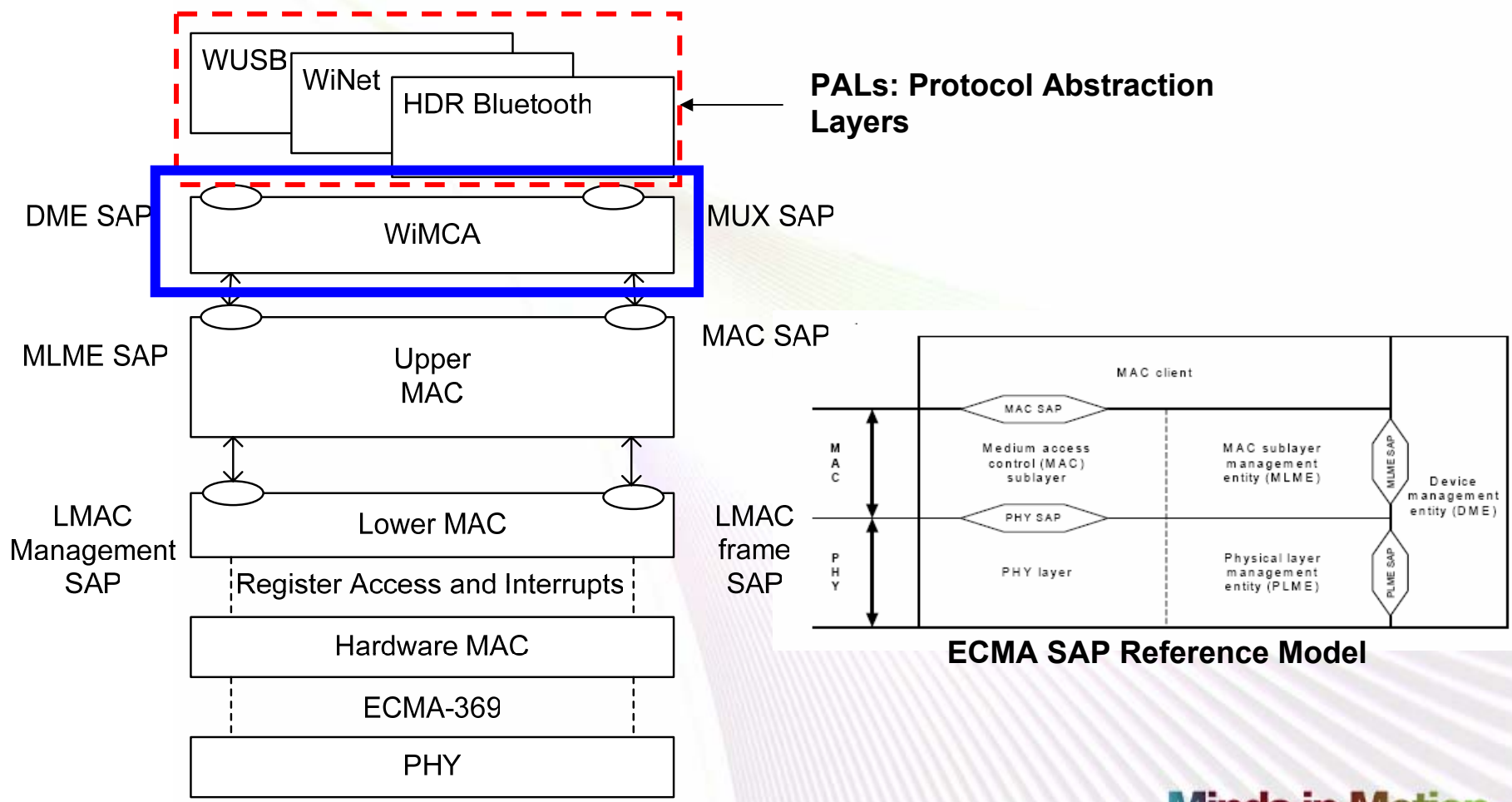
Scope of Convergence Architecture

Without the DME / MUX functionality MAC layer does not implement all MAC-specified functionality

