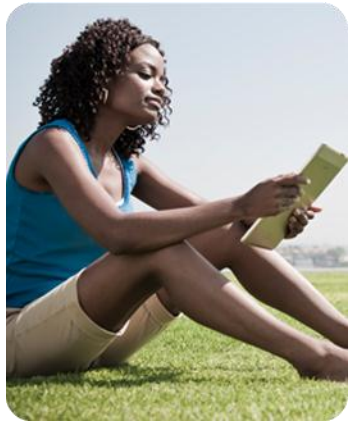
Open Source. Open Possibilities.



The AllJoyn™ Open Source Project

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Director, Engineering,
Qualcomm Innovation Center, Inc.

August 30, 2012

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Agenda

- AllJoyn Overview
- Architectural Concepts
- Security Concepts
- Performance and Deployment
- Availability and Open Source
- Q&A

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AllJoyn Overview

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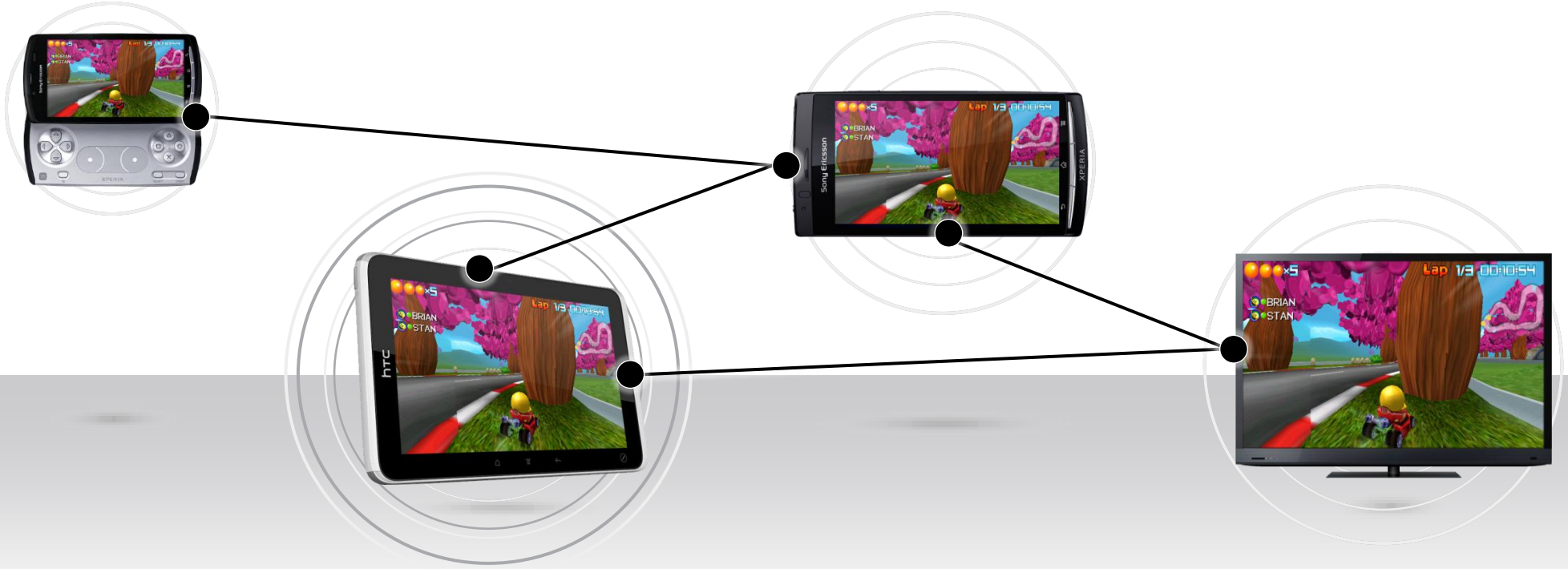
What Is AllJoyn?

An Open Source Application Development Framework Enabling Proximity-based, Peer-to-peer Networking that is Platform and Radio Bearer Agnostic



AllJoyn brings proximity awareness to mobile apps, unleashing a whole new set of user experiences to smartphones, tablets, PCs, TVs and more

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Why Peer-to-peer (P2P) Is Hard

P2P Friction Developers Face Today

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AllJoyn Makes Peer-to-peer Frictionless

DISCOVER
devices and applications around you

ADAPT
to apps and devices coming and going

MANAGE
transports like Bluetooth and Wi-Fi and message routing across them

INTEROPERATE
across disparate programming languages, operating systems, and bearers

EXCHANGE
Information in a secure manner

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Why Develop AllJoyn?

- Simplify and extend inter-device communication capabilities
- Always-on, always-connecting
- OS independent platform enabling peer-to-peer application ecosystem
- Seed the peer-to-peer application ecosystem
- Fuel new and creative application usage models

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What New Experiences Can AllJoyn Enable?

ENTERTAINMENT & GAMING EXPERIENCES

MULTISCREEN EXPERIENCES

COLLABORATIVE EXPERIENCES

AllJoyn Ushers in New User Experiences for Smartphones, Tablets, PCs & TVs

GAMES

OFFICE APPS

SOCIAL NETWORKING

IMAGING APPS

TV CONNECTIONS

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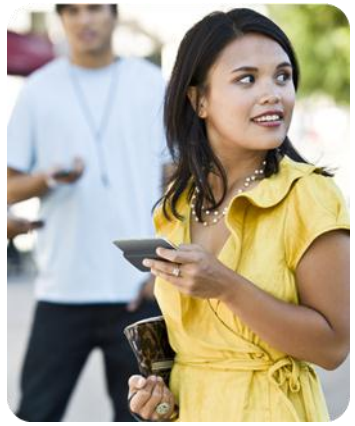
Architectural Concepts



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Overview

Designed to be easily portable to new hardware and OS platforms

AllJoyn is a distributed software bus

- Each device has bus management functionality which is commonly referred to as “the daemon“
  - Daemon functionality can be integrated on the platform or in the app itself
- Applications communicate directly with the daemon
- Daemons handle cross device communication
- A client library is used by applications to interact with the daemon

