Automotive: new frontier for mobile Linux

ICS demos: booths 24 and 67

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http://she-devel.com/
Contents

- Why automotive Linux matters
- What's different and what's hard
- Automotive open-source project survey
- Opportunities for developers and the community
Our transportation system is

Dangerous

Loud!!!

Time-wasting

Polluting

because

individuals had little power to change it …

until NOW.
Exactly one political slide

New York Times, June 23 2011
“Range anxiety”: a user perception problem

Let's help drivers better understand their needs.
# Status of Automotive Linux

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Confirmed Operating system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiat-Chrysler Blue&amp;Me (500, Delta), Kia Uvo</td>
<td>Microsoft Windows Embedded Automotive</td>
</tr>
<tr>
<td>Ford (all?)</td>
<td>MyTouch/Sync-Microsoft; OpenXC-Android</td>
</tr>
<tr>
<td>General Motors/Cadillac User Experience</td>
<td>MontaVista Linux</td>
</tr>
<tr>
<td>Geely (China); Hawtai (China)</td>
<td>Linux: Moblin (MeeGo-Tizen precursor)</td>
</tr>
<tr>
<td>Renault R-Link</td>
<td>Android</td>
</tr>
<tr>
<td>Honda (Accord, Odyssey, Pilot), Audi (A8L, Q5, A6), BMW (7-series and M models), Chrysler, Daewoo, GM (OnStar), Hyundai, Land Rover, Porsche, Saab (9-3) Renault (SM7)</td>
<td>QNX</td>
</tr>
</tbody>
</table>

Linux Foundation members: Toyota, Pelagicore, Symbio, Tieto
Automotive Linux Summit 2011 presenters: Toyota, Nissan, BMW
MeeGo Conference 2011 presenter: Nissan
# The GENIVI Alliance Membership (www.genivi.org)

## OEMs

| BMW Group | Honda | Hyundai | Jaguar | Nissan | PSA Peugeot Citroën | GM | Renault | SAIC Motor
|-----------|-------|---------|--------|--------|-------------------|----|---------|-----------|

## First Tiers

<table>
<thead>
<tr>
<th>ALPINE</th>
<th>ALPS</th>
<th>Bosch</th>
<th>Clarion</th>
<th>Continental</th>
<th>Delphi</th>
<th>Denso</th>
<th>Fujitsu Ten</th>
</tr>
</thead>
</table>

## OSV, Middleware, Hardware, and Services Suppliers

<table>
<thead>
<tr>
<th>Accenture</th>
<th>ACCESS Advanced Driver Information Technology</th>
<th>AeC</th>
<th>Airbiquity</th>
<th>akhela</th>
<th>AllGo</th>
<th>Altran</th>
<th>Analog Devices</th>
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<tr>
<td>ATX AutoNavi</td>
<td>bertrand</td>
<td>Blackbox</td>
<td>bSquare</td>
<td>Bouygues Telecom</td>
<td>Canonical</td>
<td>CentrFuse</td>
<td>chitek</td>
<td>chleon</td>
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<td>COMARCH</td>
<td>CST</td>
<td>Cybercom Group</td>
<td>dts</td>
<td>E-Gits</td>
<td>Ericsson</td>
<td>ESG</td>
<td>ETRI</td>
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<td>Garmin</td>
<td>HCL</td>
<td>HTC</td>
<td>IBM</td>
<td>iGate</td>
<td>Infosys</td>
<td>Antec</td>
<td>Intrinsyc</td>
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<td>Jambit</td>
<td>JK</td>
<td>Kistler</td>
<td>Lannan &amp; Touro</td>
<td>Luxoft</td>
<td>Humax</td>
<td>Mahindra Satyam</td>
<td>Mapscape</td>
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<td>McAfee</td>
<td>Mentor Graphics</td>
<td>MET</td>
<td>MDS</td>
<td>Mformation</td>
<td>Montavista</td>
<td>MTA</td>
<td>Mphasis</td>
<td>NAVIGON</td>
<td>Nav N Go</td>
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<tr>
<td>Neusoft</td>
<td>NOKIA Connecting People</td>
<td>novo</td>
<td>novodex</td>
<td>Pi Shurlok</td>
<td>Profusion</td>
<td>Printh</td>
<td>Pasonic</td>
<td>SORA</td>
<td>SOLARIS</td>
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<td>Pelagicore</td>
<td>PLDS</td>
<td>Qualcomm</td>
<td>RTI</td>
<td>Recargo</td>
<td>Rightware</td>
<td>spanision</td>
<td>Secunet</td>
<td>SEGULA</td>
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<td>Siemens PLM Software</td>
<td>Siresoft</td>
<td>Suresoft</td>
<td>Siw</td>
<td>Sybase</td>
<td>symbio</td>
<td>Tata</td>
<td>TATA</td>
<td>Telegeeks</td>
<td>Telemotive AG</td>
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<td>Telenav</td>
<td>TomTom</td>
<td>T-Systems</td>
<td>Tuxera</td>
<td>UNWired</td>
<td>Valeo</td>
<td>VHT</td>
<td>Wind River</td>
<td>Wipro</td>
<td>XeLabs</td>
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</tbody>
</table>