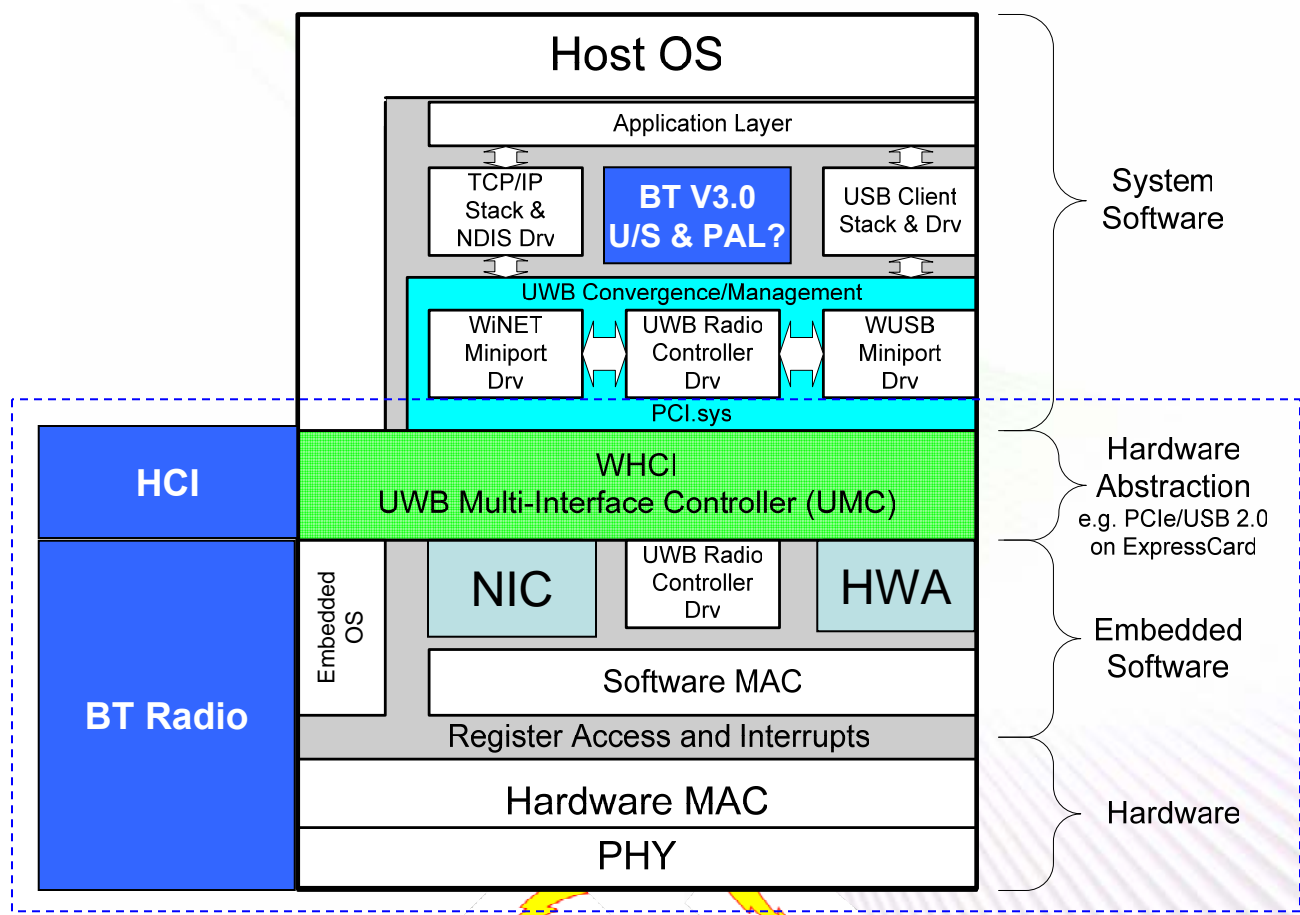


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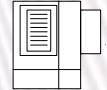
Convergence Architecture