Bus formation is ad hoc

- Based on proximal discovery of applications/services
- Abstracts link-specific discovery mechanisms

Protocol is link independent

- Ground-up implementation of the D-Bus wire-protocol with extensions
- Supports Wi-Fi and Bluetooth currently
- Wi-Fi Direct under development

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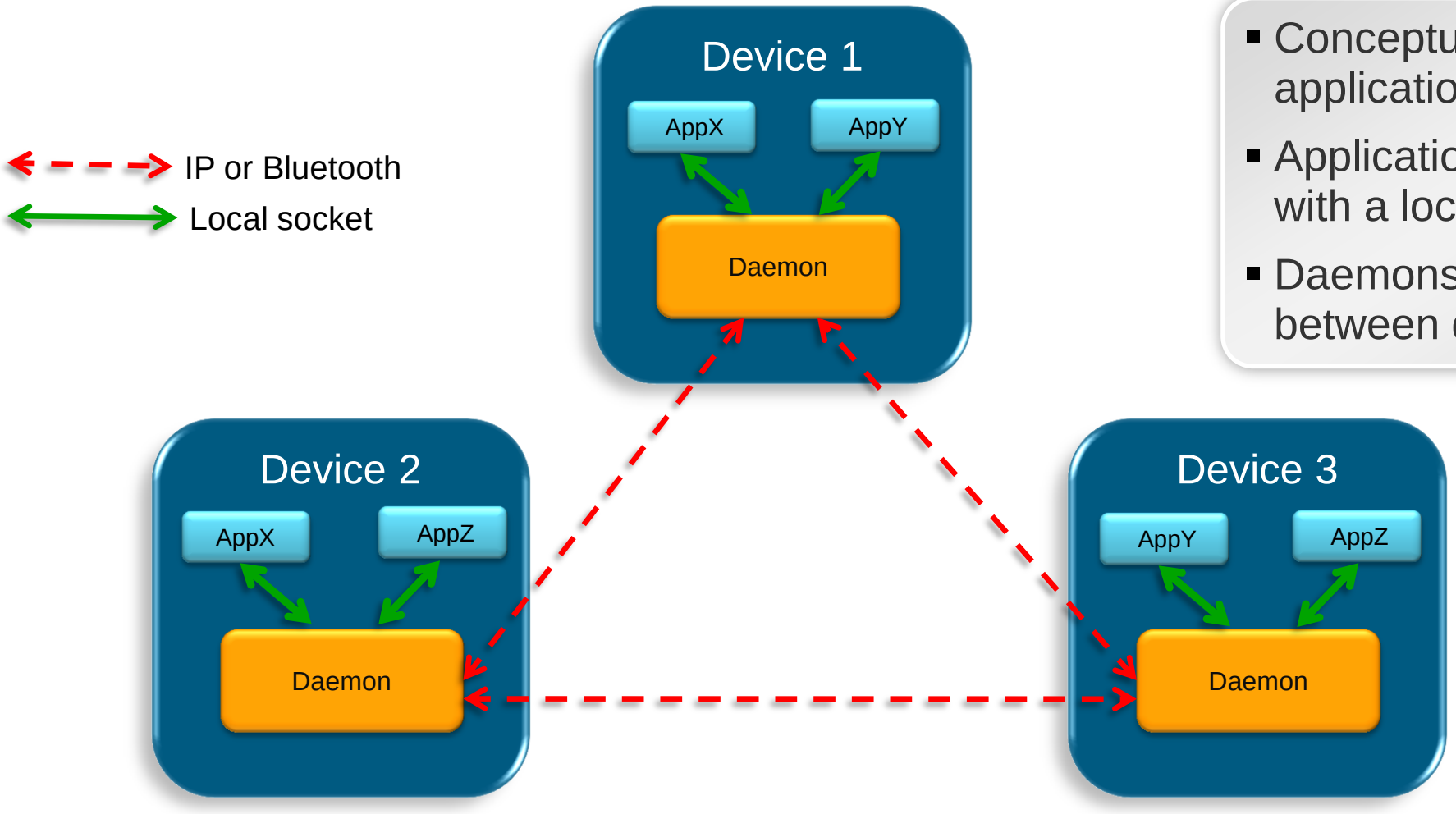
AllJoyn Distributed Software Bus



- Conceptually ***peers*** are applications not devices.
- Applications communicate with a local daemon
- Daemons handle routing between devices

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Why the D-Bus Wire Protocol?

Why reinvent the wheel?

- www.freedesktop.org/wiki/Software/dbus

IPC mechanisms used on many Linux distributions

- Deeply integrated with system services and session management
- Supports RPCs as well as unicast and broadcast events

Object oriented

- Objects, interfaces, methods, and properties

Message bus architecture

- RPC and events implemented as messages
- Publish/subscribe semantics
- P2P came from extending bus cross device; messages flow over bigger bus

Language neutral

- Bindings for C, Java, Python, Perl, etc.

