The State of AGL

Plumbing and Services

Scott Murray and Matt Porter
scott.murray@konsulko.com, mporter@konsulko.com

Konsulko Group

About Us

- Scott Murray
  - Linux user/developer since 1996
  - Embedded Linux developer starting in 2000
  - Principal Software Engineer at Konsulko Group
- Matt Porter
  - Linux user/developer since 1992
  - Embedded Linux became my full-time job starting 1999 at Motorola
  - CTO at Konsulko Group

Konsulko Group

Syllabus

- Overview of AGL
- Release history
- Current and planned features
- Build system and organization
- Key plumbing components
- AGL application framework
- AGL application APIs (bindings)
- Roadmap
- Community

Konsulko Group

Overview

Overview of AGL

- Automotive Grade Linux is an embedded Linux distribution targeting IVI and ADAS products
- Based on OpenEmbedded build system and Yocto Project Poky reference distribution
- Provides an application framework with a software cross-development kit
- Goal is to provide a secure application runtime environment and a uniform set of APIs meeting automotive and mobility use cases
- Intended to provide a common base distribution for products

Konsulko Group

History and Features

Release History

- Agile Albacore - January 2016
  - MOST driver and demo apps for HomeScreen/HVAC/Media/Navigation/Radio
- Brilliant Blowfish - July 2016
  - Application framework and Audio Routing
- Charming Chinook - January 2017
  - Bluetooth/WiFi/Radio Bindings, SDK, and additional BSP support
- Daring Dab - July 2017
  - Application framework v2, CAN/Mediascanner/Telephony Bindings, SmartDeviceLink
- Electric Eel - January 2018

Konsulko Group

Current and Planned Features

- Current
  - Application framework
  - Some core APIs (various connectivity APIs covered later)
  - Audio routing
  - Demo applications (in-tree Qt/QML based, out-of-tree HTML5)
- Future
  - Audio API
  - MediaPlayer API
  - WindowManager API
  - HomeScreen API
  - Storage API

Konsulko Group

Build System and Distribution Organization

Distribution Details

- Based on Yocto Project Poky Distribution, pyro release
- Layers
  - oe-core
  - meta-openembedded/*
  - meta-intel-iot-security
    - meta-security-framework (Cynara)
    - meta-security-smack (SMACK)
  - meta-agl
    - meta-agl-app-framework
    - meta-agl-bsp
    - meta-agl-distro
    - meta-agl-ivi-common
  - meta-qt5
  - meta-agl-demo
  - BSP Layers (vendor or community)
    - e.g. meta-freescale, meta-renesas-rcar-gen3, meta-ti

Konsulko Group

Plumbing and Services

Plumbing

- Service and application lifecycle
  - systemd
    - Each application is a service
    - AGL is considering moving to dynamic users
- Audio
  - ALSA
  - Pulseaudio
  - GENIVI AudioManager
    - Used for policy-driven audio routing in conjunction with an out-of-tree Pulseaudio module
- Graphics
  - Wayland
  - Weston with IVI shell

Konsulko Group

Plumbing (continued)

- Bluetooth
  - Bluez5
- Location
  - gpsd
  - geoclue
- Telephony
  - ofono
- Networking
  - connman
  - wpa_supplicant

Konsulko Group

Application Framework

What is the application framework?

- The AGL application framework provides a sandboxed application execution environment.
- Implements a complete application lifecycle for install and runtime control of applications
- Provides a secure environment using systemd cgroups, SMACK, Cynara, and a Cynara-enabled D-Bus daemon.
- Provides Websocket interface to bindings (application APIs)
- Applications are packaged according to W3C Widget guidelines
  - https://www.w3.org/TR/widgets/
- More information
  - http://docs.automotivelinux.org/docs/apis_services/en/dev/reference/af-main/0-introduction.html

