

Bluetooth Device Manager

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

Hendrik Bohn, Andreas Bobek, Frank Golatowski
University of Rostock
Institute for Applied Microelectronics and Computer Science

**4th International Conference on Networking
ICN 2005,**

April, 17th – 21st, 2005
St. Gilles les Baines, La Reunion



[Overview](#)

Problem
description

State-of-the-Art

Our approach

Conclusion &
future research

0. Overview

- Description of the problem
- State-of-the-art
- Our approach
- Conclusion and future research



Overview

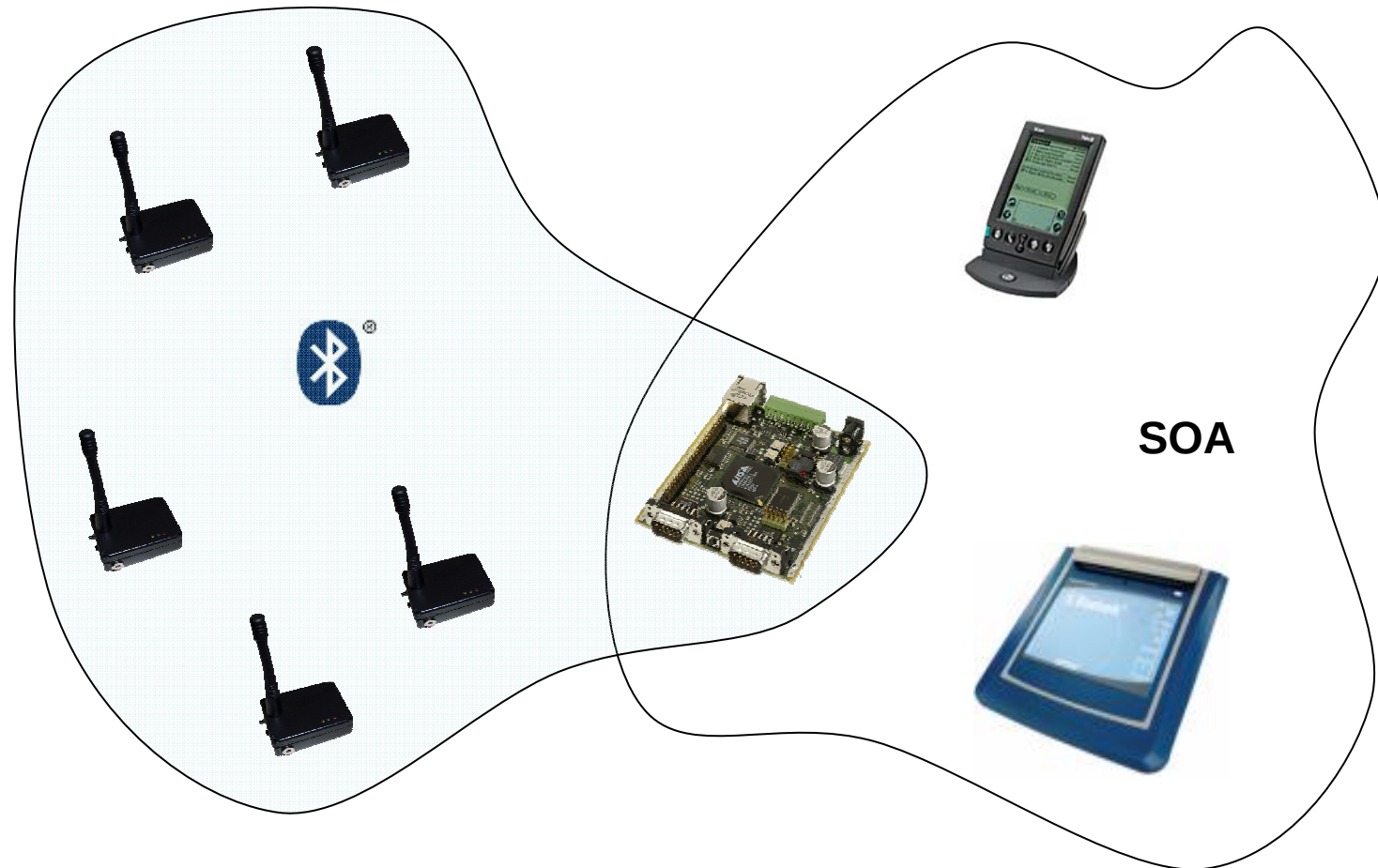
Problem
description

State-of-the-Art

Our approach

Conclusion &
future research

1. Problem description



Overview

Problem
description

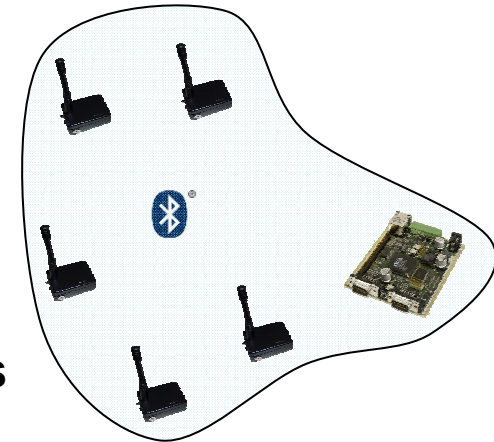
State-of-the-Art

Our approach

Conclusion &
future research

1. Problem description

- **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



Overview

Problem
description

State-of-the-Art

Our approach

Conclusion &
future research

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

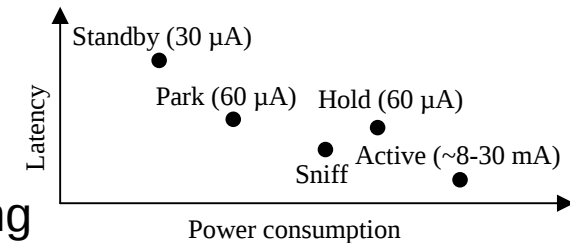


Figure adapted from Milios

