

**XILINX**

## A Brief Introduction to Bluetooth

Markets, Applications, How it Works, and Where Xilinx Fits

## Agenda

- What is Bluetooth?
  - Bluetooth in the home and on the road
  - Overview of Bluetooth devices and applications
  - Market forecast
  - Bluetooth vs. other wireless LAN technologies
- Inside Bluetooth
  - How it works
- Xilinx opportunities in Bluetooth
  - Immediate opportunities
  - Long term prospects

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### The Obligatory Bluetooth Question

*Where Does the Name Come From?*

- Ericsson, the principal inventor, borrowed the name from Harald Bluetooth (son of Gorm)
  - The King of Denmark circa 900AD
  - United Denmark and Norway
- Seemed like a good name for uniting many dissimilar devices from different manufacturers

Learn your Viking name at:  
[www.gorm.com/name/index.htm](http://www.gorm.com/name/index.htm)

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## What is Bluetooth?

A unique new wireless technology specifically for:

- Short range
  - Up to 10 meters typically
- Modest performance (721Kbps)
- Dynamic configurability
  - i.e. ad hoc networking/roaming
- Low power
  - Well suited to handheld applications
- Support for both voice and data

And an *EXPLOSIVE* growth market!!!

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## What is Bluetooth Good For?

No Wires!  
 In the home  
 On the move

Personal Area Networking (PAN)  
 Enabling a collection of YOUR personal devices to cooperatively work together

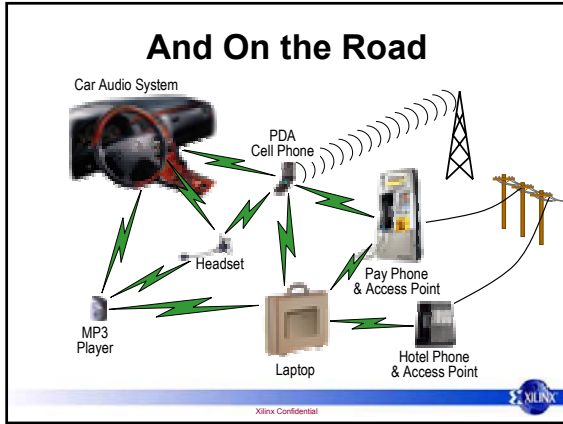
Locality sensitive services (i.e. roaming)  
 Visibility and access to additional resources, but only when they are within range and useful to you

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## Bluetooth in the Home

### No Wires

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### Bluetooth in Computer Products

**Computer devices**

- Laptop computers
- PDA/HPCs
- Desktop PCs
- Broadband access points
  - Ethernet/xDSL/cable
- Printers
- Scanners
- Video projectors
- Web tablets

**Computer applications**

- Peripheral connectivity
  - Printers
  - Scanners
  - Video projectors
- Network access
  - Broadband access points
  - Packet radio cellular phones
- File synchronization
  - Calendars
  - Contact management
- File transfer
  - VCards
  - MP3
  - Digital pictures

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### Bluetooth in Telephone and Consumer Products

**Telephone devices**

- Cellular handsets
- Wireless headsets
- PSTN access points
  - Payphones
  - Hotel/home phones

**Consumer devices**

- Set-top boxes
- Digital cameras
- MP3 audio players
- Home audio systems

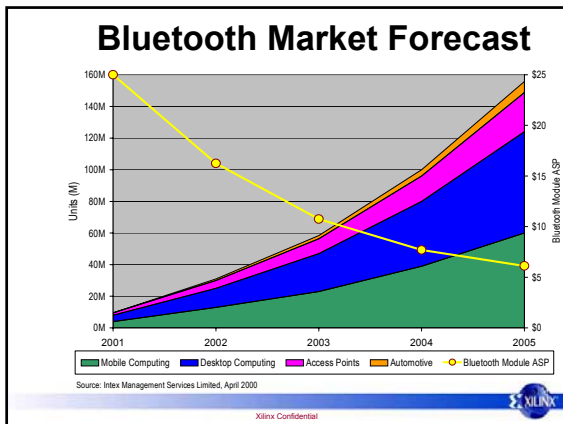
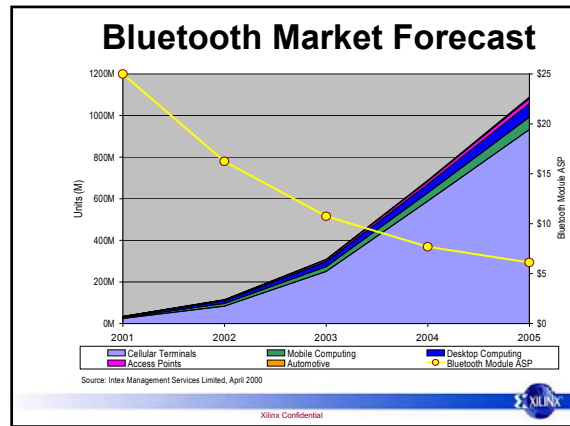
**Telephone applications**