## Silicon

<table>
<thead>
<tr>
<th>ARM</th>
<th>Freescale</th>
<th>Intel</th>
<th>ISSI</th>
<th>Marvell</th>
<th>Micrel</th>
<th>NetLogic</th>
<th>NVIDIA</th>
<th>Renesas</th>
<th>ST</th>
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</thead>
</table>


What is “in-vehicle infotainment”? 

What “infotainment” calls to mind

What IVI could be

Courtesy Tata Consultancy Services
“Infotainment” 1st due to desire to monetize media sales

“91% of respondents said they would love to see a lane-change, blind-spot warning system …

83% said they would like in-vehicle technologies that would automatically call a tow truck …

Nearly ¾ said they'd like technology that would stop their car if the driver suffers a heart attack …

That’s about as far from Angry Birds as you can get.”

– Accenture survey data courtesy of GigaOm
Challenges for IVI

- Little-understood UI/UX
- Security: leave car in auto shop overnight
- Novel sensors, data buses and architectures
- Safety: not “kill -9” but kill dead!
Car is laboratory for new controls and displays

New UIs will debut in cars and migrate to other form factors.

“Kinect piano”

Do we need a motion-sickness.css for passengers?
Cadillac User Experience: Linux by MontaVista

Status: limited developer pre-release, widely available Spring 2012
MontaVista's approach to security challenge

- Multicore SoC (ARM, ATOM)
- MontaVista Linux
- SE Linux (NSA Security)
- GENIVI Compliant Stack
- OEM Custom Apps
- Untrusted Apps
- MV Linux Container
- Android Apps
- Android
- HAL
- HTML5 Apps
- MontaVista Modii™ HTML5
- Seating Position 1
- Seating Position 2
- Seating Position 3

Excellent ELCE video by MontaVista: http://tinyurl.com/7emextu
Ubuntu-IVI Remix

Generating a lot of vendor interest.
Renault's R-Link is first native Android application

Renault debuts R-Link, an in-dash Android system with app market

By Zachary Lutz posted Dec 9th 2011 2:38PM

“application developers will progressively upgrade its content and offer more apps. They will be downloadable directly to the tablet inside the car or via 'My Renault' account thanks to the R-Link Store”

OBDGPSLogger Real-time Vehicle Diagnostics
Capture Plot

There and Back Again: Lunch in El Segundo

Just going down to El Segundo for lunch, taking slightly different paths each way. By the airport, there's a large apparently blank bit; that's where I was in a tunnel and my GPS couldn't get a lock.

This trip was driving my Mini Cooper S.

Google Earth Screenshots

Developer Chunky_Ks (Gary Briggs) will demo in Booth 48
Tripzero: How do I test this in my car?

- ~$40 scantools access vehicle data and controls
- nOBDy runs on any tablet/smartphone/laptop that supports Qt

http://sf2011.meego.com/program/sessions/vehicle-communications-meego
Tripzero: nOBDy is a GPL'ed plugin framework

Demo in Booth 48

Docs: http://nobdy.wikia.com/wiki/Nobdy_Wiki
OpenXC project: **AODPK** (Android) CAN scanner

Status: limited developer pre-release
What can we contribute?

- App that autosubmits your destination information from car nav system to casual carpooling website
- “Where's the cheapest gas within a mile of the highway between here and where my tank will be empty?”
- “Bump” pairing with friends' vehicles to enable proximity alerts
- IRC, identica, diaspora, PGP integration
How to get involved

- Work on an automotive or intelligent transport open source project
- Develop for one of the car manufacturer's new app stores
- Buy a car that runs Linux
- Ask car dealers what OS the car runs, and say you would prefer Linux
- “Linux Inside” bumper stickers? Penguin swallowing an MS logo?
Summary: don't let this moment pass!