Konsulko Group

Binding Overview

- The API binding mechanism abstracts an application's UI from its back end logic
- This allows re-using application logic with different UI implementations (e.g. Qt and HTML5)
- Allows the application framework to control access to APIs and resources in a fine-grained manner, effectively sandboxing applications based on their API permissions.
- End goal is to provide a complete and consistent API for AGL applications
- More information
  - http://docs.automotivelinux.org/docs/apis_services/en/dev/reference/af-binder/afb-overview.html

Konsulko Group

Binding Registration

- Binding implementation is a shared library
- A binding implementation:
  - Registers a unique binding ***api*** name
  - Registers a list of binding verbs to perform actions
  - Contains the binding verb/event backend implementation
  - Optionally registers ***preinit*** and ***init*** routines for the binding
  - Optionally registers a ***specification*** containing an OpenAPI v3 description of the binding
  - Optionally registers a text ***info*** description of the binding
  - Optionally registers an ***onevent*** callback for handling subscribed events
  - Optionally set ***noconcurrency*** flag to avoid concurrent verb calls

Konsulko Group

Application and Binding Initialization

- Application and binding packaging (widget) includes a config.xml file that:
  - Specifies the name, description, author, license
  - Lists any permissions that the package requires
  - Lists any bindings that the package requires
  - Lists any bindings that the package provides
- Application framework spawns an instance of afb-daemon
  - Loads and initializes the specified bindings
  - Executes the application, passing port number and authentication token arguments to it for binding access
  - Important to remember that each instance of the binding is separate
- More details
  - http://docs.automotivelinux.org/docs/apis_services/en/dev/reference/af-main/config.xml.html
  - http://docs.automotivelinux.org/docs/apis_services/en/dev/reference/af-binder/afb-bindings-overview.html

Konsulko Group

Application Binding Usage

- Submit requests in JSON format via HTTP or WebSocket
  - e.g. [2, "9999", "hvac/set", { "LeftTemperature" : 16}]
- Receive request status (success or failure) and any additional requested data
- Responses are also in JSON format
- Can subscribe / unsubscribe for events
- Events arrive asynchronously via WebSocket
- More details
  - http://docs.automotivelinux.org/docs/apis_services/en/dev/reference/af-binder/afb-bindings-writing.html

Konsulko Group

APIs

Upstream AGL Bindings

- Master Binding
- Bluetooth Binding
- WiFi Binding
- Radio Binding
- Telephony Binding
- MediaScanner Binding
- MediaPlayer Binding
- GPS Binding
- GeoClue Binding
- GeoFence Binding

Konsulko Group

WIP Bindings

- Audio Bindings
- New HomeScreen/WindowManager Bindings
- CAN Bindings

Konsulko Group

Master Binding

- Features
  - Application lifecycle facilities
    - Install
    - Uninstall
    - Start
    - Terminate
    - Pause
    - Resume
    - List
    - State

Konsulko Group

Master Binding API

- Verbs
  - **afm-main/runnables** - list runnable apps
  - **afm-main/detail** - info on app
  - **afm-main/start** - start an app
  - **afm-main/once** - start an app once
  - **afm-main/terminate** - terminate an app
  - **afm-main/pause** - pause an app
  - **afm-main/resume** - resume an app
  - **afm-main/runners** - list running apps
- Verbs (continued)
  - **afm-main/state** - get state of an app
  - **afm-main/install** - install an app
  - **afm-main/uninstall** - uninstall an app
- Events
  - None

Bluetooth Binding

- Features
  - Device discovery, pairing, connection, and settings
  - Device priority list
  - AVRCP Bluetooth binding controls
  - Media metadata, and position tracking
- Future
  - Clean up