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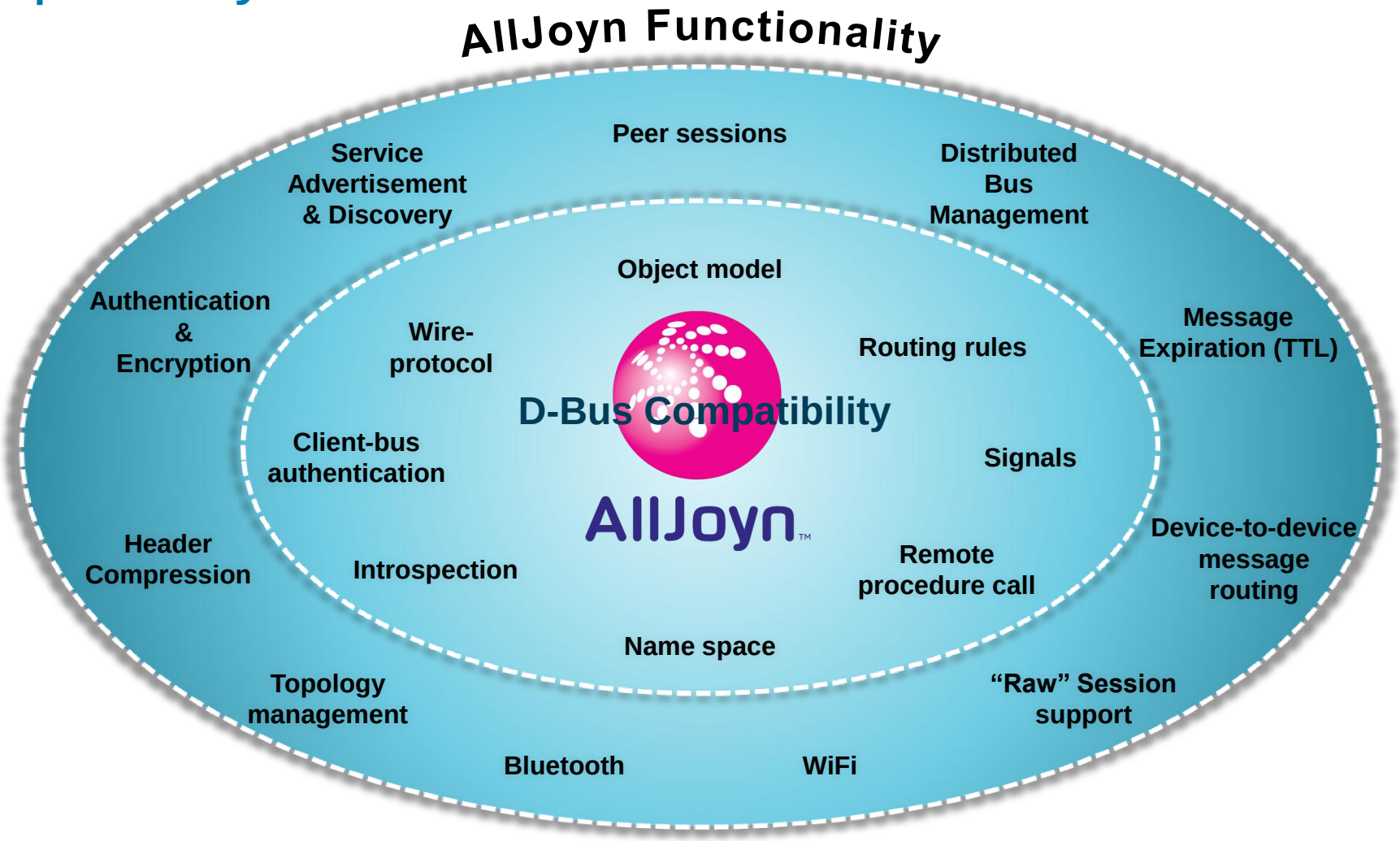
D-Bus Compatibility



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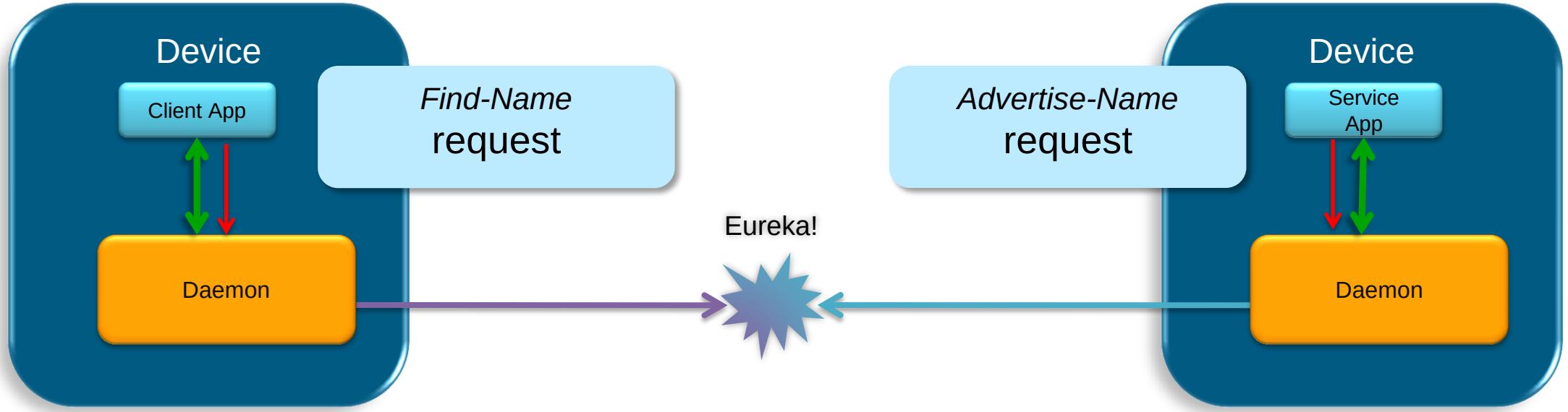
Ad Hoc Bus Formation



Actual discovery mechanism is transport dependent:

- On Wi-Fi a light-weight IP multicast protocol
- On Bluetooth device discovery with EIR and SDP query
- On Wi-Fi Direct pre-association discovery