Possible Wireless Host Architecture



WiNET peripheral
e.g. Projector

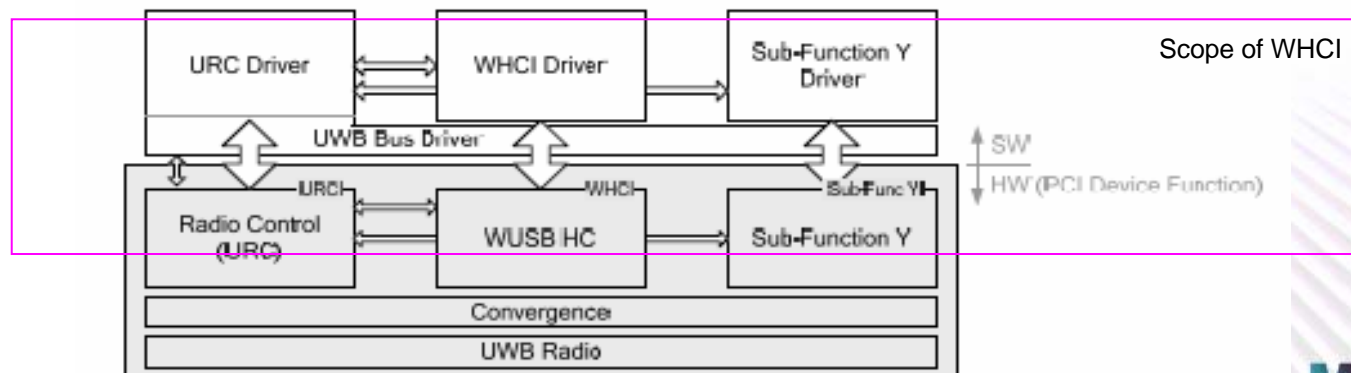


WiUSB peripheral
e.g. Printer

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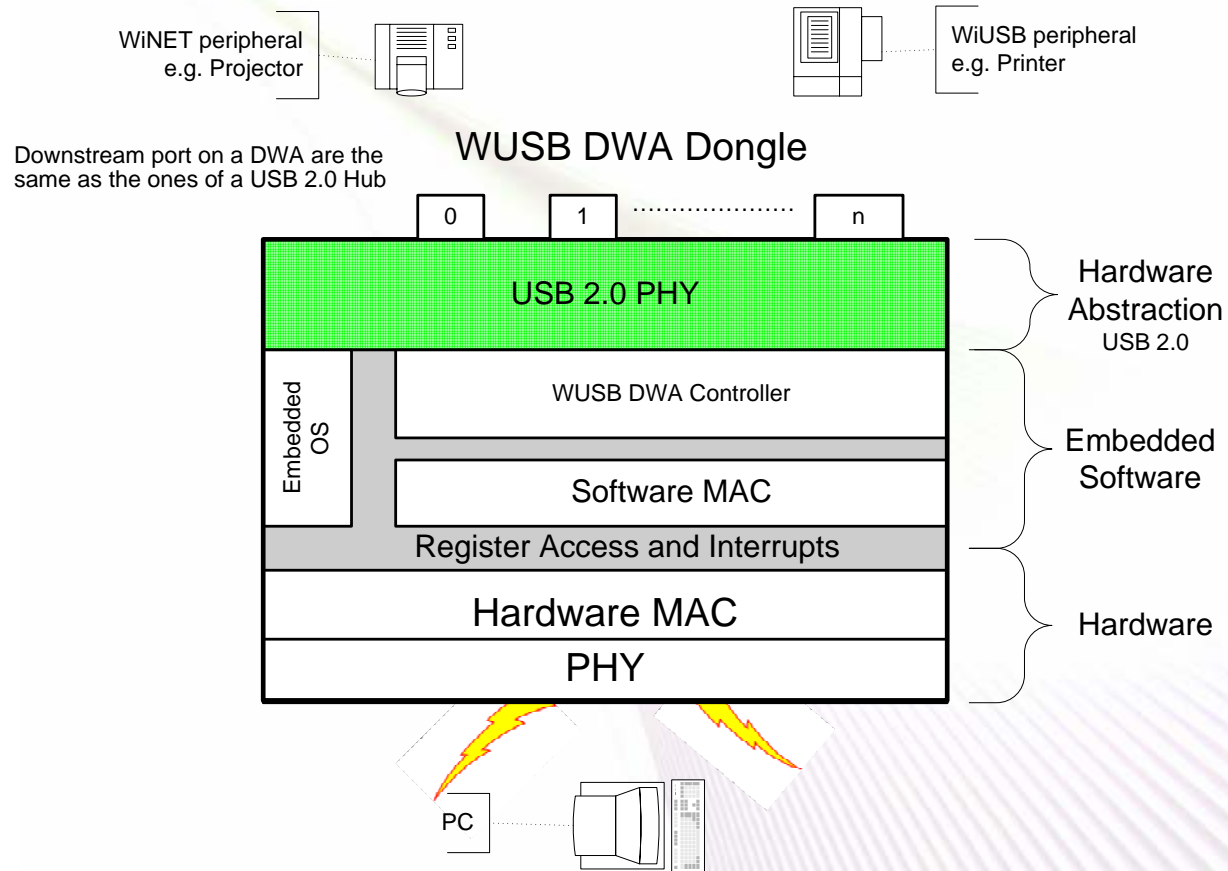
PCI Host Architecture

