Bluetooth Device Manager

Connecting a large number of resource-constrained devices in a service-oriented Bluetooth network

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0. Overview

- Description of the problem
- State-of-the-art
- Our approach
- Conclusion and future research
1. Problem description
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- **Low power** approach needed for sensors
  - Reduction of processing
  - Reduction of communication
- Bluetooth **only** supports up to **8 active devices** in a piconet
  - Network requires to support a large number of devices
2. State-of-the-Art

- **Low power** approaches
  - **Sniff mode:**
    - Varying sniff interval and serving time (Garg et al.)
    - Adapting serving time to burst of traffic (Chakraborty et al.)
  - **Hold mode:**
    - Adapts hold intervals according to estimated traffic (Zhu et al.)
  - **Increasing the number of slaves**
    - **Park mode:**
      - Examining the effect of number of slaves on throughput and latency time (Lee et al.) – not used for low power

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*Figure adapted from Milios*
3. Our approach – The Bluetooth Device Manager

- Bluetooth **gateway** device is always **master**
- New **devices enter** the **network** and **are parked** by the master
- Desired **services are accessed** regularly or on demand **by waking up** corresponding device
- **After service access** device is **parked** again
- Device leaves the network
3. Our approach – Service Description

- Services are described using **Bluetooth Service Discovery Protocol** (SDP)
- Devices work as **SDP servers only**
- SDP requests are sent by the master during connection establishment and service access

- Three types of devices are supported:
  - *Always-active* devices (e.g. streaming)
  - *On-demand* devices
  - *Cached* devices (e.g. temperature)

- Two new service attributes:
  - *MaximumParkInterval* (Unsigned Integer)
  - *AlwaysActive* (Boolean)
4. Conclusion and future research

**Conclusion:**
- Low-power issues and large piconet issues were introduced
- Concept for low-power Bluetooth piconet with a large number of devices was presented
- Network is managed by predefined master containing the Bluetooth Device Manager
- Bluetooth Service Discovery Protocol (SDP) was utilized

**Future research:**
- Finishing the implementation and examine the performance results
- Suitable scheduling algorithm will be developed
- Connecting the Bluetooth Device Manager to another SOA (mapping between Bluetooth SDP and SOA)
- Adapting the concept to Bluetooth scatternets
Any questions?

Thank you for your attention!

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A1. Bluetooth Service Discovery Protocol (SDP)

• Offers searching and browsing for devices
• Devices can be both: SDP clients and servers
• Neither any kind of notification mechanism nor methods to access a service
• Some attribute ID and related values (service class) are predefined by Bluetooth Special Interest Group (SIG)
• New service classes are defined as subclass of an existing one extended by new attributes
• Service classes are represented by 128-bit Universally Unique ID (UUID)
A2. Bluetooth Park Mode

- Synchronization on beacon channel in certain time interval (up to 40.96s)
- Device loses Active Member address and obtains an 8-bit Parked Member address and an 8-bit Access Request address
- Devices can be unparked by master or send an unpark request in the beacon access window