An Introduction to Bluetooth

Stonestreet One
Presentation Goals

- What is Bluetooth?
- Can we implement it ourselves?
- What can it do?
- Can we buy it?
- Cost?
- Time?
Bluetooth History

- Began as a private development effort at Ericsson in 1994
- 5 companies joined to form the Bluetooth Special Interest Group (SIG) in 1998
- First specification released in July 1999
- Current specification is version 1.1
Interoperability is key to success

SIG defines Qualification process

Qualified device may use the Bluetooth logo and trademark

Qualified products listed on the Bluetooth SIG website
Bluetooth SIG Overview

- Membership Levels
  - Promoter Companies
  - Associate Members
  - Adopter Companies

- Organization
  - Management
  - Marketing
  - Qualification (BQB, BQTF)
  - Working Groups
Bluetooth Goals

- Open Specification
- Voice and Data Capability
- Worldwide Usability
- Short-Range Wireless Solutions
## Where does Bluetooth fit in?

<table>
<thead>
<tr>
<th>Technology</th>
<th>Ideal Application</th>
<th>Range (m)</th>
<th>Data Rate (Mbps)</th>
<th>Current Required</th>
<th>Cost ($)</th>
<th>Connection Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR</td>
<td>Device synchronization, data transfer</td>
<td>1</td>
<td>16</td>
<td>Low</td>
<td>10</td>
<td>Single Freq</td>
</tr>
<tr>
<td>Bluetooth</td>
<td>Cable Replacement, Ad hoc PAN</td>
<td>10-100</td>
<td>&lt; 1</td>
<td>Medium</td>
<td>10</td>
<td>FHSS</td>
</tr>
<tr>
<td>HomeRF</td>
<td>PCs to consumer goods</td>
<td>50</td>
<td>1-2</td>
<td>High</td>
<td>45</td>
<td>FHSS</td>
</tr>
<tr>
<td>802.11b</td>
<td>High speed LAN</td>
<td>100+</td>
<td>11</td>
<td>High</td>
<td>45</td>
<td>DSSS</td>
</tr>
</tbody>
</table>
Bluetooth Technology 101

- Radio Frequency Based
- 2.4 GHz ISM band
- Bandwidth
- Maximum – 723.2 kb/s
- Specification includes Protocols and Profiles
## Bluetooth Data Rates

<table>
<thead>
<tr>
<th>Packet Type</th>
<th>Max Payload (bytes)</th>
<th>Symmetric Rate (kbps)</th>
<th>Asymmetric Rate (kbps) Forward</th>
<th>Asymmetric Rate (kbps) Reverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM1</td>
<td>17</td>
<td>108.8</td>
<td>108.8</td>
<td>108.8</td>
</tr>
<tr>
<td>DH1</td>
<td>27</td>
<td>172.8</td>
<td>172.8</td>
<td>172.8</td>
</tr>
<tr>
<td>DM3</td>
<td>121</td>
<td>258.1</td>
<td>387.2</td>
<td>54.4</td>
</tr>
<tr>
<td>DH3</td>
<td>183</td>
<td>390.4</td>
<td>585.6</td>
<td>86.4</td>
</tr>
<tr>
<td>DM5</td>
<td>224</td>
<td>286.7</td>
<td>477.8</td>
<td>36.3</td>
</tr>
<tr>
<td>DH5</td>
<td>339</td>
<td>433.9</td>
<td>723.2</td>
<td>57.6</td>
</tr>
<tr>
<td>HV1</td>
<td>10</td>
<td>64</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>HV2</td>
<td>20</td>
<td>64</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>HV3</td>
<td>30</td>
<td>64</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Bluetooth Modules (con’t)

<table>
<thead>
<tr>
<th>Class</th>
<th>Power</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>20 dBm</td>
<td>100 m</td>
</tr>
<tr>
<td>Class 2</td>
<td>0-4 dBm</td>
<td>10 m</td>
</tr>
<tr>
<td>Class 3</td>
<td>0 dBm</td>
<td>1 m</td>
</tr>
</tbody>
</table>

**Interface**

<table>
<thead>
<tr>
<th>Interface</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>UART</td>
<td>Universal Asynchronous Receiver-Transmitter</td>
</tr>
</tbody>
</table>
Usage Model vs. Profiles

- **Usage Models**
  - Define real world situations
  - Resulted in profiles

- **Profiles**
  - Included in the specification
  - Instructions for implementing Usage Models
Real World Scenarios

- **Cable Replacement**
  - PCs & peripherals, home networking, headsets

- **Data and Voice Access Points**
  - E-mail, web access, cordless telephone, etc.

- **Ad-hoc Networking**
  - Business card exchange, multi-player games, vending machines, white goods, etc.