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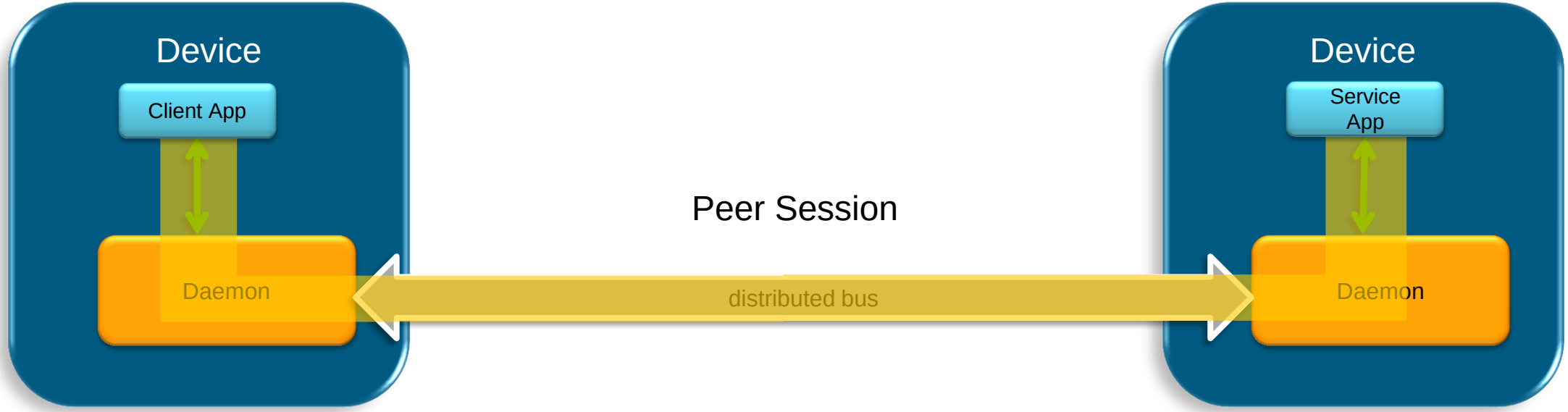
Ad Hoc Bus Formation



Once connected daemons form a single bus with a shared namespace

- Peers can discover when other peers join or leave the bus
- Peers can make RPC calls and send and receive events
- Session reference counting keeps device-to-device connections alive
- Multicast events can be sent to all peers in the session

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Object Model

AllJoyn applications expose their functionality via objects

- These are typically organized in a hierarchy

Objects implement interfaces (one or more)

Interfaces are composed of members, which fall into three categories

- Methods – classic OO object interaction
- Signals – asynchronous event notification
  - Can be broadcast, multicast, or point-to-point
- Properties – data members
  - These are accessed by built-in get/set methods

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Bus Attachments, Objects, Proxy Objects

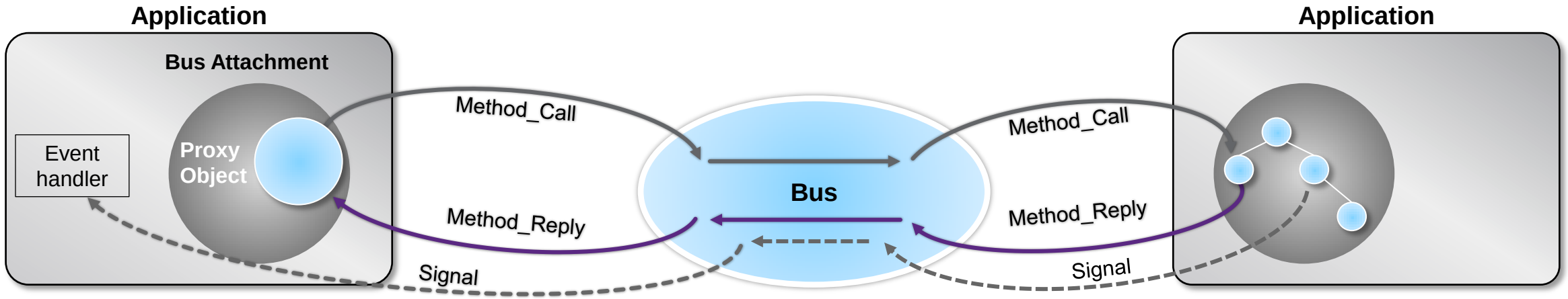
An application needs a Bus Attachment to communicate with/over bus

- Bus Attachments provide a root (/) for the object hierarchy
- Path names look like file paths (e.g., /org/AllJoyn/Games/chess)

Objects live within the Bus Attachments

Proxy Bus Objects are local representations of remote Bus Objects

- Applications use proxy bus objects to make method calls to remote objects



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Language Bindings

Native implementation for AllJoyn is C++

Java binding is available for Android

C binding, Unity Binding publicly available

Binding for JavaScript is under development for NPAPI

Objective C binding will be available for iOS

C#, WinJS, and Visual Basic will be available for Windows RT

Object model is similar for all bindings

- Create a BusAttachment to connect to the bus
- Create BusInterface(s) that will be implemented by BusObjects
- Create and register BusObject(s) with the BusAttachment
- BusObjects handle remote method calls and emit Signals
- Applications call methods on remote objects using ProxyBusObjects
- Applications register Signal handlers with BusAttachment

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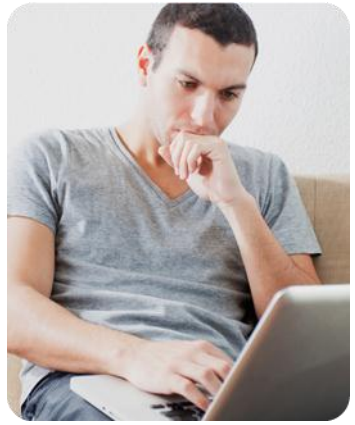
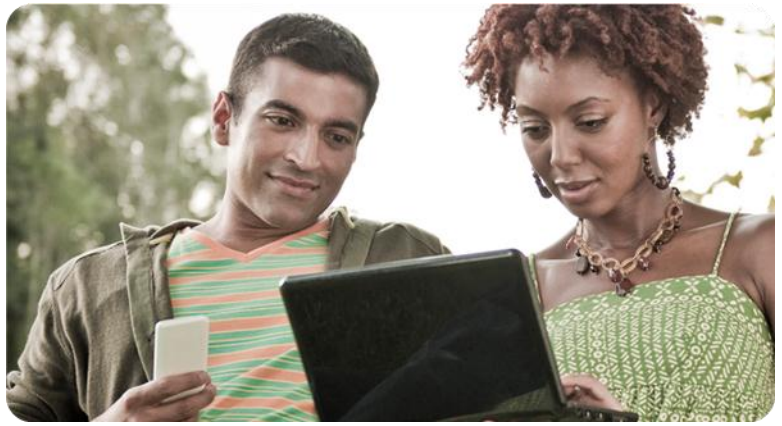
Security Concepts