Opportunity to create new standards

Thanks to Intel and Texas Instruments for HW donations.
Trades parts count for security?

- Atom or ARM SoC running GNU/Linux
- Cortex-M
- In-dash GPCPU
- Sensor data R/O
- DSP
- GPU
- MIPS with OpenWRT
- Firewall
- Front-seat RT audio and video incl. alarms
- Control: R/W
- 16-bit MCU running RTOS
- CAN and MOST buses
- Encapsulated legacy system
- Backseat entertainment
- Atom or ARM running Android

Backseat entertainment

Atom or ARM running Android

In-dash GPCPU

Atom or ARM SoC running GNU/Linux

Cortex-M

Sensor data R/O

DSP

GPU

Firewall

Front-seat RT audio and video incl. alarms

Control: R/W

16-bit MCU running RTOS

CAN and MOST buses

Encapsulated legacy system
Problem: what IVI HW should devs use?

- ARM dominates, but Atom strong in IVI.
- Atom HW with CAN bus and GPS is costly: use dongles.
- ARM boards (e.g. BeagleBoard) cheaper.
- Multiple displays and controls needed.
- Touch, voice, video gesture, joystick?
Smog check connector = access to vehicle sensors

OBD-II connector on left of steering wheel sees dozens of ECUs, sensors and controls via serial bus
Features of nOBDy

- Based on Qt toolkit and QML (Qt Modelling Language) – Booths 24 (Qt) and 67 (ICS)
- TCP, Bluetooth, D-Bus support
- Websocket/HTML5 browser interface based on JQuery Mobile
- Provides communications interface to CAN (Controller Area Network) vehicle data bus
- GPLv2, source on gitorious
- Based on libobd, OBDGPSLogger and gpsd projects
- Available as .deb and (soon) RPM packages
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Cadillac User Experience based on MontaVista

Status: SDK expected, Spring 2012
Back-end “cloud programming” in IVI

**WebTraffic**
New auto technology aggregates and sends vehicle data to Web clouds, allowing customers to remotely track their cars and much more.

**HOW IT WORKS:**
Car sensors, or smartphones, can connect to internet servers that can send and receive information.

**Inside View**

**Tracking Uses**
- **Consumer:** Apps can beam trip plans to the car’s navigation system
- **Corporate:** Track individual employee’s use of company cars
- **In the Future:** Crash avoidance, traffic planning

**Remote Control Uses**
- **Consumer:** Apps send warnings to customers when the car’s oil or tire pressure need checking
- **Corporate:** Energy companies can shut off electric-car charging at peak periods
- **In the Future:** Dynamic road signs

Source: WSJ research

Graphic by Alberto Cervantes/The Wall Street Journal
nOBDy's stack

Your Qt, QML or Javascript application here!

nOBDy plugin framework

QML  JQuery  HTML5

Qt  OpenLayers  OBDGPSLogger

OpenStreetMap  gpsd  libobbd

Linux kernel and device drivers

New plugins that talk TCP can be written in any language.
# IVI UX Additional Features

**IVI UX**: media player, instrument cluster, RSE, navigation, diagnostic surround view, hands-free phone

**IVI app frameworks**: vehicle sensor data access, vehicle control, Terminal Mode, touch and gesture input

**IVI API layer**: multi-screen video, multi-zone audio, consumer electronic device connectivity, inertia-based application control

**Core OS layer**:
- Sensor framework
- Split-screen video
- Speech recognition
- Speech synthesis
- Acoustic echo cancellation

- Noise suppression
- OTA software updating
- Tethered device indexing
- Phone synchronization
- Multi-user support

**Kernel layer**: <250ms boot, power management, vehicle buses

**Drivers**: automotive button/knob input devices, vehicle data sensors

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Courtesy
Nathan P. Willis,
http://tinyurl.com/3m4loer
How to get involved: community projects

- OBDGPSLogger: [http://icculus.org/obdgpslogger/](http://icculus.org/obdgpslogger/)
- OBDref: [https://github.com/canurabus/obdref](https://github.com/canurabus/obdref)
- Mp3car: [http://www.mp3car.com/](http://www.mp3car.com/)
How to get involved: corporate-backed FLOSS

- OpenXC: http://openxcplatform.com/

- Ubuntu IVI Remix: 

- Renault R-Link (Android): 

- Bosch-ETAS Busmaster: https://github.com/rbei-etas/busmaster
Opportunity: save energy through *ad hoc* networking

Use this . . . to save energy . . .

with cars, too: 802.11p WAVE.