EUWB: Research and development efforts in area of IP delivery over Ultra-wide Band

WALTER Plenary Session

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Background : WUSB only future for UWB?

- EUWB partners believe that a UWB solution based on the ECMA 368 (WiMedia) standard has a future outside WUSB…

- Why?
  - UWB out performs 802.11g/n, the closest alternative technology, in terms of;
    - Maximum achievable application level throughput
    - Power consumption; particularly in terms of energy per bit

      Eb = P*T ***energy per Bit*** (where P is the power and T the ***bit*** duration)
    - Design-in complexity; particularly in terms of antenna complexity

Background : IP is King!

- EUWB partners propose that, complementary to WUSB, an Internet Protocol (IP) based approach is possible
  - Many applications require flexibility and ubiquitous approach supported through transport over the internet protocol
  - Can still use ECMA 368 (WiMedia) standardised approach to deliver IP packets over UWB
  - How can we provide a simple transport for IEEE 802.3 frames over a WiMedia compliant MAC?

Objectives of this presentation

- *Describe the efforts of the EUWB partners in the areas of Internet Protocol delivery over UWB*

- *Promote and harmonise a common understanding of our motivations and objectives*

Introduction

- Contents
  - Brief summary of the objectives of EUWB
  - Introduction to the application 'clusters' which require Internet Protocol delivery *over* UWB
    - *Identifies where the requirements or '**pull**' for Internet Protocol delivery over UWB is emerging*
  - What is the status of IP delivery over UWB in EUWB today?
    - *Describes the efforts and current status of the research and development effort in the area of Internet Protocol delivery over UWB in EUWB*
  - What is the future of IP delivery over UWB in EUWB
    - *Where do we want to develop our approach to IP delivery over UWB in the future?*

Brief summary of Objectives of EUWB

- EUWB - Coexisting Short Range Radio by Advanced Ultra-Wideband Radio Technology
  - Built upon previous PULSERS and PULSERS II EU Research and Development projects
  - Framework 7 Research and Development Project, 21 major industrial and academic partners from Europe and Israel
  - Started in April 2008 and will last three years
  - Goals :
    - Facilitate growth of UWB technology in a number of market segments;
      - Public transport, automotive and home environment
    - Market segments may be different, but all enabled by the unique features of UWB Radio technology;
      - Highly scalable with regard to complexity, operating range, costs and data throughput as well as location precision accuracy
      - Combination of high data rate (e.g. WiMedia / ECMA 368) and low data rate approaches UWB and 60 GHz
    - Support standardisation and regulation activities that will promote and complement these research and development activities

Web site: http://www.euwb.eu/

Introduction to HDR Application "clusters"

- Work packages and their tasks are organised to address so called logical application "clusters"

- Of these "clusters", public transport and home environment applications use deliverables which support IP delivery over UWB based on HDR research and development activities
  - Automotive scenarios use LDR UWB approach
    - Sensor cable replacement within the car
    - Localisation of tags in the car 'cabin'

- For IP delivery over UWB, the public transport and home environment applications are most relevant and are discussed in the following slides

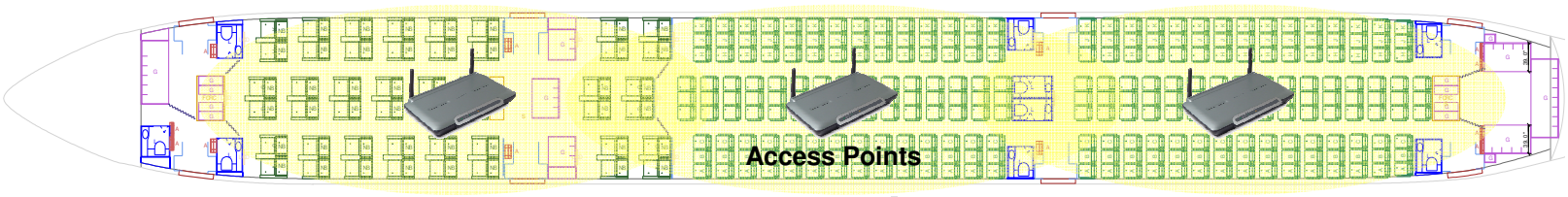
Public transport cluster objectives (1)

