# AIRS: A Mobile Sensing Platform for Lifestyle Management Research and Applications

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# Outline

- Scenarios & Challenges

- Main Platform Abstractions

  - Supported Sensors

  - Supported User Interactions

- Insights from Experiments

# Possible Scenarios

- Lifestyle management

  - Activity recording

    - Aim at stress management, activity management, …

    - Use available mobile platforms and sensors

- Wardriving scenarios

  - Correlate information from mobiles, here GPS and WLAN/BT

- User research

  - Get insight into usage of mobile device in certain conditions

# What is the WSN Here?

- 4 billion mobile subscribers

  - Some countries approaching 50% smartphone penetration

- Smartphone capabilities staggering

  - GHz speeds in multi-cores

  - >1GB RAM

  - Gbyte storage

  - Programmed like any other general processing environment

**-> Smartphones are the largest WSN available at the moment**

# Challenges

- Battery life

    - Mobile devices are for personal use!

- Configurability

    - Allow for trading off requirements of scenario and needs of end users

- Support for storing and synchronisation

    - Accommodate privacy and security issues!

- Connectivity

    - Do not assume always-on, cater to different models

# Challenges (2)

- Extensibility

  - Support future information sources as well as processing algorithms

- Support user interactions

  - Blend into available mobile UI framework

  - Utilise users' knowledge!

- Sharing

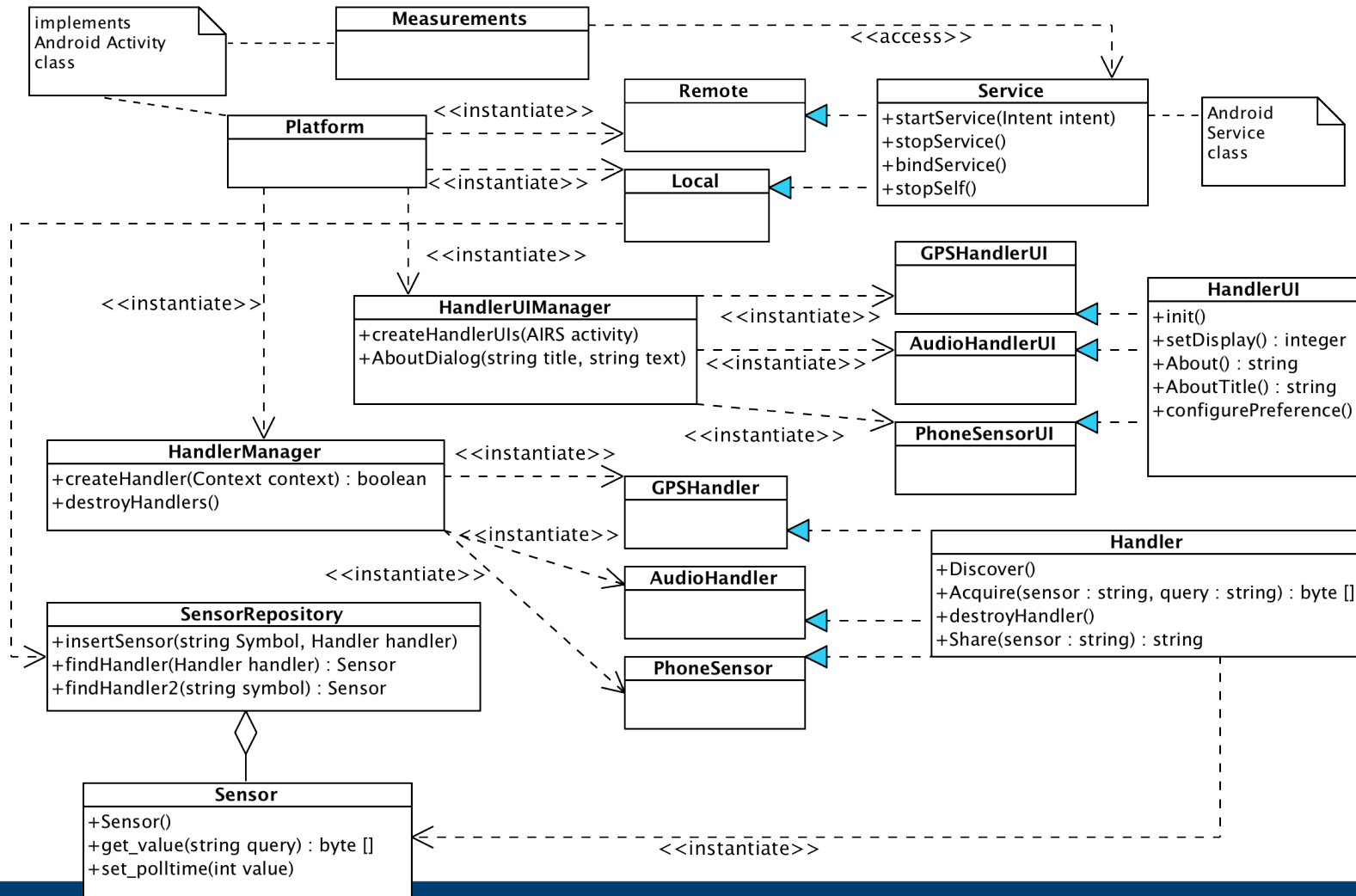  - Important in the age of social networks!