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Design of Security Framework

Authentication and encryption is designed to be app-to-app

- Trust relationship established between the applications
- The bus is not involved other than to route
- Device pairing not required unless the transport requires it
- In case of Bluetooth AllJoyn does not normally trigger pairing

Security is enabled per-interface

- Authentication and key exchange initiated on demand

Security-enabled interface

- Authentication is required to make method calls
- Authentication required to receive signals
- All messages are encrypted

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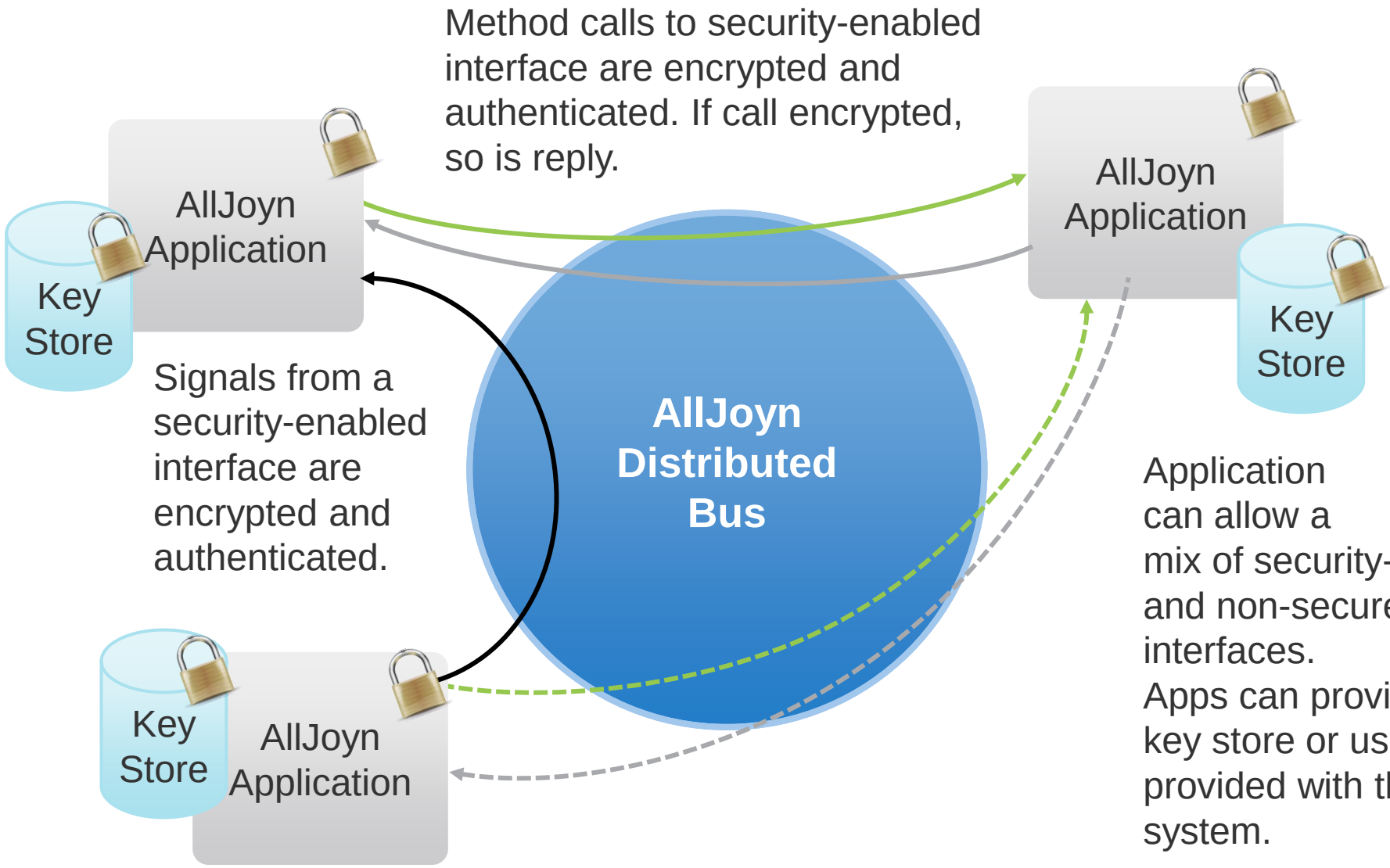
Security Model – Authentication and Encryption



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Built-In Authentication Mechanisms

Three mechanisms supported

- Mechanism negotiated using SASL protocol
- Mechanism chosen by Application developer
- Mechanisms adapted from TLS protocols per RFC 5256

Pin-code

- Authentication with a single-use password
- Trust relationship is persistent

Logon

- User name and password type
- Password required every time peers connect

Certificate-based

- RSA public key authentication and X.509 certificates
- Trust relationship lasts while certificate valid

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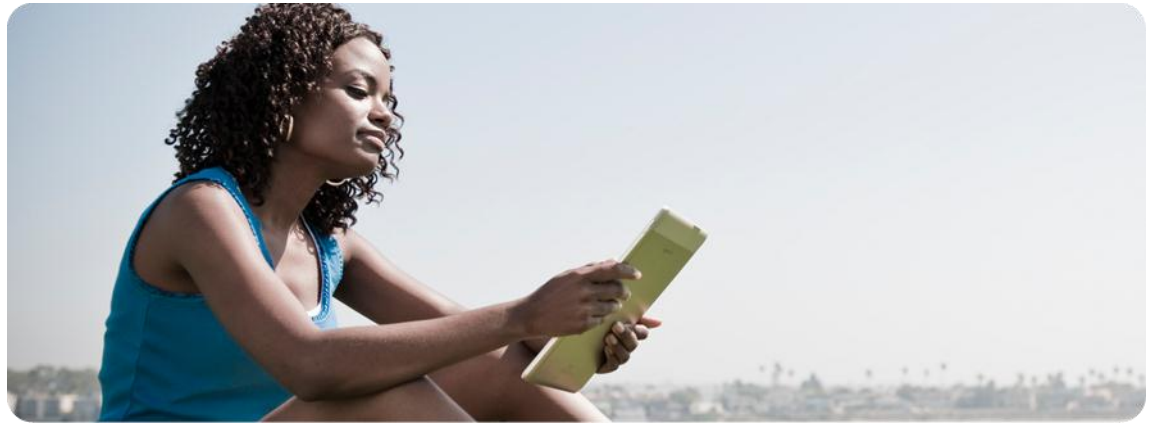
Performance & Deployment