Scenario: Wireless Applications in Aircraft Cabin

Flight Attendant Terminal

Cabin Illumination

Passenger Service Units



Access Points

Mobile Flight Attendant Terminal

Signs & Buttons

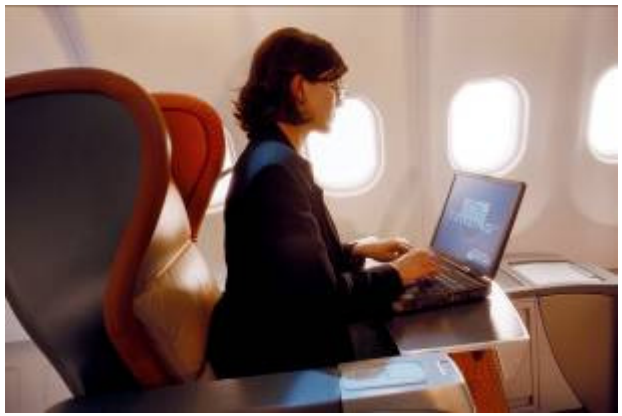
Surveillance Cameras

Sensors

Passenger Entertainment

Public transport cluster objectives (2)

1. Wireless Network Infrastructure for *Passenger Communications*
   - In-Flight Entertainment
   - Access to intra/internet with PED



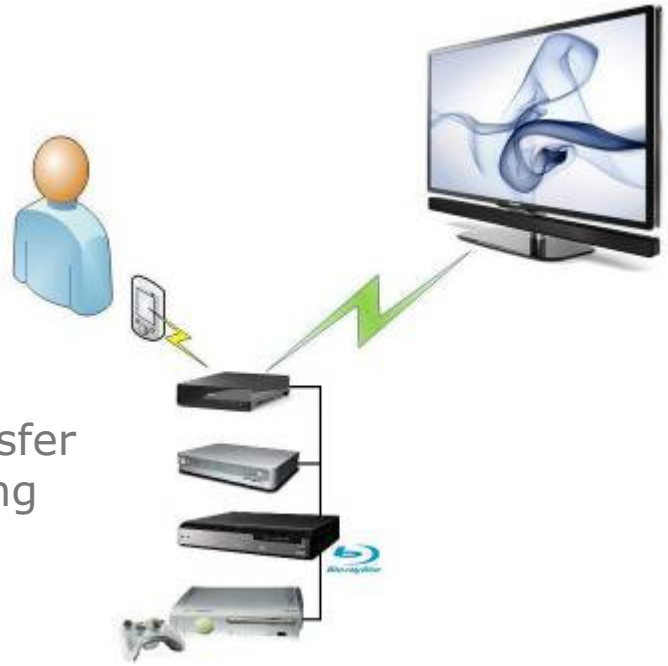
2. Communication Between *Onboard Devices*

- Connect and locate mobile or fixed cabin devices reducing cable needs
- Locate wireless devices

Home environment cluster objectives

- Focuses on two application scenarios
  - Multiband/multimode UWB platform activity with 60 GHz radio
  - Localisation and tracking algorithms
    - Location of speaker boxes in surround sound systems within room
    - Send the appropriate audio signal over the wireless UWB link
  - Concept :An 'Entertainment Hub'