Konsulko Group

Bluetooth Binding API

- Verbs (**Bluetooth-manager/***)
  - **power** - set power on/off
  - **start_discovery** - start device discovery
  - **stop_discovery** - stop device discovery
  - **discovery_result** - get discovered devices
  - **remove_device** - remove a device
  - **pair** - start pairing process
  - **cancel_pair** - cancel pairing process
  - **connect** - connect to device
  - **disconnect** - disconnect from device
- Verbs (continued)
  - **device_priorities** - get device priorities list
  - **set_device_property**
  - **set_property** - set bluetooth property
  - **set_avrcp_controls** - avrcp control
  - **send_confirmation** - confirm PIN
  - **subscribe** - subscribe event
  - **unsubscribe** - unsubscribe event
- Events
  - **connection** - connection changed
  - **device_added**
  - **device_removed**
  - **device_updated**

WiFi Binding

- Features
  - Discovers WiFi APs
  - Connect and Disconnect from APs
  - WPA2 passkey input
  - Connection status
  - Manages network connections
- Future
  - Clean up
  - Rewrite as a provider to a high level Network Management Binding

Konsulko Group

WiFi Binding API

- Verbs
  - **wifi/activate** - Activate WiFi
  - **wifi/deactivate** - Deactivate WiFi
  - **wifi/scan** - Scan Wifi
  - **wifi/scan_result** - Get scan result
  - **wifi/connect** - connect to AP
  - **wifi/disconnect** - disconnect from AP
  - **wifi/status** - status of AP connection
  - **wifi/insertpasskey** - supply AP passkey
  - **wifi/subscribe** - subscribe event
  - **wifi/unsubscribe** - unsubscribe event
- Events
  - **wifi/passkey** - passkey requested
  - **wifi/networkList** - AP list changed

Radio Binding

- Features
  - Radio binding based on rtl-sdr SDR FM demodulation code previously used to build the QtMultimedia plugin from the Chinook release
  - Additional hooks added to FM demodulation code to add scanning support
  - Radio QML application reworked to use binding in place of QtMultimedia QRadio class
    - Only minimal changes were required, the QML interface for the binding emulates QRadio's interface to a large degree
    - Application enhanced to add scanning support
- Future
  - Additional tuner hardware support
  - Metadata support (e.g. RDS)
  - HD Radio support

Konsulko Group

Radio Binding API

- Verbs
  - **radio/frequency** - get/set frequency
  - **radio/band** - get/set band
  - **radio/band_supported** - check band support
  - **radio/frequency_range** - get band frequency range
  - **radio/frequency_step** - get band frequency step
  - **radio/start** - start audio
  - **radio/stop** - stop audio
- Verbs (continued)
  - **radio/scan_start** - start scanning
  - **radio/scan_stop** - stop scanning
  - **radio/stereo_mode** - get/set stereo mode
  - **radio/subscribe -** subscribe event
  - **radio/unsubscribe -** unsubscribe event
- Events
  - **radio/frequency** - frequency has changed
  - **radio/station_found** - scanning has found a station

Telephony Binding

- Features
  - Bluetooth Hands-Free Profile (HFP) device support
  - Originate a voice call
  - Answer an incoming voice call
  - Provide status and information on voice call connections
  - Depends on ofono, bluez, and pulseaudio
- Future Development
  - In-call sending of dial tones (for conference bridges, etc.)
  - Call waiting/hold/forwarding
  - Voice modem support

Konsulko Group

Telephony Binding API

- Verbs
  - **telephony/dial -** dial a phone call
  - **telephony/hangup -** hangup an active phone call
  - **telephony/answer** - answer an incoming phone call
  - **telephony/subscribe** - subscribe event
  - **telephony/unsubscribe** - unsubscribe event
- Events
  - **telephony/callStateChanged** - state of a phone call has changed
  - **telephony/incomingCall** - incoming call is ringing
  - **telephony/dialingCall** - outgoing call is being dialed
  - **telephony/terminatedCall** - call has been terminated

MediaScanner Binding

- Features
  - Media binding to report media insertion/removal
  - Media detection and path reporting
  - Receive metadata from Bluetooth binding
  - Depends on lightmediascanner