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Message Optimizations

Header compression

- Designed to significantly reduce the size of message headers

Time to live

- Designed to support isochronous data (e.g. real-time streaming/gaming)

Multipoint sessions

- Bounds the scope of broadcast signals to session members
- Provides mechanism for deciding when radios are no longer in use

Designed for an optimized experience on mobile embedded devices

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Deployment Options

AllJoyn applications require the daemon functionality

There are three options for deployment on Android:

- Platform Integration
  - Standalone daemon for system, can use WiFi as well as BT
  - Started at system startup via initialization scripts
- Downloadable APK Daemon
  - Single daemon for system, restricted to WiFi only
  - Launched via intent
  - Available in 2.3 release, but deprecated with 2.5 release
- Application Integration
  - Daemon functionality resides in the application
  - Also launched by intent
    - Will only be used if neither of the other two is available
  - Like the APK: restricted to WiFi only, but will support WiFi Direct in near future
  - Each application will full Alljoyn functionality

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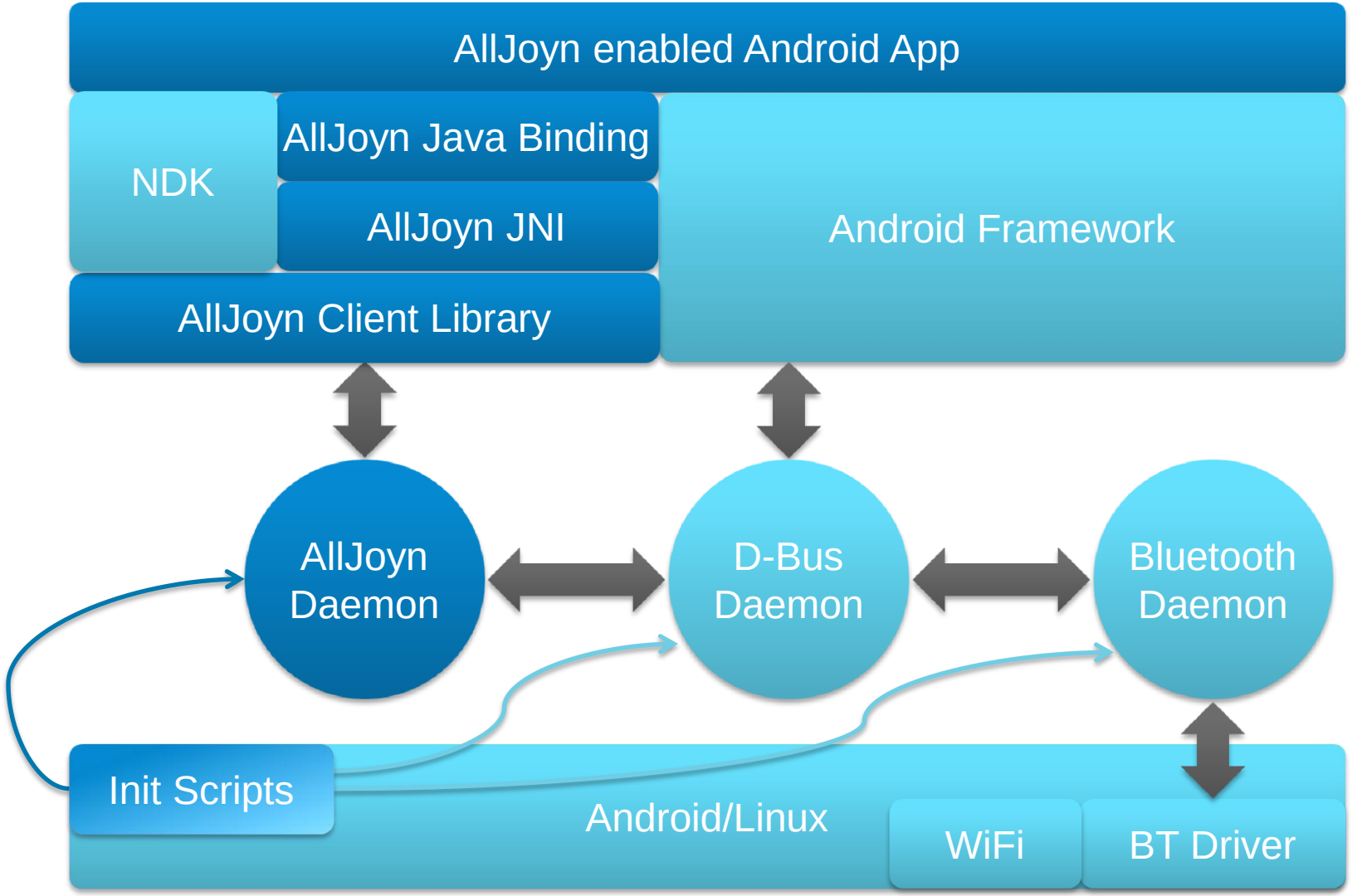
AllJoyn Platform Integration



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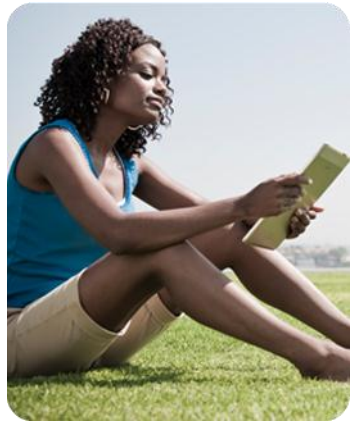
Availability and Open Source