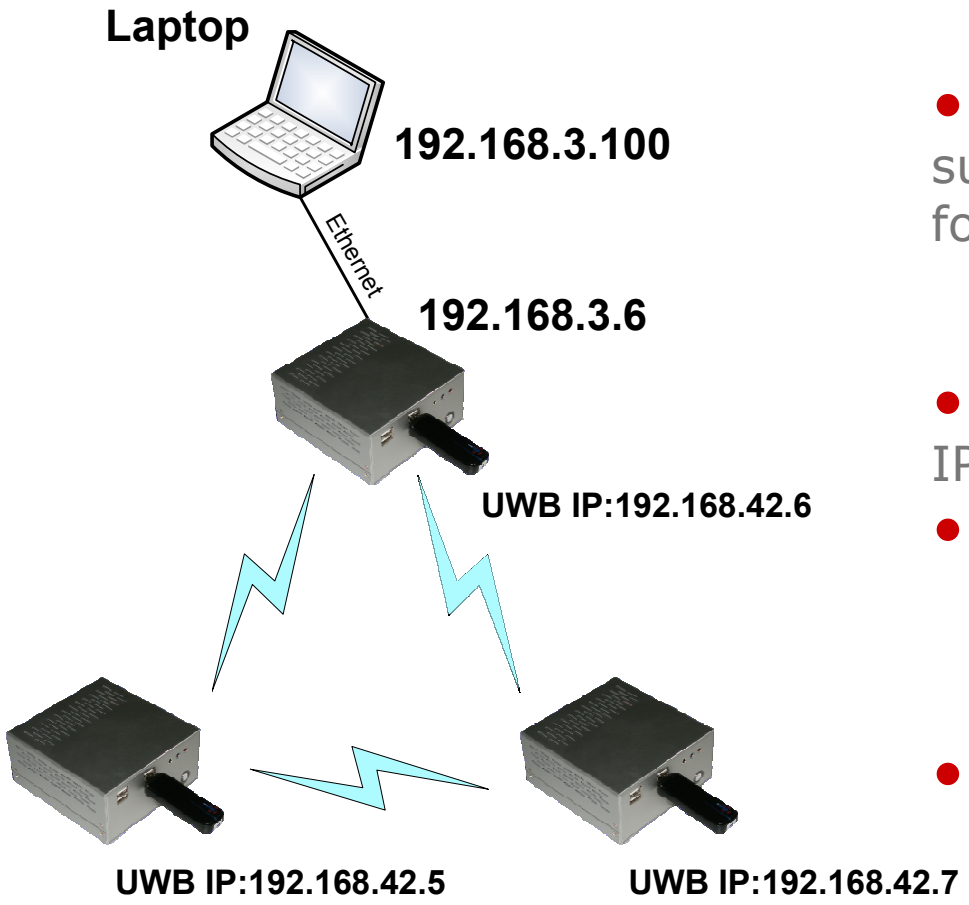
Wireless support for high rate data transfer as well as uncompressed video streaming



Status of IP delivery over UWB in EUWB

- Two approaches are being developed;
  - WiMedia Link Layer Protocol (WLP)
    - Based on research, development and implementation of the WiMedia Link Layer specification
      - As published in draft version v1.084
    - Led by Hochschule für Technik und Wirtschaft Dresden (**HTW**), Universität Duisburg-Essen (**UDE**) and **EADS**
    - Supported through MAC I/F of the High Data Rate (HDR) UWB Hardware platform developed by TES Electronic Solutions (**TES**) and **Wisair**
  - Internet Protocol over Ultra-wide Band or 'IPoUWB'
    - This is '*WLPLite*'
    - *No complex association model and no concept of WSS (VLAN-tagging)*
    - *Frame delivery over Hard DRP, not PCA*
    - *No wireless-to-wireless bridging capability i.e. no frame forwarding*
    - Led by **TES** and supported by **Wisair** PHY
    - Implemented in the High Data Rate (HDR) UWB Hardware platform developed by TES Electronic Solutions (**TES**) and **Wisair**