- Wireless Host Controller Interface (WHCI) specification describes:
 - PCI / PCIe configuration registers
 - Register-level HW / SW IF between host system SW and host controller
 - UWB Multi-Interface Controller (UMC)
 - UMC is a hardware functional component for the WiMedia UWB radio platform
 - Provides UWB Radio Controller Interface (URCI)
 - WUSB HC Capability and Operational registers
 - Version 0.95 WHCI focus is WUSB Host System
 - Future versions may support more Protocol Adaptation Layers (PALs) functions such as WiNet



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Probable WUSB Device Architecture



Part 3
Describe Architectural
Challenges



Introducing the Universal Protocol Abstraction Challenge

- Three architectures specified
 - WHC using PCI, HWA & DWA using USB 2.0
- How could support for multiple applications be integrated using concurrent PALs on mobile/handheld devices?
- The Universal Protocol Abstraction Challenge...

View of Mobile Device / Handset Integration

- **Standardized hardware interface**
 - Modular with compact form factor
 - SDIO e.g. WiFi and Bluetooth SDIO cards
- **Reduce complexity of host software and provide simpler integration**
 - Push Convergence, PAL software & interfaces below hardware abstraction
 - Move in same direction as Bluetooth single chip solution i.e. profile level interfaces become PAL-level interfaces
- **Expandable/extendable feature support**
 - Low, medium and high-end options offering differing protocol options WUSB, WiNet, BT V3.0...