Konsulko Group

MediaScanner Binding API

- Verbs
  - **mediascanner/media_result** - get all available multimedia
  - **mediascanner/subscribe** - subscribe event
  - **mediascanner/unsubscribe** - unsubscribe event
- Events
  - **mediascanner/media_added** - media is attached to the device
  - **mediascanner/media_removed** - media is removed from device

MediaPlayer Binding

- Features
  - Media audio playback and control
  - Depends on GStreamer
- Future
  - Video playback

Konsulko Group

MediaPlayer Binding API

- Verbs
  - **mediaplayer/playlist** - get/set playlist
  - **mediaplayer/controls** - playback controls e.g. play, pause, etc.
  - **mediaplayer/metadata** - get metadata of current track
  - **mediaplayer/subscribe** - subscribe event
  - **mediaplayer/unsubscribe** - unsubscribe event
- Events
  - **mediaplayer/metadata** - position/duration of current track
  - **mediaplayer/playlist** - playlist changed

GPS Binding

- Features
  - Provides GNSS location data
    - Latitude
    - Longitude
    - Altitude
    - Speed
    - Time
  - Depends on gpsd

Konsulko Group

GPS Binding API

- Verbs
  - **gps/location** - Get GNSS data
  - **gps/subscribe** - subscribe event
  - **gps/unsubscribe** - unsubscribe event
- Events
  - **gps/location** - GNSS data updated

GeoClue Binding

- Features
  - Provides GeoClue location data
    - Latitude
    - Longitude
    - Altitude
    - Speed
    - Heading
    - Time
  - Supports gathering location data from multiple sources:
    - WiFi AP databases
    - 3g/4g 3GPP tower information
    - GeoIP database
    - GPS
  - Depends on GeoClue

Konsulko Group

GeoClue Binding API

- Verbs
  - **geoclue/location** - Get GeoClue location data
  - **geoclue/subscribe** - subscribe event
  - **geoclue/unsubscribe** - unsubscribe event
- Events
  - **geoclue/location** - GeoClue data updated

GeoFence Binding

- Features
  - Add/remove/list geographic bounding boxes
  - Generates enter/leave events when ingress/egress occurs in fenced bounding box
  - Generates event indicating that a user is “dwelling” at a location based on a configurable timeout
  - Depends on GPS binding for location data
- Future
  - Add support for GeoClue binding location data
  - Add support for per-fence dwell transition timing
  - Convert “dwell”, “entered”, and “exited” to separately subscribed events

Konsulko Group

GeoFence Binding API

- Verbs
  - **geofence/add_fence** - add a geofence bounding box
  - **geofence/remove_fence** - remove a geofence bounding box
  - **geofence/list_fences** - list all geofence bounding boxes
  - **geofence/dwell_transition** - get/set dwell transition time
  - **geofence/subscribe** - subscribe event
  - **geofence/unsubscribe** - unsubscribe event
- Events
  - **geofence/fence** - geofence event occurred

Next Steps

Roadmap

- Bluetooth PBAP support
  - Integration with telephony API
- Completion of MediaPlayer binding
- Video support for MediaPlayer binding
- Speech recognition / TTS binding
- WWAN modem binding
- Audio Bindings
- New HomeScreen/WindowManager Bindings

Konsulko Group

Getting Involved

Community

- IRC: #automotive on Freenode.net
- Mailing list: https://lists.linuxfoundation.org/mailman/listinfo/automotive-discussions
- Weekly developer call: https://wiki.automotivelinux.org/dev-call-info
- JIRA: https://jira.automotivelinux.org
- Gerrit: http://gerrit.automotivelinux.org/gerrit

Konsulko Group

Resources

- Wiki
  - https://wiki.automotivelinux.org/start
- Developer Docs
  - Getting Started
    - http://docs.automotivelinux.org/docs/getting_started/en/dev/
  - APIs
    - http://docs.automotivelinux.org/docs/apis_services/en/dev/

Konsulko Group

Questions?