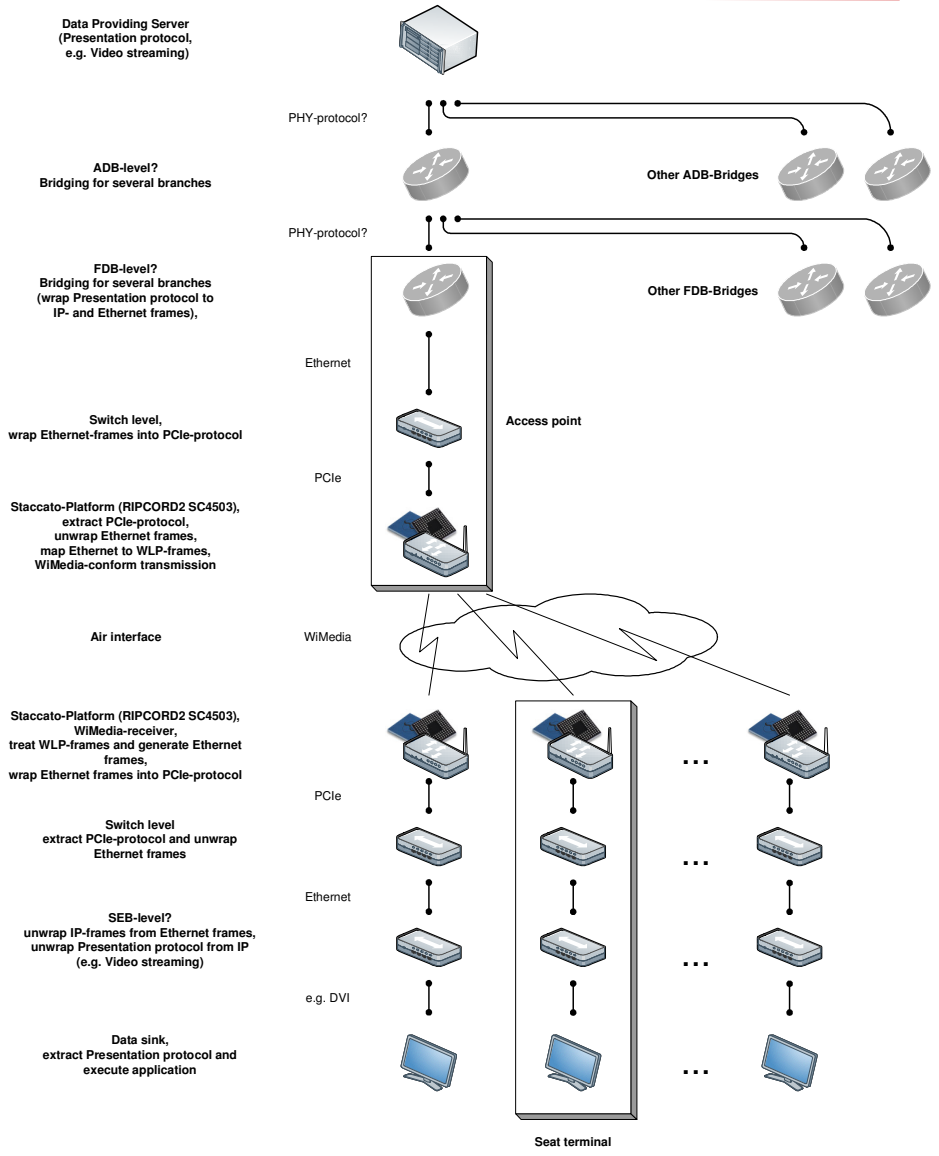
WLP : Demonstrator



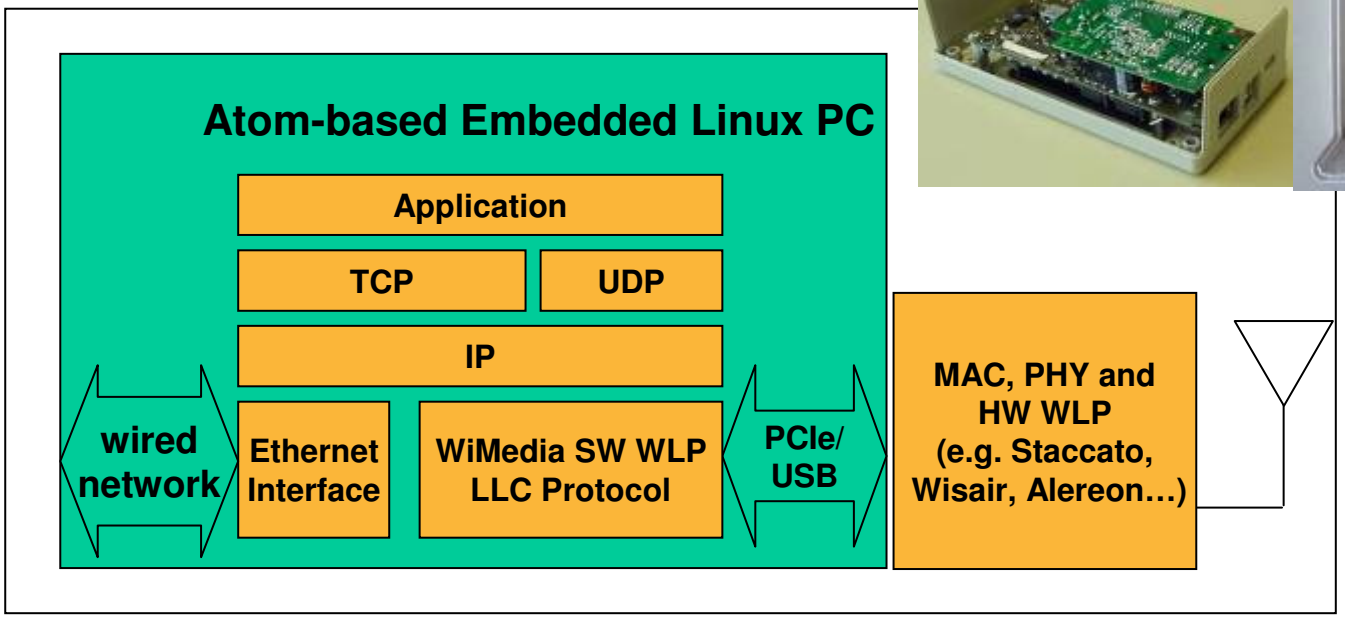
- Based on IOGEAR WUSB HW
  - Intel / Alereon chipset
- Initial P2P WiMedia/WLP Linux support available as open source code for Linux
  - WiUSB support added to Linux Kernel in v2.6.29
- Added P2M capability and IPv6 for IP multicast support
- Improved link stability
  - Automatic link management
  - Alternative channels scanning and link monitoring functions implemented
- Improved performance
  - Up to **150 Mbps** TCP traffic achieved using IPERF