# Objective of Our Contribution

- Design and develop a mobile device platform for recording a large variety of information sources, addressing the aforementioned challenges

- Make the platform available to the wider community to drive adoption towards a common framework rather than continuing individual realisations
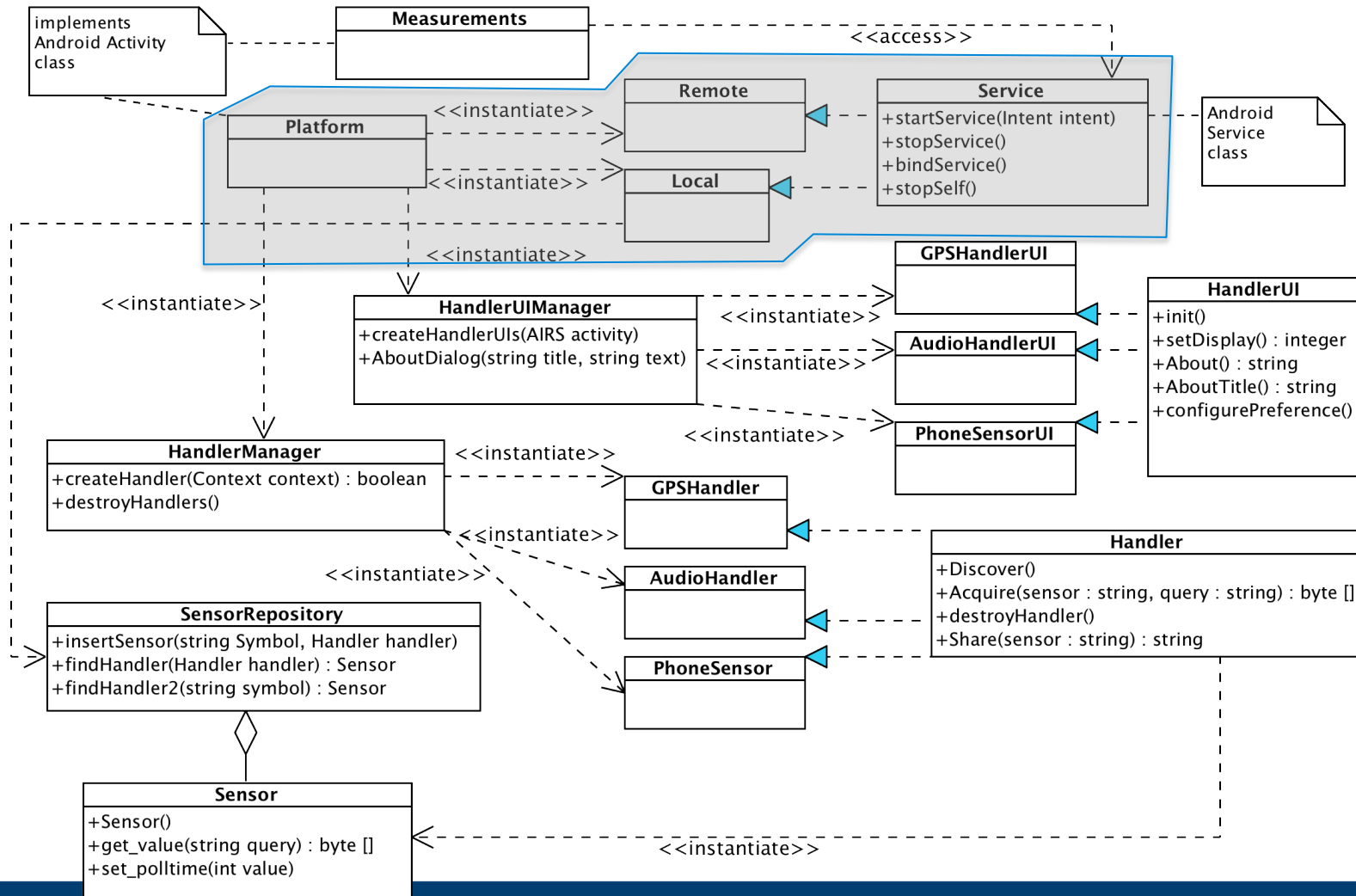
# Platform Choice: Android

