Future Challenges of IrSimple Protocol: Efficient Flow Control Scheme and Long Distance Capability

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Outline

- NGN and WPAN
- WPAN technologies
- Overview of IrSimple protocol
- Future Challenges of IrSimple Protocol
- Conclusion and Future works
NGN and WPAN

NGN
- An IP based network
- Supports wide range of services over the same network
- Focuses on seamlessly integrating the existing wireless technologies

WPAN
- Bluetooth
- Zigbee
- IrDA

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# Comparison between different WPAN technologies

<table>
<thead>
<tr>
<th></th>
<th>IrDA</th>
<th>Bluetooth</th>
<th>Zigbee</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISM band</td>
<td>Infrared</td>
<td>RF (2.4 GHz)</td>
<td>RF (2.4 GHz)</td>
</tr>
<tr>
<td>Range</td>
<td>1m (for UFIR and GigaIr, the distance is 20cm)</td>
<td>Up to 10m</td>
<td>Up to 70m</td>
</tr>
<tr>
<td>Connection Type, Direction</td>
<td>Point-to-Point, Narrow Angle (30 degrees)</td>
<td>Multipoint, Omni-directional</td>
<td>Multipoint, Omni-directional</td>
</tr>
<tr>
<td>Maximum Data Rate</td>
<td>100 Mbps (1Gbps will be available soon)</td>
<td>1Mbps</td>
<td>250Kbps</td>
</tr>
<tr>
<td>Security</td>
<td>Line of sight requirement ensures the security</td>
<td>Authentication, encryption, spread spectrum</td>
<td>Authentication, encryption, spread spectrum</td>
</tr>
<tr>
<td>Approximate Cost</td>
<td>$1</td>
<td>$3</td>
<td>$1</td>
</tr>
</tbody>
</table>

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**IrSimple protocol: the missing link?**

- IrDA has adopted 2 new protocols
  - **IrSimple**: For instant and quick (but small sized) data transfer (i.e. transferring photo, mp3, presentation slide)
  - **IrBurst**: For large data block transfer (i.e. transferring movie file or streaming)

**How IrSimple protocol works?**

- IrSimple eliminates the channel listening and device discovery procedures, required in the existing IrDA protocols
- Establishes the connection immediately to provide simple and fast data transfer.
Conversation sequence

Fig. Standard IrDA and IrSimple protocol conversation

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Application Scenarios (1)

Fig. Object transfer between mobile phone and other devices or mobile phone

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Application Scenarios (2)

Source: NTT Docomo webpage

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Performance Comparison of IrSimple and OBEX for various bit error rates *

- IrSimple has almost 64% improvement in throughput efficiency over OBEX over 100Mb/s IrDA links with a low turnaround time of 0.01ms.

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User’s Experience

Fig. Comparison of image transfer for two million pixel (500k byte) sized photo

Previous IrDA protocol with 4Mbps data rate

IrSimple with 4Mbps data rate
Future Challenges of IrSimple Protocol

- Efficient flow control scheme
  - Lower layer (link layer) instead of higher layer (IrSMP layer)
  - Reduces redundant data retransmissions

- Long Distance Capability
  - Increase link distance beyond 1 meter guaranteed by IrDA.
  - The link distance can be increased in two ways
    - By increasing transmitted light intensity
    - By increasing receiver sensitivity
Improving Flow Control Scheme

Fig. Existing Flow Control scheme

Fig. Proposed Efficient Flow Control scheme

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When Receive Ready (RR) frame from secondary station is lost

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When Receive Ready (RR) frame from primary station is lost
When Data (UI) frame is lost
Long distance capability: Increasing Transmitted Light Intensity

<table>
<thead>
<tr>
<th>Minimum luminance in the vicinity of 1cm²</th>
<th>mW/cm²</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
</tr>
</thead>
<tbody>
<tr>
<td>The maximum attainment distance</td>
<td>cm</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>100</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Gain area</td>
<td>cm²</td>
<td>400</td>
<td>900</td>
<td>1600</td>
<td>2500</td>
<td>10000</td>
<td>40000</td>
<td>90000</td>
</tr>
<tr>
<td>Required minimum luminance</td>
<td>mW/Sr</td>
<td>3.6</td>
<td>8.1</td>
<td>14.4</td>
<td>22.5</td>
<td>90</td>
<td>360</td>
<td>810</td>
</tr>
<tr>
<td>The maximum allowable luminance</td>
<td>mW/cm²</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Minimum Distance that can be received</td>
<td>cm</td>
<td>0.08</td>
<td>0.13</td>
<td>0.17</td>
<td>0.21</td>
<td>0.42</td>
<td>0.85</td>
<td>1.27</td>
</tr>
</tbody>
</table>
### Long distance capability: Increasing Receiver Sensitivity

<table>
<thead>
<tr>
<th>Minimum quantities of light for each cm²</th>
<th>mW/cm²</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
<th>0.009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard maximum distance</td>
<td>cm</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Gain area</td>
<td>cm²</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Minimum luminance</td>
<td>mW/Sr</td>
<td>3.6</td>
<td>3.6</td>
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</tr>
<tr>
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<td>cm</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>100</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Gain area</td>
<td>cm²</td>
<td>400</td>
<td>900</td>
<td>1600</td>
<td>2500</td>
<td>10000</td>
<td>40000</td>
<td>90000</td>
</tr>
<tr>
<td>Reception magnification</td>
<td></td>
<td>1</td>
<td>2.25</td>
<td>4</td>
<td>6.25</td>
<td>25</td>
<td>100</td>
<td>225</td>
</tr>
<tr>
<td>Reception radius</td>
<td>mm</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Radius of antenna</td>
<td>mm</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td>2.5</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>
Conclusion and Future Works

An improvement in the existing flow control

- At IrLAP layer
- To reduce redundant traffic in the system.
- Can recover all possible error cases

Existing IrDA physical layer

- Can support at least 3 meters distance
- Increasing transmitter intensity
  - Increases the minimum distance between devices
- Increasing receiver sensitivity
  - Radius of the required concentrator/lens/antenna is practical

Future works

- To modify the error recovery scheme
- More applications of IrSimple protocol
- To complement the drawbacks of other WPAN technologies
Acknowledgement

Special thanks go to Telecommunications Advancement Foundation (TAF), Japan for their support.

Thank You.
IrDA links conversation scheme

Station A

Contents

Contents

Station B

Download Data Activity Time DDAT(A)

Turn Around Time TAT(A)

Data Acknowledge DA(B)

Turn Around Time TAT(B)

Download Data Activity Time DDAT(A)

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