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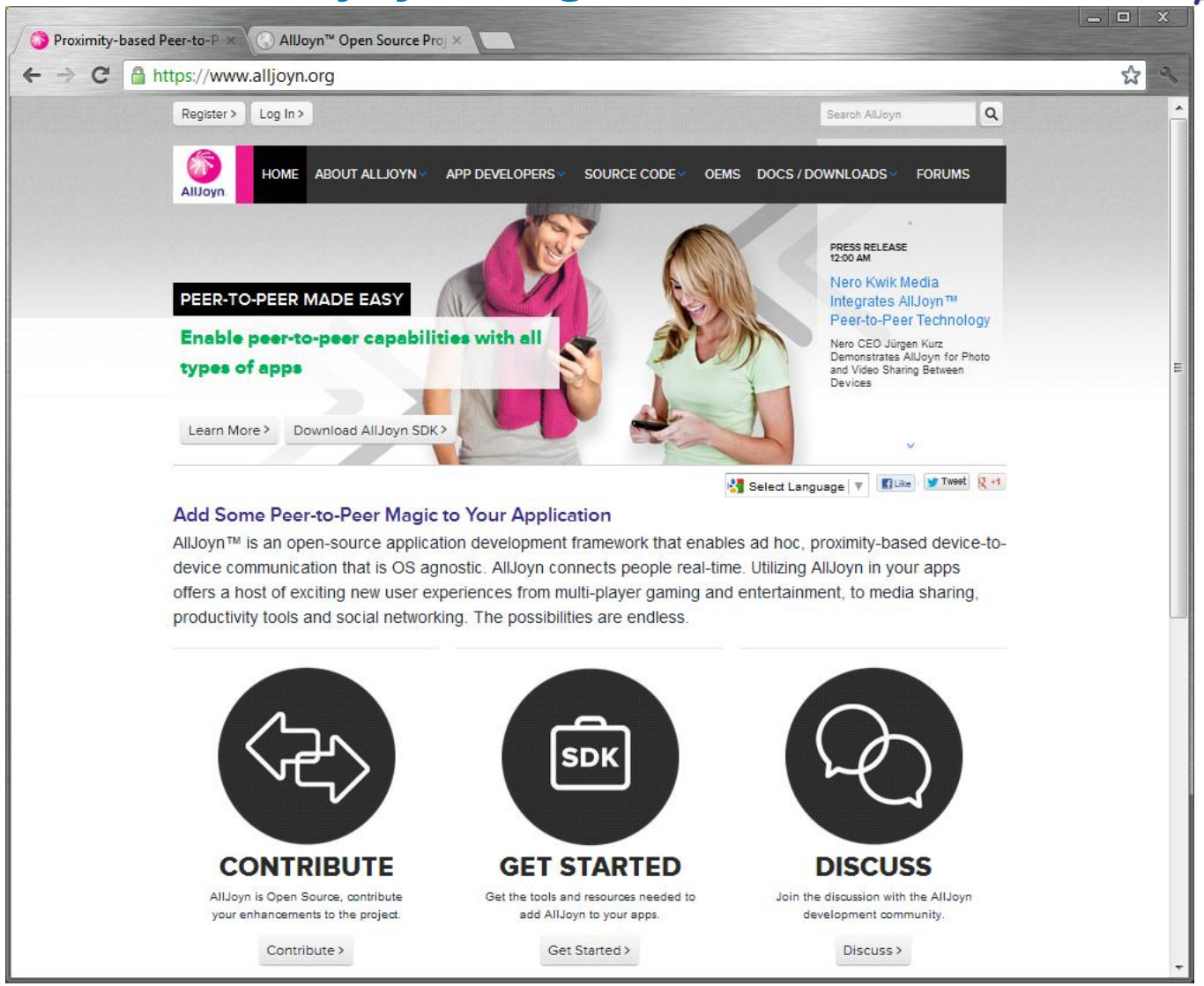
AllJoyn Open Source Project: www.alljoyn.org

- AllJoyn is an Open source project
- Source available on GitHub
  - http://alljoyn.github.com
- Accepting 3rd party contributions
- Binary SDKs available on alljoyn.org
  - Currently have Android, and Windows
  - Recently released 2.6
- Licensed using Apache 2.0
  - Flexibility to use and modify