Overview

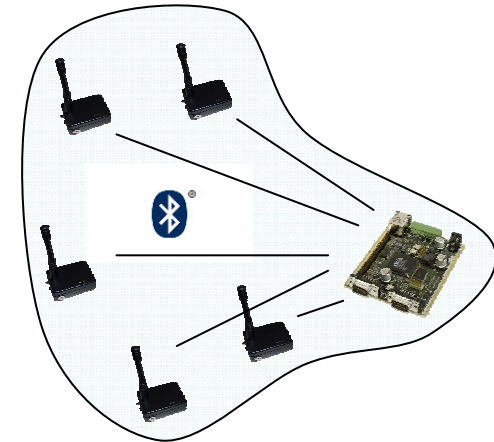
Problem
description

State-of-the-Art

[Our approach](#)Conclusion &
future research

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



Overview

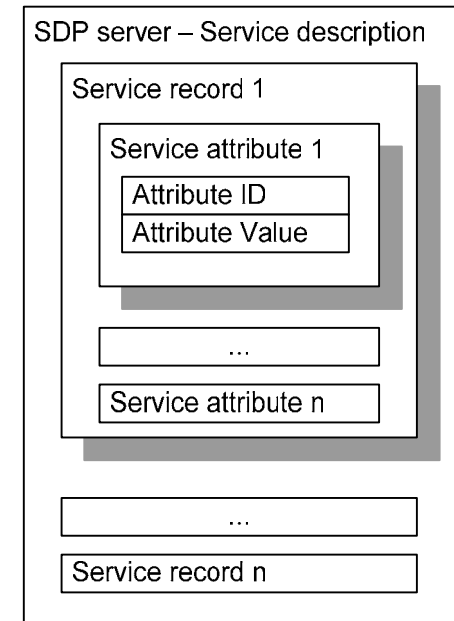
Problem
description

State-of-the-Art

[Our approach](#)Conclusion &
future research

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)



Overview

Problem
description

State-of-the-Art

Our approach

Conclusion &
future research

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



Overview

Problem
description

State-of-the-Art

Our approach

Conclusion &
future research

Any questions?

Thank you for your attention!

Hendrik Bohn

University of Rostock
Institute for Applied Microelectronics and Computer Science
hendrik.bohn@uni-rostock.de



Overview

Problem
description

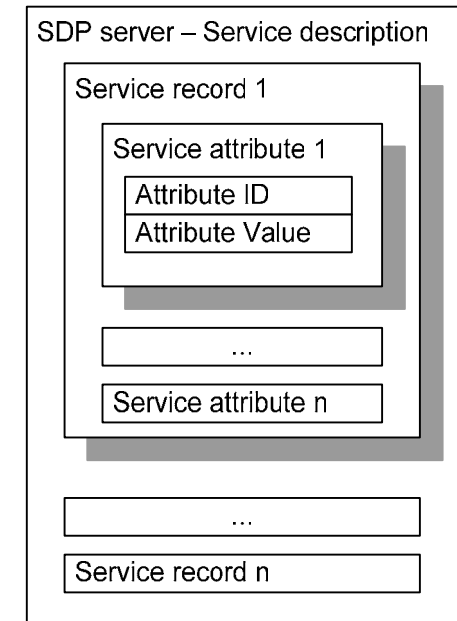
State-of-the-Art

Our approach

Conclusion &
future research

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)



Overview

Problem
description

State-of-the-Art

Our approach

Conclusion &
future research

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