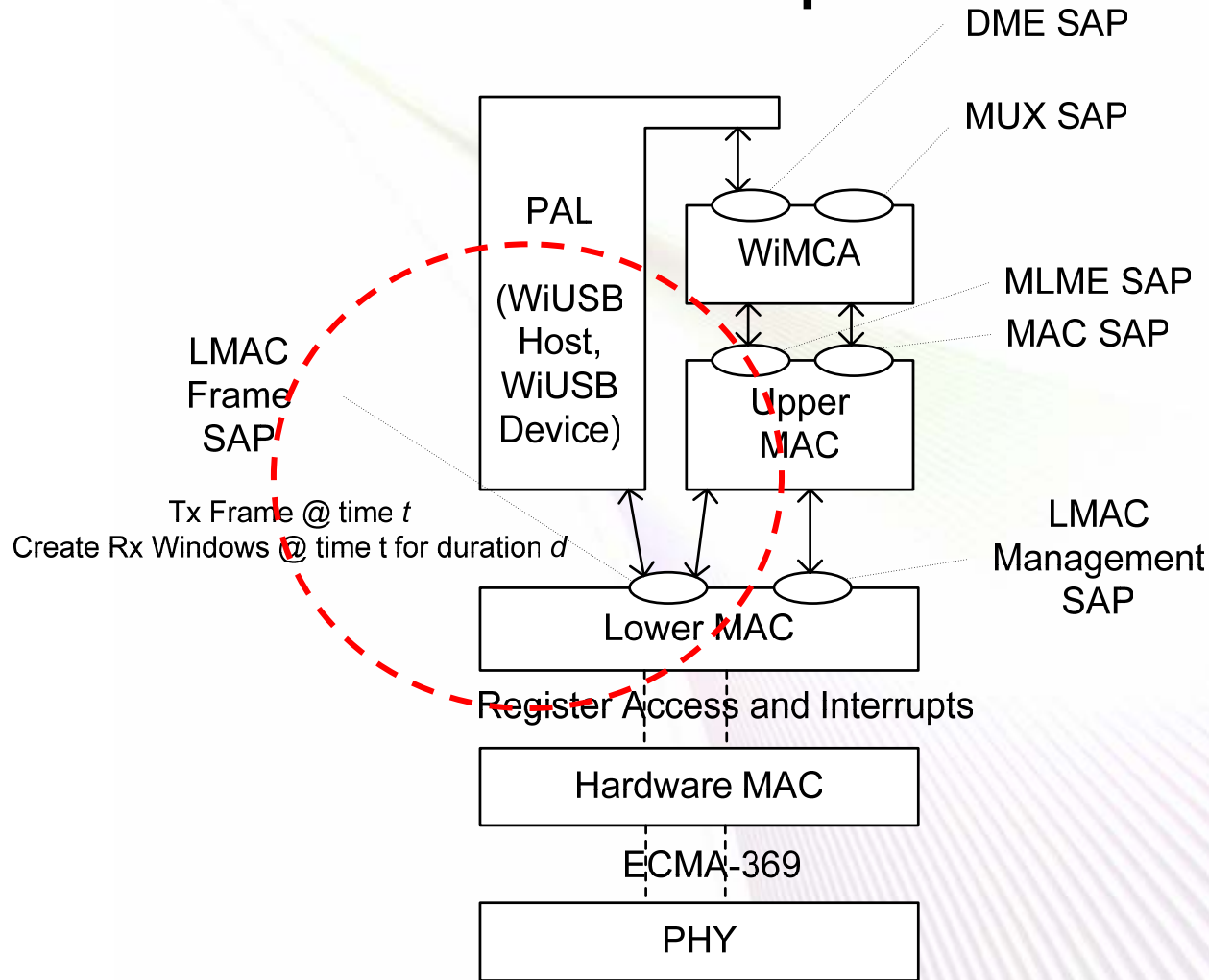
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WUSB Issues To Overcome

- Concurrent support of WUSB and other PALs challenging
 - WUSB Specification v1.0 is not compatible with Convergence Architecture concepts and some parts of the WiMedia MAC specification e.g. directed beaconing and non-beaconing devices
- Host must ensure MMC transmissions begin on micro-second boundaries +/- 40 nanoseconds
 - WUSB clock (synchronised to WiMedia superframe clock) is used to define frame scheduling
 - Every MMC contains the WUSB time of the next MMC (chaining) and list of transmit descriptors defining timing of all subsequent data out, data in and handshake frames
 - Coding selection is per frame, not per device/delivery ID
 - MMC packets always at low rate (53.3 Mbps)
 - Data packets at rate supported by host and device

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Architectural Impact of WUSB

