OPC UA App development for Android

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Introduction

• OPC UA has become increasingly popular recently

• Smartdevice market has grown exponentially over the last 10 years

• Could we make use of the vast amount of smartdevices in an OPC UA environment?
Targets

• Determine if Android is suitable for OPC UA

• Implement an Android App that provides all of the standard OPC UA client features

• Evaluation of the Android development environment

• Consider possible use cases
OPC Unified Architecture

• Interoperability standard for secure and reliable exchange of data for industrial applications

• Platform independent, service oriented architecture

• Specifications define the interface between Clients and Servers (or Servers and Servers)
OPC UA Address Space

- Server has an Address Space
- Address Space contains Nodes
- Node relationships defined by References
  - Can be imagined as an hierarchial tree structure
  - Can have circular references!
OPC UA Services

• Address Space information is accessed through Services

• Services provide interfaces for
  – Data Access
  – Historical Data Access
  – Alarms & Conditions
  – Historical Alarms & Conditions
  – Methods
  – ...

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Android Operating System

• Open source mobile operating system
  – Currently developed by Google

• The most popular operating system for smart devices
  – Roughly 80% market share
App development

• The native programming language is Java
  – Using a Java SDK for OPC UA is a solid choice

• Android apps consist of four main components:
  – Activities
  – Services
  – Content providers
  – Broadcast receivers
Activities and Fragments

• Activities typically represent a single activity in an app

• Fragments are User Interface elements for Activities
  – can represent a part of or a whole view

• Design possibilities:
  – Several activities with single fragment
  – Single activity with multiple fragments
  – Combination?
Activities and Fragments

Connect Activity

Connect Fragment

→

Browse Activity

Browse Fragment
Activities and Fragments

Client Activity

Connect Fragment → Browse Fragment
Services

- Background workers
- Used typically for async tasks or long lasting operations
- Activities launch Services and can bind to them
- Don’t require the Activity for staying alive
Services for an OPC UA client

• Perfect for running the OPC UA client for communication between the Activity and an OPC UA server

• Allows running OPC UA service requests async
  – Can do other things while OPC UA service calls are handled in the background

• Can be left running in the background to gather data while the Activity isn’t in use (e.g. Listen for alarms)
Content providers

- Give access to shared data on device/web/storage
- Access depends on given permissions
  - Requested during installation
- Also provide means to write data to app private storage
Content providers for an OPC UA client

• Allows data logging to SQLite database

• Enables saving connection settings and history
Broadcast receivers

- Broadcasts are system wide events
- Apps can listen for specific events with receivers
- Apps can create custom broadcasts
Broadcast receivers for an OPC UA client

- Good for relaying events from the Service to the Activity

- Activity can react to events from the Service:
  - Connection information
  - New data received
  - Alarm received
  - Event received
Design principles

• Unified experience – each app should feel similar

• Keep it simple

• Let users figure out how things work through use of common interaction models
  – Swipe gestures, two finger zooming, ...
Development environment

• Developed with Android Studio
  – Started with Eclipse and the Android Developer Tools – plugin

• Different platforms were used for testing:
  – Google Nexus 7
  – Google Nexus 6
  – Samsung Galaxy Tab 10
  – Various other smartphones
Implemented structure

- OPC UA client as a Service
- Single Activity with multiple Fragments
  - Each feature as own Fragment
- Data storing in SQLite
OPC UA client Service

- Runs separately from the Activity
- Manages OPC UA connections
- Provides OPC UA functions for the App to use
- Reports information through Broadcasts
Implemented OPC UA features

- Data Access
- Historical Data Access
- Alarms & Conditions
- Historical Alarms & Conditions
- Methods
Main Activity

- Manages Fragments
- Provides access to SQLite storage
- Starts the OPC UA client Service
- Acts as a temporary data store when changing Fragments
Connect Fragment

- Allows creating new connections
- Provides access to previously used connections
New Connection Fragment

- Input view for connection details
Status Fragment

- Displays connection status
- Manages disconnecting from server
Navigation Fragment

- Provides view of all connections
- Allows changing active connection
- Access point to OPC UA features
Browse Fragment

• OPC UA server navigation

• Gives access to features:
  – Subscriptions
  – History
  – Node information
  – Methods

• Challenge: how to display huge Address Spaces in while navigating deeper?
Browse Fragment Challenge
Monitor Fragment

- Displays subscribed values
- Provides option to view all or a single server
- Allows editing values
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Events Fragment

- Displays events received from the OPC UA server
  - Color codes severities
- Provides additional information on select
Event Fragment

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  - Color codes severities

- Provides additional information on select
Data Value History Fragment

- Displays value history as a graph
- ... or as a list
- Timespan selected either from predefined intervals or custom date range
Data Value History Fragment

- Displays value history as a graph
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Event History

- Displays event history the same way as real-time events
- Time selection same as Data Value history
Methods

• Enables user to call Methods on server

• Displays Input & Output parameters with their descriptions
Additional Fragments

When starting the application the first screen to be shown is the Connection screen. From this screen you can either create a new OPC UA connection with the "Connect to new server" button, or if you have used the client before you can select one of the previously created connections from the History list.
Possible use cases

• Alarm monitoring

• Maintenance assistance – Qr codes on devices?

• Process control

• Data retrieval from field devices
Conclusions

• Android offers a flexible environment
  – Development tools feel mature

• All of the required features were implemented

• Vast amount of available devices offers many opportunities
Questions?