- Hands free use
- File synchronization
  - Calendars
  - Contact management
- Land line I/F for voice and data

**Consumer applications**

- File transfer
  - MP3
  - Digital pictures
- Peripheral connectivity
  - Keyboard/mouse/remote
  - Printer

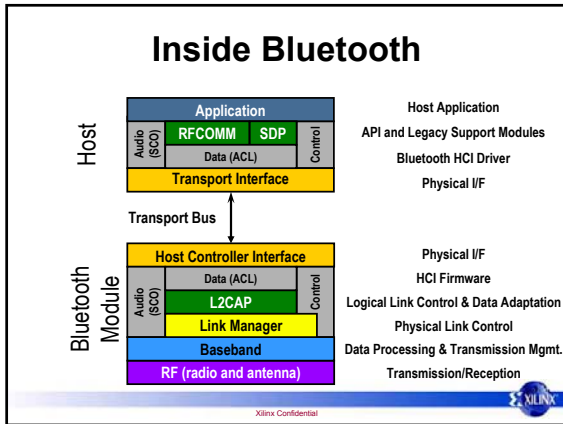
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### Bluetooth Vs. Other WLANs

	Technology					
	Bluetooth	HomeRF	802.11b	HyperLAN	802.11a	HyperLAN2
Frequency Band	2.4GHz	2.4GHz	2.4GHz	2.4GHz	5GHz	5GHz
Technology	Frequency Hopping Spread Spectrum	Frequency Hopping Spread Spectrum	Direct Sequence Spread Spectrum	Gaussian Minimum Shift Keying	Orthogonal Freq. Division Multiplexing	Orthogonal Freq. Division Multiplexing
Performance	720Kbps	1.6Mbps	11Mbps	23Mbps	~50Mbps	~50Mbps
Range	<10 meters	50 meters	100 meters	?	?	?
Power	Very Low	Medium	Medium	Medium	Medium Hgh?	Medium Hgh?
Relative Cost	Low Very Low	Medium/Low	Medium	Medium	High	High
Target Applications	Cable Replacement Wireless Data Wireless Voice Personal Networks	Wireless Data Wireless Voice	Wireless Data	Wireless Data	Wireless Data	Wireless Data
Fixed NW Support	PPP, Ethernet	?	Ethernet	Ethernet	Ethernet	Ethernet, IP, ATM, PPP, ISM, UWB
Key Features	Very Low Power Voice and Data Raining Low Cost Good noise immunity	Voice and Data Moderate Cost	Good Performance	Good Performance	High Performance	High Performance
Promoters	2000+	<50	~100	<50	~100	<50
Regional Support	Worldwide	US	US/Asia	Europe	US	Europe
Shipping	Now	Now	Now	Now	2001	2001

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### L2CAP

#### Logical Link Control and Adaptation Protocol

- Manages the creation and termination of virtual connections called Channels with other devices
  - Negotiates and/or dictates parameters
    - Including Security and Quality of Service (QoS) etc.
- Manages data flow between the host and Link Manager
  - Multiplexing of multiple concurrent host I/O operations
  - Segmentation And Reassembly (SAR) of various data formats between the host and Bluetooth

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### Link Manager

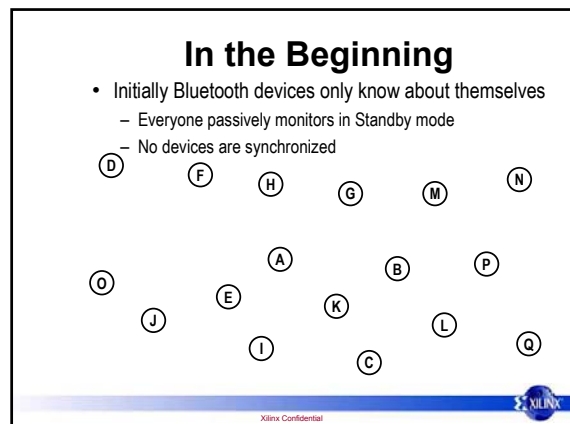
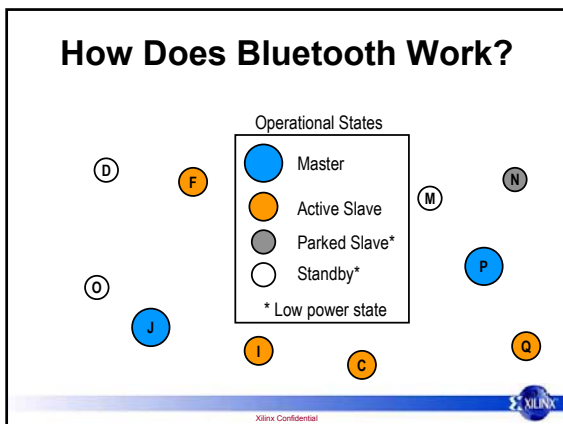
- Physically manages creation, configuration, and termination of device to device links
- Also manages the data flow between the L2CAP and Baseband through established channel
  - Forwards data from the L2CAP to the Baseband with its associated link specific transmission parameters
  - Forwards data from the Baseband back to the L2CAP associated to its specific source channel