- Allows for easy background recording

- Exposes many system-level sources of information

- Allows easy access to, e.g., WLAN, BT

- Allows for integration of BT/USB accessories

- Support for widgets on launcher screen

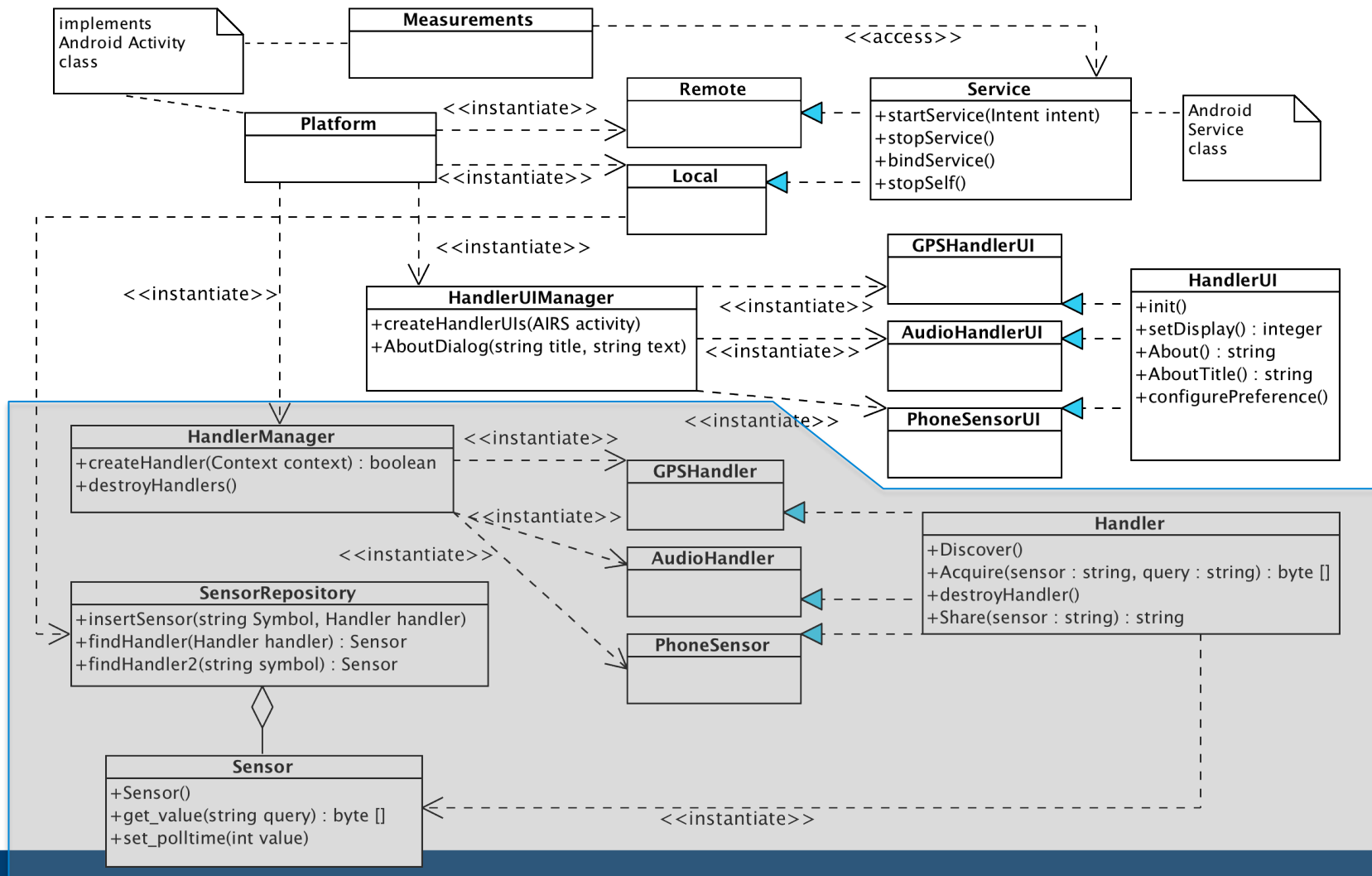- Larger user base

- More device form factors