WLP : Network Simulation

- A UML implementation of the latest WLP-draft (1.084) is being developed
  - Implements WLP within a network simulator
  - Supports path to development within a microprocessor hardware architecture
- Status:
  - The work on the implementation of the WLP network simulator is ongoing
  - Further theoretical network WLP simulation studies



WLP : UWB Access Point Demonstrator



IPoUWB : Isn't IPoUWB same as WLP?

- Basic approach to IPoUWB is to remove unnecessary complexities of WLP…
- keeping it simple…
- Transport unsecure / secure IP packets over a ECMA 368 (WiMedia) compliant MAC
- Point-to-point and/or point-to-multi-point (including multi-cast)

IPoUWB : 'Conceptual' Protocol Layer Diagram

TV / PC / Set-top box | Smart Phone | Network Storage | Access Point

Applications

A/V Stream | VoIP | NFS / Samba

RTP | SIP | RTP | SIP / H.323

Existing Protocols

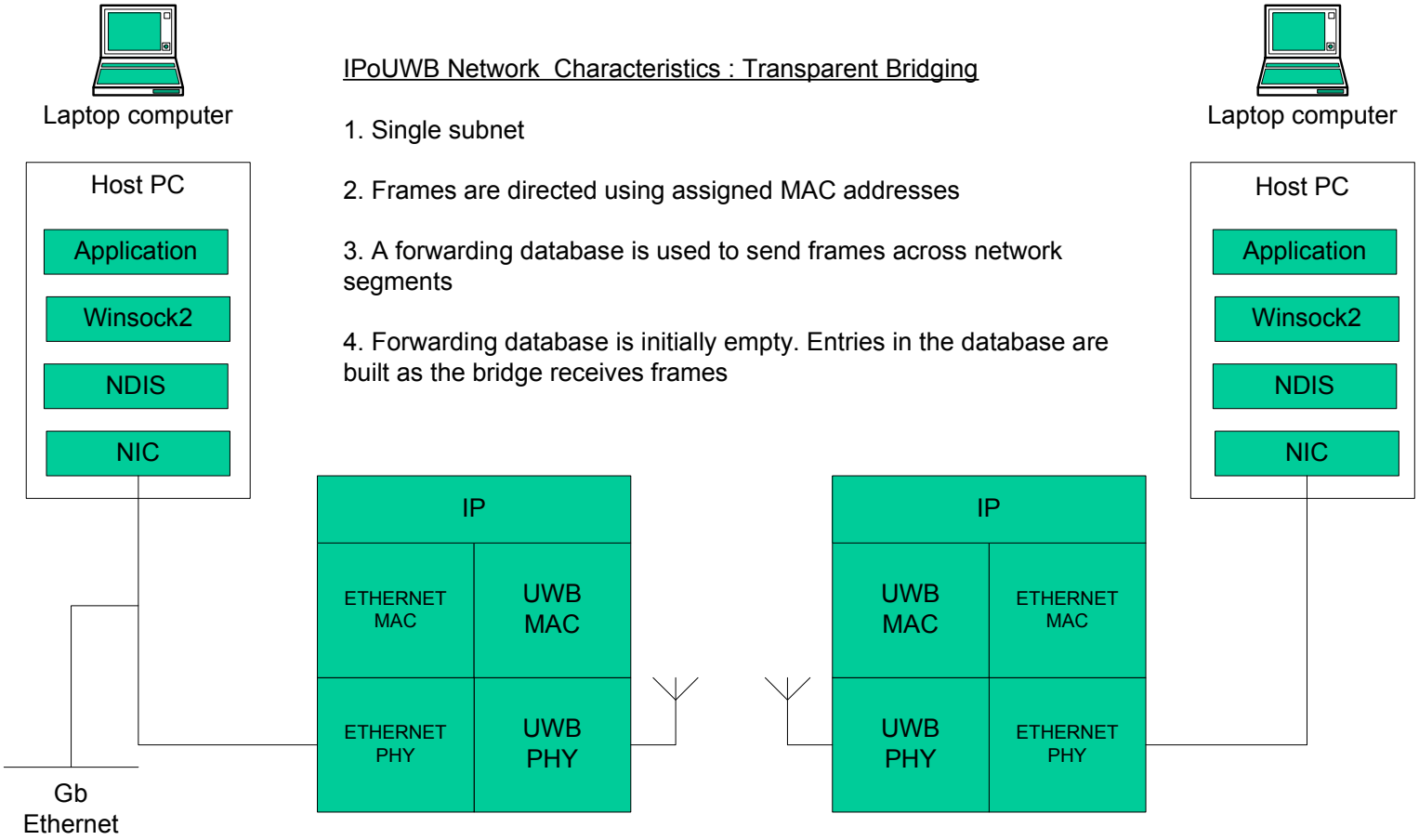
UDP | TCP

IP

ECMA 368 MAC / PHY

UWB Common Radio Platform

IPoUWB : Simple Point-to-Point Layer Model



IPoUWB Network Characteristics : Transparent Bridging

1. Single subnet

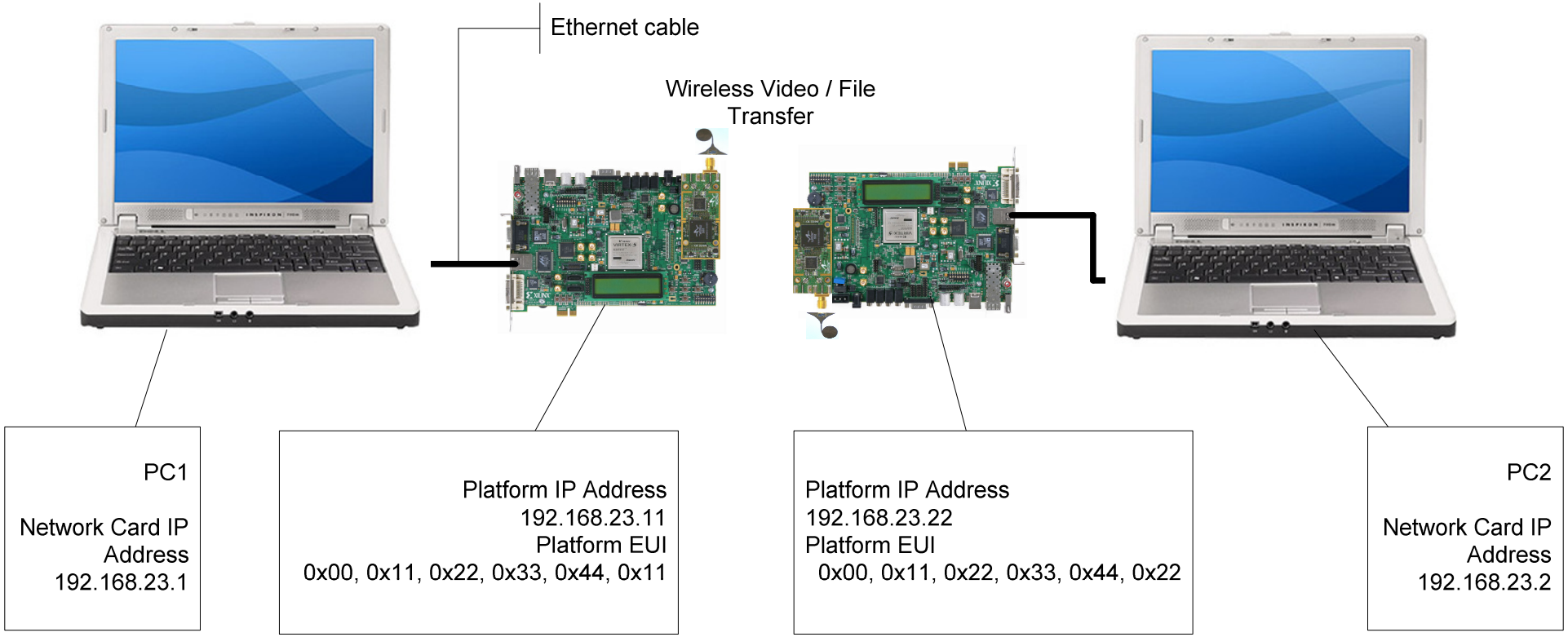
2. Frames are directed using assigned MAC addresses