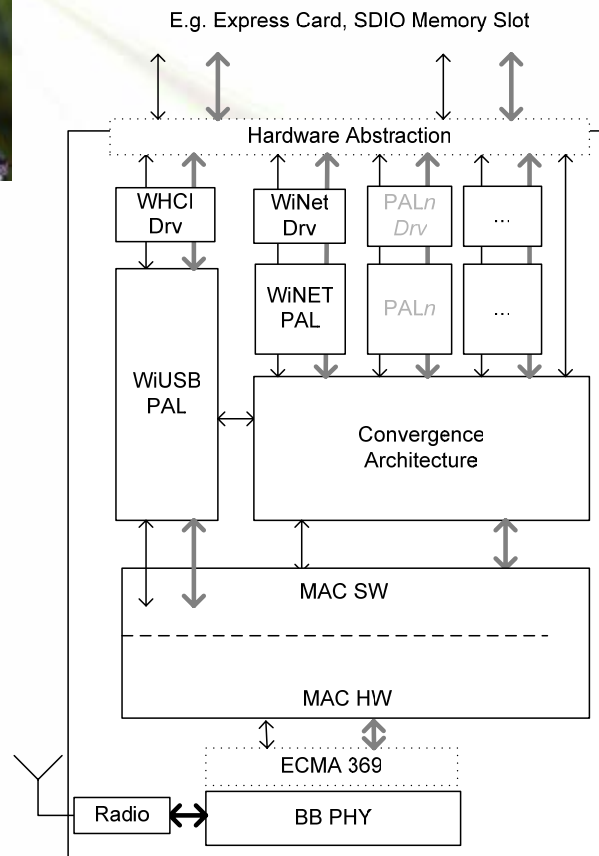


Consider Formalizing Convergence Architecture

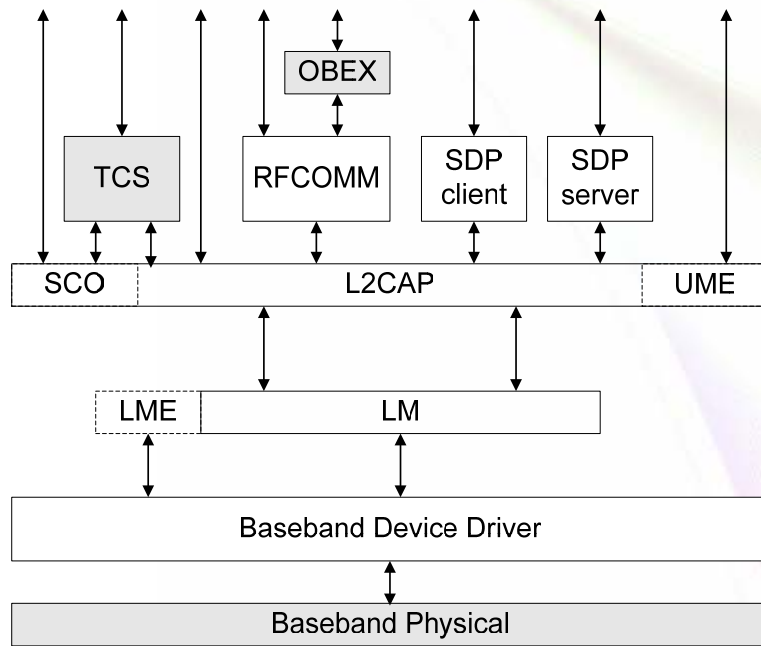
- Specify the normative parts of the MAC specification defining DME/MUX
 - Don't believe there's momentum or inclination...
- Specify SAPs & Standardise Service Primitives
 - Perhaps there's new-found motivation based on BTv3.0
- Consider impact of regulatory landscapes & BTv3.0 spectrum
 - BTv3.0 to use unlicensed radio spectrum above 6 GHz
 - European and Japanese regulatory masks significantly different from US
 - Restrictions on BG#1 (DAA, low duty cycle), restriction on BG#3 & BG#5

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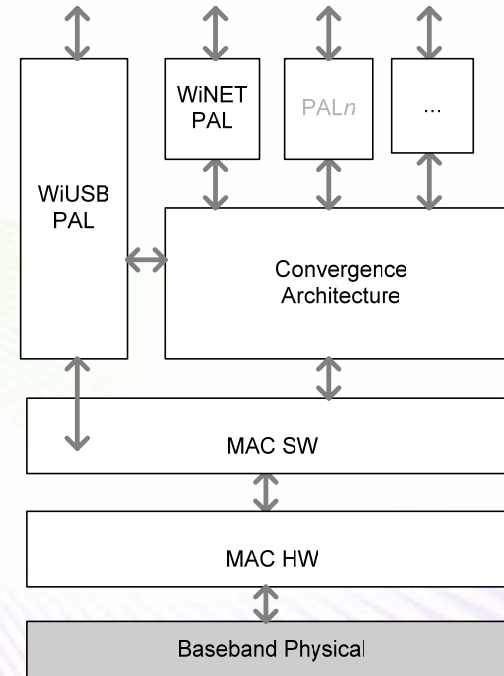
Proposed High-Level Architecture