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### Baseband

- Performs all digital data processing operations
  - Speech coding
  - Data whitening
  - Optional encryption/decryption
  - Packetization
  - Header and payload error detection and correction
- Manages and controls the radio interface

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### Inquiry

**Discovering Who's Out There**

- Inquiry discovers what other devices are within range

10 meters

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### Paging

**Creating a Piconet**

- Paging creates a Master/Slave link called a Piconet

10 meters

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### Expanding a Piconet (1)

- Successive Pages can attach up to 7 Active Slaves to a Piconet at one time

10 meters

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### Parking

- To save power and/or to connect to even more devices Active Slaves can be Parked (*up to 256 total!*)

10 meters

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### Expanding a Piconet (2)

- Masters can then attach additional Active Slaves using Active Member Addresses freed up through Parking

10 meters

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### Scatternets

- Bluetooth devices can participate in multiple Piconets simultaneously creating a topologies called Scatternets

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### Advanced Scatternets

- Scatternets can evolve into extremely complex structures creating a rich fabric of many, many, devices

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### Xilinx in Bluetooth

*Opportunities for Spartan-II and CoolRunner*

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### Where Xilinx Fits

- CoolRunner
  - Low-Power system integration applications
    - Handheld especially
- Spartan-II
  - Bluetooth enabled versions of existing computer, communications, and consumer products
    - Set top box, MP3, digital modems, printers, gaming consoles, etc.

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### Xilinx in Bluetooth Today (1)

*CoolRunner Peripheral Integration, Power Management, and Component Integration*

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### Xilinx in Bluetooth Today (2)

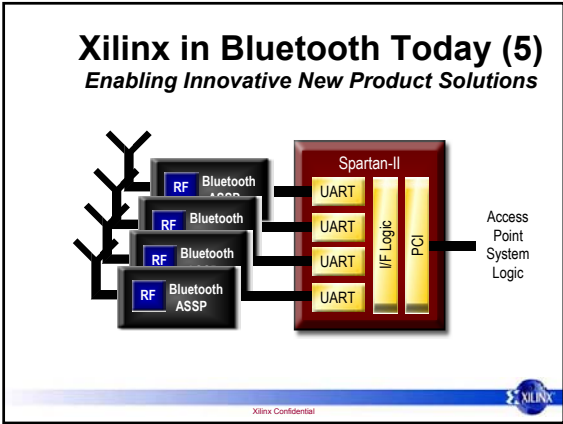
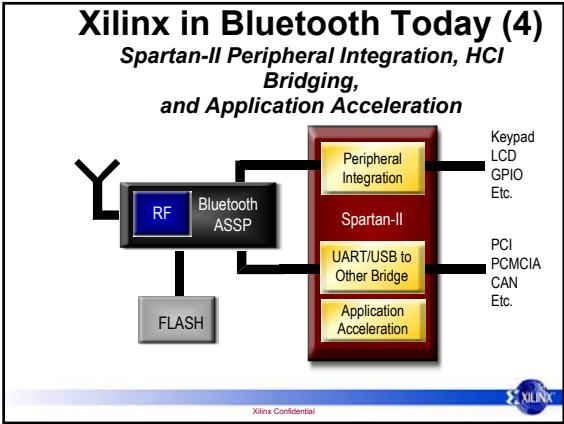
*CoolRunner Power Management and Peripheral Integration*

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### Xilinx in Bluetooth Today (3)

*Spartan-II Application Acceleration, HCI Bridging, Component Integration, and Peripheral Integration*

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### So Who Is Bluetooth?

Nine Promoters

Founders

Y2K Additions

And over 2000 additional SIG members

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