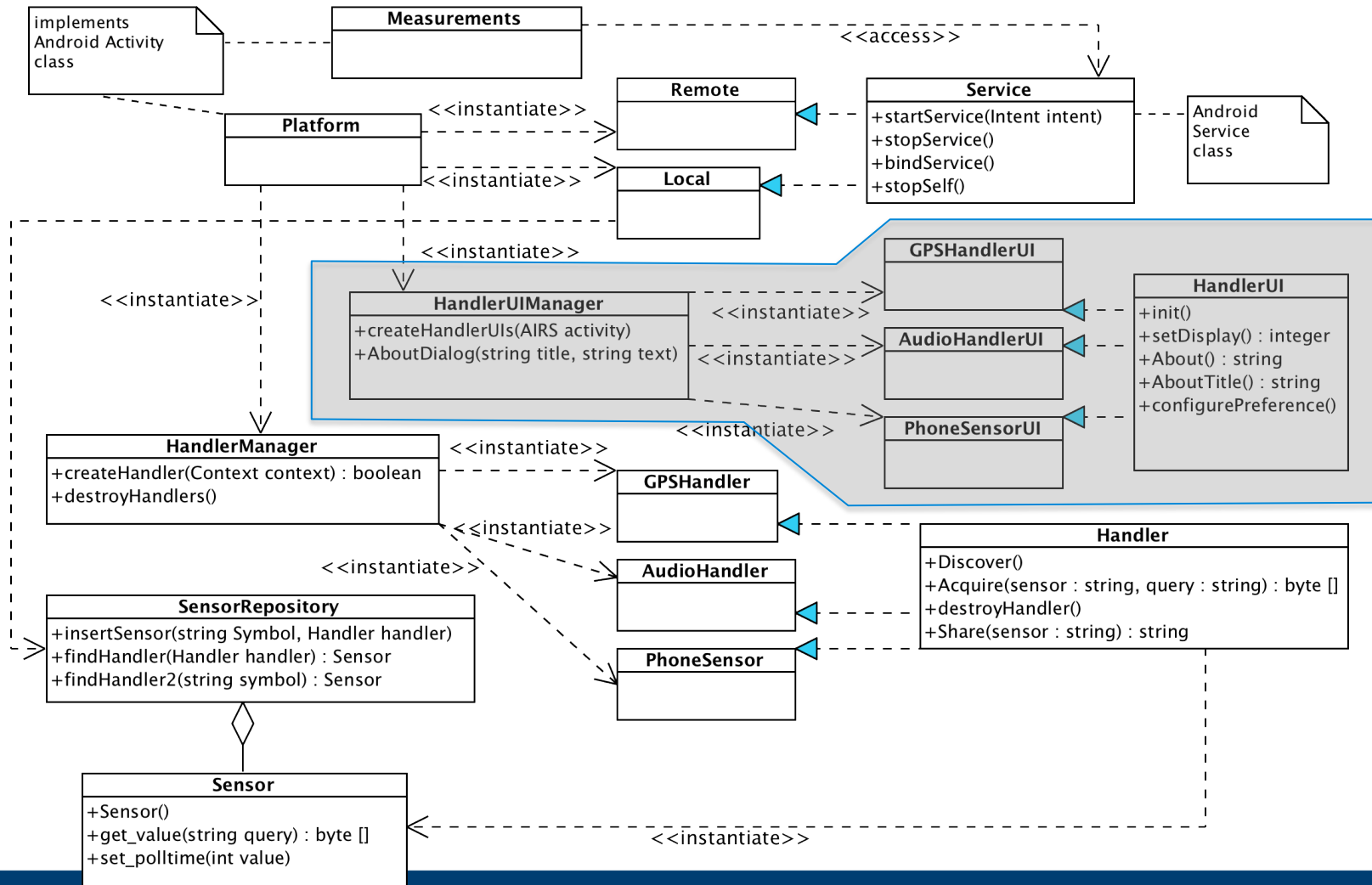
# Main Platform Abstractions
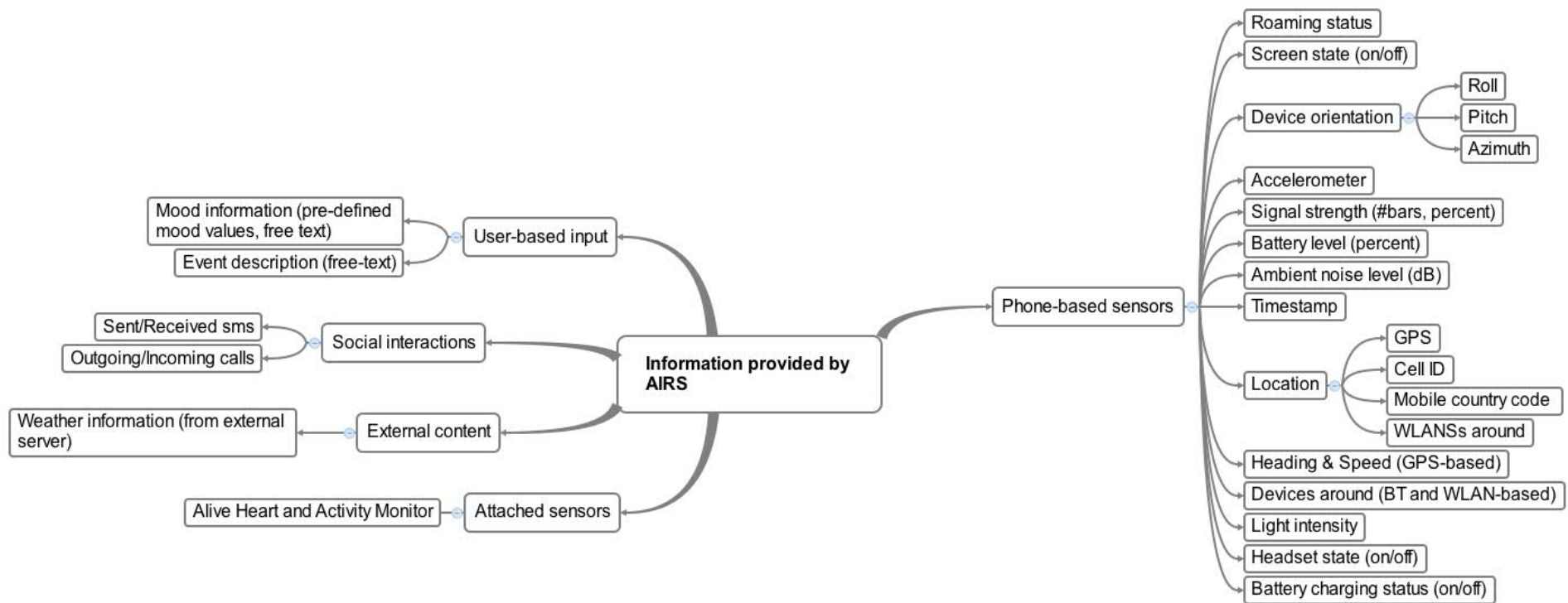
# Main Platform Abstractions