3. A forwarding database is used to send frames across network segments

4. Forwarding database is initially empty. Entries in the database are built as the bridge receives frames

IPoUWB : EUWB HDR UWB Platform

- TES *VIRGIL*™ UWB Development Platform
- Supports IP frame delivery over ECMA-368 UWB MAC



IPoUWB : Current Performance

- **TES have delivered Release 1.1 of High Data Rate (HDR) UWB platform**
- **Current status:**
  - Defined open 'MAC' interface
  - Completed integration of the Wisair 532 Module ay MAC-PHY interface
  - Demonstrated 'IP' point-to-point connectivity, delivering IPoUWB
  - Prepared analysis and design of HDR positioning feature
  - Added support for acknowledgements & re-tries (I-Ack)
  - Delivered performance enhancements which achieve:
    - **MAC throughput Performance > 310 Mbps**
    - **Application level throughput (50:50 MAS Map – Unsafe Hard DRP)**
      - **UDP > 140 Mbps**
      - **FTP (TCP/IP) ~ 140 Mbps**
    - **Application level throughput (90:10 MAS Map – Unsafe Hard DRP)**
      - **UDP > 280 Mbps**

Future of IP delivery over UWB in EUWB

- EUWB has reached the mid-way point in the project with 18 months to run
  - Expect short extension of 3 months to facilitate support of ICT 2011 conference
- In the next phase of the project, the following objectives remain;
  - Extend IPoUWB platform to support;
    - Point-to-multi-point
    - Ranging and localisation
    - Interoperability testing
    - Higher layer clock synchronisation algorithm
  - Extend WLP investigations;
    - Extend WLP network simulator to allow further theoretical network WLP simulation studies
    - Improve connection stability by extending link quality monitoring and including channel changing

Questions?

Thank you for your attention

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Back-up

- The following slides are for back-up and may be useful…

Comparison Short range Wireless Technology

	IPoUWB (ECM-368/WiMedia)	802.11g	802.11n
Operating Frequency	3.1…4.8 GHz and/or 6…10 GHz	2.4 GHz	5 GHz and/or 2.4 GHz
PHY rate	480 Mb/s	54 Mb/s	300Mb/s (2 streams)
Typical App. Throughput	≈ 200 Mb/s	≈ 30 Mb/s	≈ 100 Mb/s
Typical average power consumption	< 400µW (now) 40...80 µW (target)	~ factor 10 over UWB	~ factor 20 over UWB
Range LOS	Up to 10m	≈ 40m	≈ 70m
Antennas	Simple single antenna system	Diversity antenna	Multiple antennas required for MIMO

Power consumption of 802.11n based systems has not been fully analysed by TES yet, however indications suggest that it is significantly higher than 802.11g