Comparison of Bluetooth & WiMedia



Bluetooth



WiMedia UWB

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Summary of Architectural Challenges

- UWB Architecture in mobiles / handhelds similar to current Host proposals
- Clear benefits from:
 - Reduced complexity of host software
 - Push Convergence Architecture onto host controller
 - Better integration of WUSB and Convergence Architecture and WiMedia MAC
 - Standardized hardware interface with compact form factor

Introducing

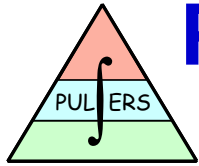


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 - UWB Service Offering
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Pervasive **U**ltra-wideband **L**ow **S**pectral **E**nergy **R**adio **S**ystems (Phase II)

- Research presented partially supported through participation in Project PULSERS
- Industry-led initiative of 36 major industrial and academic organisations
 - PULSERS started January 2004 within the IST Programme (FP6) of the 6th EU Framework Programme
 - Phase II continues and extends the successful work carried out in Phase I
 - Aims to research Ultra Wide Band (UWB) innovative devices
 - From proof of concept and arriving to fully working experimental prototypes enabling verification of the objectives and the technical approach

<http://www.pulsers.eu>

Example: Portable Media Player Ref. Design

- TES CDM reference platforms are designed to be time-to-market accelerators for specific products
- Integration candidate for proposed 'Host-less' WiMedia based UWB architecture
- "Host-less" architecture would help to free resources on the DaVinci processor for some other, better use (graphics, audio, video processing, as required...)
- CDM/RP DVMM is based on TI's new line of highly integrated TMS320DM6446 DaVinci™ processor



HARDWARE FEATURES

- TI DaVinci DM6446 SOC with ARM9 and C64 DSP
- 128 MB DDR2 RAM,
- 16MB NOR Flash
- 32MB NAND

Display

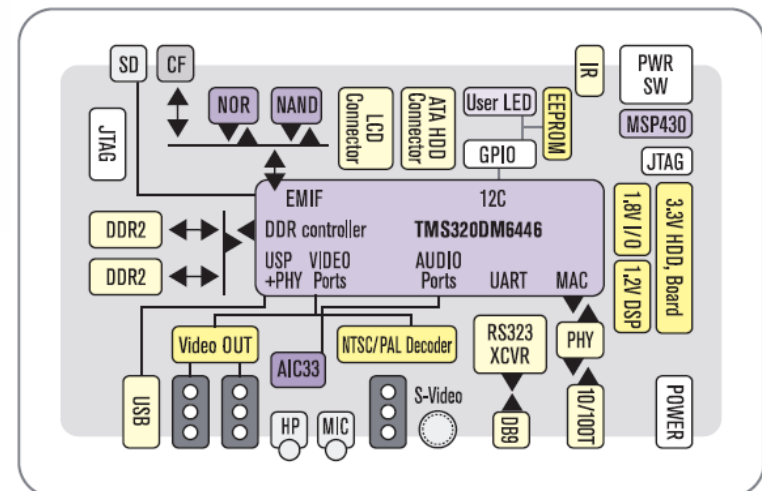
- QVGA LCD

Mass Storage

- 2.5" 80GB 5400RPM HDD
- Compact Flash and SD support

General I/O

- Programmable IR receiver
- 10/100 base-T Ethernet
- On board power supply
- Programmable GPIO and LED
- USB 2.0 host support



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Thank You!



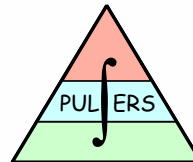
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 **TEXAS INSTRUMENTS**

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