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implements
Android Activity
class

**Measurements**

<<access>>

**Remote**

**Service**
+startService(Intent intent)
+stopService()
+bindService()
+stopSelf()

Android
Service
class

**Platform**

<<instantiate>>

<<instantiate>>

**Local**

<<instantiate>>

**GPSHandlerUI**

**HandlerUI**
+init()
+setDisplay() : integer
+About() : string
+AboutTitle() : string
+configurePreference()

<<instantiate>>

**HandlerUIManager**
+createHandlerUIs(AIRS activity)
+AboutDialog(string title, string text)

<<instantiate>>

**AudioHandlerUI**

<<instantiate>>

<<instantiate>>

**PhoneSensorUI**

**HandlerManager**
+createHandler(Context context) : boolean
+destroyHandlers()

<<instantiate>>

**GPSHandler**

<<instantiate>>

**Handler**
+Discover()
+Acquire(sensor : string, query : string) : byte []
+destroyHandler()
+Share(sensor : string) : string

<<instantiate>>

**AudioHandler**

**SensorRepository**
+insertSensor(string Symbol, Handler handler)
+findHandler(Handler handler) : Sensor
+findHandler2(string symbol) : Sensor

**PhoneSensor**

**Sensor**
+Sensor()
+get_value(string query) : byte []
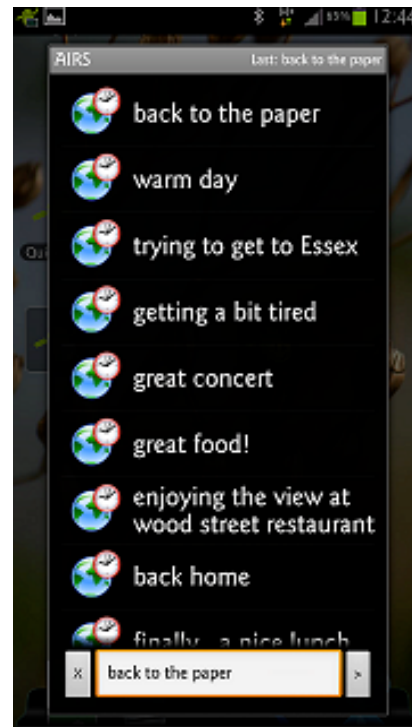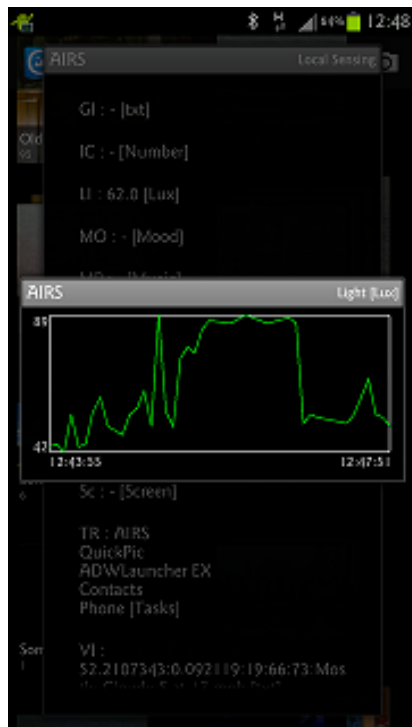+set_polltime(int value)