- **Medical**
  - Monitoring devices

- **Industrial**
  - Inventory management systems
Specification v1.1 Profiles

- Generic Access Profile
- Service Discovery Application Profile
- Serial Port Profile
  - Virtual COM port
  - Dial-up Networking Profile
  - FAX Profile
  - LAN Access Profile
  - Headset Profile
Specification v1.1 Profiles (con’t)

- Generic Object Exchange Profile
  - Object Push Profile
  - File Transfer Profile
  - Synchronization Profile

- TCS
  - Cordless Telephony Profile
  - Intercom Profile
Post Specification v1.1 Profiles

- Human Interface Profile
- Hands-free Profile
- Hardcopy Cable Replacement Profile
- Personal Area Networking
- SIM Access Profile
- Audio/Video Profiles
- Printing Profiles
- Others
Networking Profiles

Dial-up Networking
- AT-commands over SPP

LAN Access
- PPP over SPP

Access Point

Network
Headset Profile

Profile provides:

- Both devices must provide capability to initiate connection and accept/terminate calls.
- Volume can be controlled from either device.
- Audio gateway can notify headset of an incoming call.
Object Push Profile

Profile provides:

- Limited client-server interactions:
  - exchange objects between devices
  - pull objects from server
  - push objects to server

- Uses OBEX to transfer vCard, vCalendar, vNote, and vMessage objects.
File Transfer Profile

Profile provides:

- **Enhanced client-server interactions:**
  - browse, create, transfer folders
  - browse, pull, push, delete files

- **Uses OBEX**
TCS Profiles

Intercom

Cordless Telephony
Hands Free Profile

Profile supports:

- Hands-free unit may support these capabilities:
  - Retrieve and display registration status
  - Retrieve and display call status
  - Initiate, answer, reject, terminate a call
  - Initiate a call using voice recognition
  - Initiate a call using memory dialing
  - Three-way calling
  - Volume control
Human Interface Device Profile

- Other HID devices:
  - knobs
  - switches
  - buttons
  - sliders
  - trackballs
The Future of Bluetooth

- Radio2 Working Group
  - Working to overcome bandwidth, interference, and connection setup issues while remaining compatible with current radio

- Other Working Groups
  - Audio/Video, Car, Co-existence, HCI, ISDN, Local Positioning, Personal Area Networking, Printing, Still Image, UDI

- Study Groups
  - Industrial Automation
Requirements of Success

- **Interoperability**
  - Between manufacturers
  - Between types of devices

- **Ease of Use**
  - No user’s guide
  - Self-descriptive interface

- **Low Price**
  - Same or less than the cable it is replacing

- **Low Power Consumption**
  - No/little additional charging
About Stonestreet One
Company Overview

- Short-range wireless solutions provider
- Specialize in embedded application design and development
- Provide services to leading companies in industries such as:
  - Automotive
  - Mobile communications
  - Food Service Equipment
  - Biomedical
  - Industrial Controls
Bluetooth Experience

- Associate Member; Bluetooth SIG
- First Bluetooth stack Qualified in December 2000
- Developed Bluetooth training course
- Provides Bluetooth design services to numerous Fortune 1000 companies
- Relationships with over 50 customers and 16 partners
Bluetooth Partners

- Alps
- Avnet
- Ericsson
- gigaAnt
- Hitachi
- Memec/Insight
- MindReady
- MontaVista

- Philips
- QNX
- Silicon Wave
- Taiyo Yuden
- Texas Instruments
- Toshiba
- Wind River
- Zeevo
Bluetopia® Bluetooth Protocol Stack
Bluetopia Features

- Written in ANSI-C
- Customizable RAM and ROM requirements
- Hardware encapsulation, along with ANSI-C and flexible RAM/ROM footprint, allows for ease of porting
- Shared API among existing platforms
- Proven on numerous Operating Systems, processors, and Bluetooth chipsets
- Versions of Bluetopia for major operating systems (Windows, Windows CE, QNX, Linux) allow for easier prototyping and testing of embedded applications
Bluetooth Development Tools & Hardware

DP Series Bluetooth Development Tool Set
Bluetooth Hardware

- **SPR-200**
  - RS232 cable replacement
  - optional battery power
  - application/processor on-board
  - use for development
  - use for reference designs
  - Available from Inside Out Networks

- **USB Dongle**
  - line powered
  - compact size
  - FCC Certified
  - Bluetooth Qualified
Bluetooth Design Services

- “Total Bluetooth Solution”
  - Turnkey product prototype development
- Hardware and software
- Customized OEM modules
- Application development
- Expert Bluetooth engineers with valuable development experience
Stonestreet One Summary

- Bluetooth Products and Services
  - Bluetopia Bluetooth Protocol Stack
  - BTExplorer
  - Development Tools
  - Products

- Engineering Services
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