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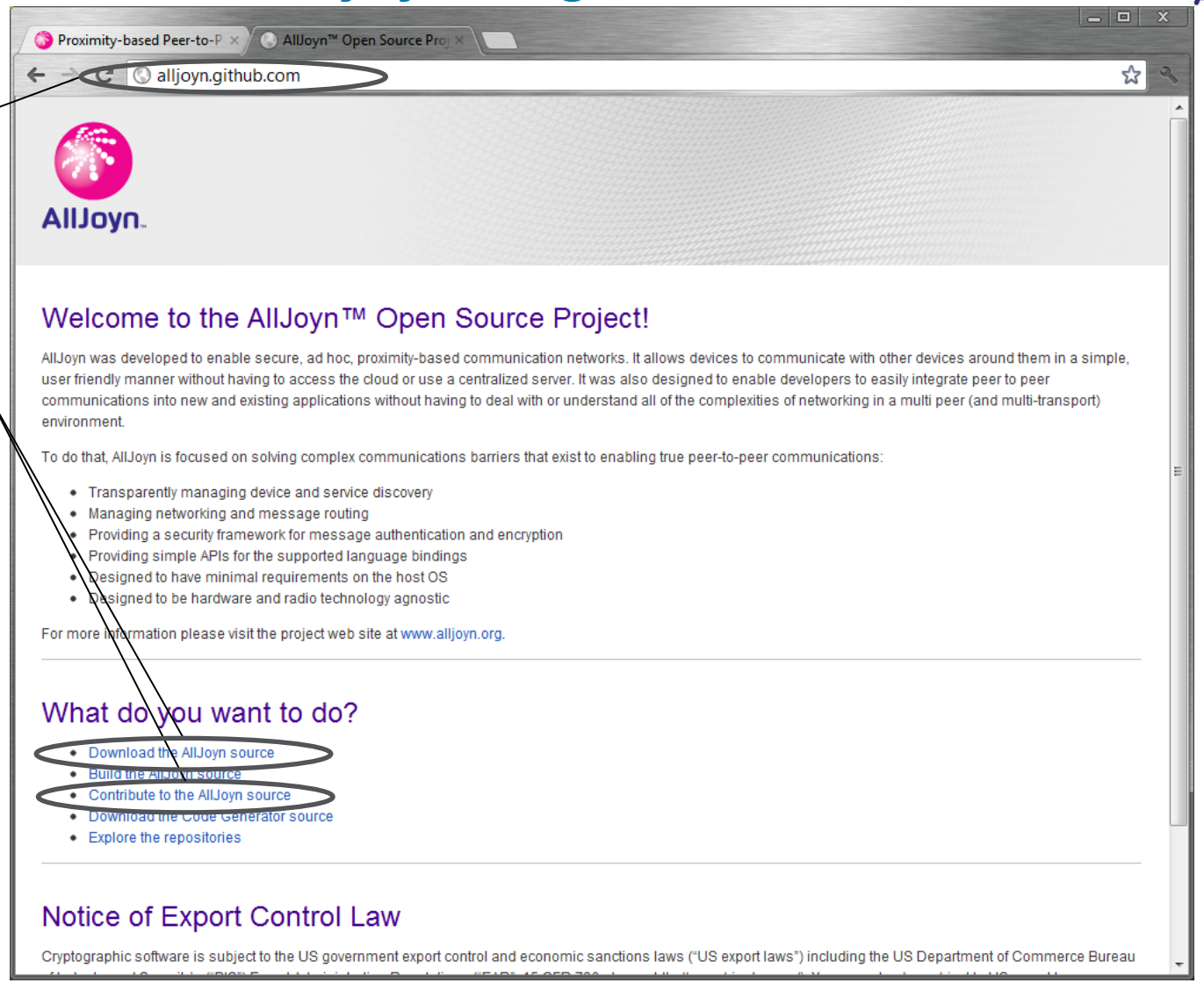

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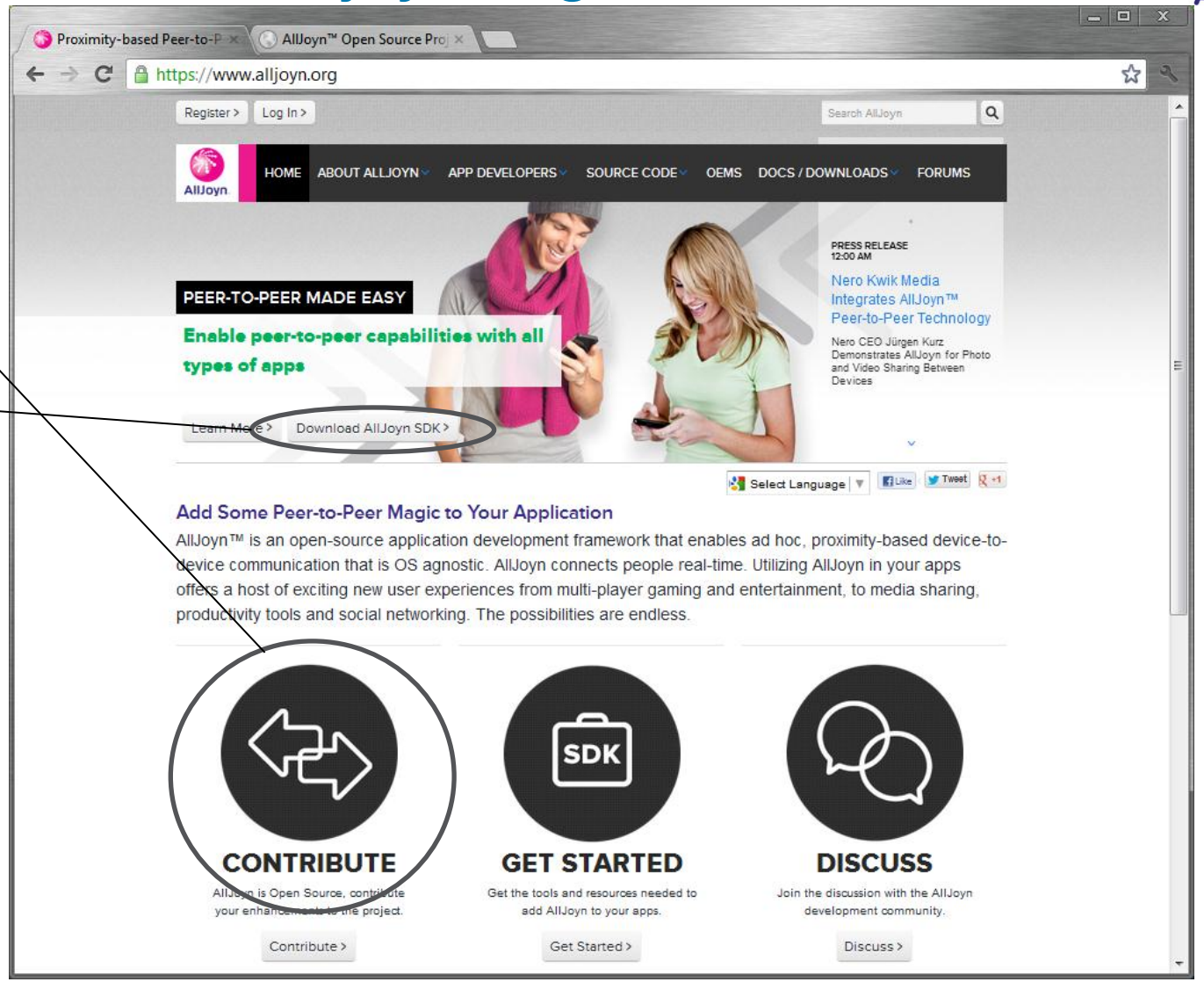

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