<<instantiate>>

# Supported Sensors



- 60+ sensors supported
- Abstracted by Handler interface
- Stored in Sqlite DB

- Most sensors realised via callbacks
- Integrating new sensors possible

# Supported User Interactions



- Visualise through timeline or maps

- Annotate through widgets utilising the user's knowledge of the current context

- Enable Handlers to expose setting UI

- Sharing of individual values

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# Conducted User Experiments

- **Realistic usage**: Lifestyle monitoring scenario

  - Feedback from usage into extending the platform

  - GPS, BT & audio plus many other callback sensors

- **Controlled setting:** wardriving scenario

  - Getting insight into battery consumption of 'heavy' sensors

  - GPS & WLAN with 15s and 30s intervals, no personal use of devices

- **Challenges:** Repeatability of experiments & Differences in device platforms

# Battery Usage

- GPS, WLAN, BT and audio recording major power sources

  - Settings influence the consumption

- Battery usage around 6-8% average per hour

- Higher variance for lifestyle scenario due to end user usage
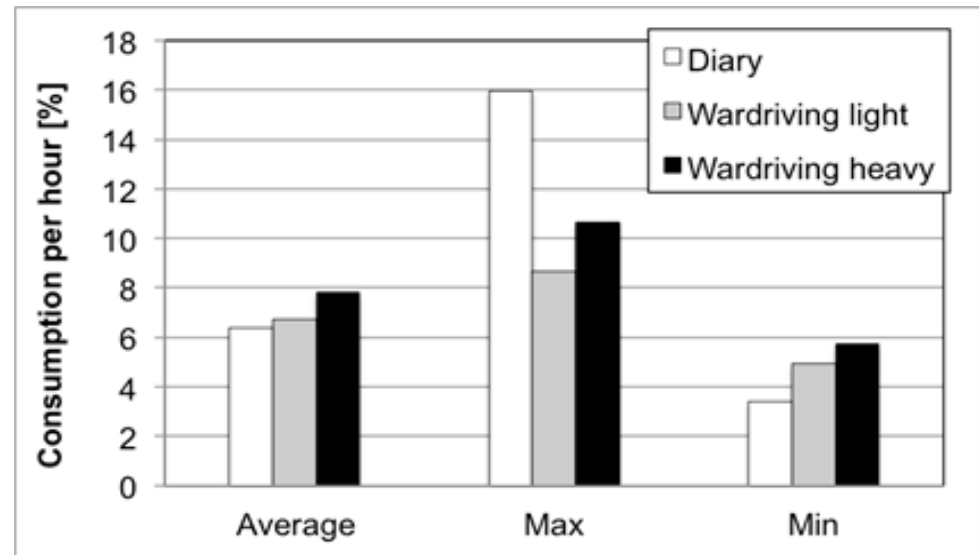


Used devices:
- Galaxy Nexus running Android 4.04 for lifestyle scenario
- Two Galaxy S running Android 2.3.5 for wardriving scenario

# Feedback into Design

- Support for configurability important since needs change over time

    - Configure what is recorded, when, with what sampling rate/accuracy

    - Template-based recording possible

- Support for user contributions important to complement recordings

    - Free text allows for user-level semantics to be added

    - Mood annotations prove to be useful and accurate

# Summary: AIRS Platform - Features

- Supports integration of a wide range of current and future sensors

- Provides configuration interfaces for settings and choosing sensors

- Provides quick start mode from the main application launcher screen, using the last selected sensors (if they are still available)

- Visualises current value or historical timelines

- Provides two widgets, one for free-text user annotations and one for mood-related annotations

- Supports local recording with values stored in a phone-local database

- Support remote recording with data sent to a remote server

# Conclusions

- Design & implement a mobile device platform ready for use

    - Used in research projects on lifestyle management

    - Extensible in terms of supported information sources

- Make software available to wider community

    - Available for download in Google Play Store

    - Currently >5500 downloads

- Allows for recording scenarios without depleting battery

    - Usage-based experiments show possible day-long recordings!

# More Information

- AIRS @ PlayStore

- PAL project on lifestyle monitoring

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