Developing Automotive Linux

Alison Chaiken
North Bay Linux Users Group
July 9, 2013
alison@she-devel.com
Who cares? (and Why?)

- Crashes cause over 30,000 deaths in U.S. annually.
- Intelligent transportation systems are where developers can target global warming, peak oil and energy insecurity.
- Phones and tablets are joining PCs in technological maturity.
- Connected car business is growing exponentially.
Agenda

- Why automotive software matters
- Status of Linux in automotive
- Show me the code: what's in automotive Linux
- Opportunities to get involved
Cities of the future are inspiring.
San Mateo Smart Corridor construction is underway
Radically rethought cars are on sale

TWIZY

FROM
£6,895*

› View prices

- Integrated cable and charger
- 4-point front seatbelt
- 4 different colours available
- Scissor doors and clear sky roof available as options

*Availability depending on the versions

› View all specifications

DRIVE THE CHANGE
Autonomy is closer than most suspect

Volvo Promises Autonomous Tech by 2014

BY DAMON LAVRINIC 10.24.12 2:27 PM

From Wired Autopia
Quiz

• The most important center of automotive software development is _____________.
• T/F: autonomous vehicles won't be legal for many years.
• T/F: car companies will never release substantial source code.
• The company leading development of autonomous vehicle technology is ______________.
• T/F: Asian companies are developing for internal markets only.
• The OS with largest install base in cars is ______________.
(Understandable) Misconceptions about Automotive SW

- The most important center of automotive software development is Silicon Valley, Germany.

- Autonomous vehicles will never be legal in the U.S. are legal in Nevada, California, and Florida.

- Car companies will never release source code have put up repos for automotive software: G.M., GENIVI, Automotive Grade Linux

- Only Google plus Mobileye, Continental, Audi, Volvo, Toyota, and Bosch are serious about autonomous vehicle development.

- Chinese and Indian companies are developing for internal markets only now own Volvo, Jaguar Land-Rover, and Hummer.
# Current Public Status of Automotive Linux

<table>
<thead>
<tr>
<th>Carmaker</th>
<th>Confirmed Operating system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiat-Chrysler Blue&amp;Me, Kia Uvo</td>
<td>Microsoft Windows Embedded Automotive</td>
</tr>
<tr>
<td>Ford (all?)</td>
<td>Microsoft MyTouch/Sync (+ OpenXC Android dongle and SmartPhoneLink)</td>
</tr>
<tr>
<td>General Motors, Tesla</td>
<td>GNU/Linux</td>
</tr>
<tr>
<td>Geely (China); Hawtai (China)</td>
<td>GNU/Linux: Moblin (MeeGo-Tizen precursor)</td>
</tr>
<tr>
<td>Renault R-Link</td>
<td>native Android</td>
</tr>
<tr>
<td>Jaguar Land-Rover, Tata, Toyota</td>
<td>AGL and Tizen (GNU/Linux)</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), Mercedes (S- and C-class)</td>
<td>QNX</td>
</tr>
</tbody>
</table>

**GENIVI Alliance** (Linux-based): 160+ members including 11 “OEMs”
Automakers and Free Software get Acquainted
Current GENIVI Members
(as of 02 October 2012)

The GENIVI Alliance Membership (www.genivi.org)

<table>
<thead>
<tr>
<th>OEMs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW Group</td>
<td>HONDA</td>
</tr>
<tr>
<td></td>
<td>PSA PEUGEOT CITROEN</td>
</tr>
<tr>
<td></td>
<td>GM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>First Tiers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ALPS</td>
<td>BOSCH</td>
</tr>
<tr>
<td></td>
<td>clariion</td>
</tr>
<tr>
<td></td>
<td>DENSO</td>
</tr>
<tr>
<td></td>
<td>DSV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OSV, Middleware, Hardware, and Services Suppliers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCESS</td>
<td>AEC</td>
</tr>
<tr>
<td></td>
<td>Agero</td>
</tr>
<tr>
<td></td>
<td>allnaca</td>
</tr>
<tr>
<td></td>
<td>akka</td>
</tr>
<tr>
<td></td>
<td>alicona</td>
</tr>
<tr>
<td></td>
<td>altran</td>
</tr>
<tr>
<td></td>
<td>altintas</td>
</tr>
<tr>
<td></td>
<td>altisense</td>
</tr>
<tr>
<td></td>
<td>angara</td>
</tr>
<tr>
<td></td>
<td>app/ioc</td>
</tr>
<tr>
<td></td>
<td>areva</td>
</tr>
<tr>
<td></td>
<td>artesia</td>
</tr>
<tr>
<td></td>
<td>arsenic</td>
</tr>
<tr>
<td></td>
<td>asimov</td>
</tr>
<tr>
<td></td>
<td>assa abloy</td>
</tr>
<tr>
<td></td>
<td>Astrium</td>
</tr>
<tr>
<td></td>
<td>astra</td>
</tr>
<tr>
<td></td>
<td>atmel</td>
</tr>
<tr>
<td></td>
<td>aura</td>
</tr>
<tr>
<td></td>
<td>avago</td>
</tr>
<tr>
<td></td>
<td>avaya</td>
</tr>
<tr>
<td></td>
<td>avanti</td>
</tr>
<tr>
<td></td>
<td>avinci</td>
</tr>
<tr>
<td></td>
<td>awards</td>
</tr>
<tr>
<td></td>
<td>axelion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silicon</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ARM</td>
<td>freescale</td>
</tr>
<tr>
<td></td>
<td>FUJITSU</td>
</tr>
<tr>
<td></td>
<td>intel</td>
</tr>
<tr>
<td></td>
<td>ISSI</td>
</tr>
<tr>
<td></td>
<td>MSTAR</td>
</tr>
<tr>
<td></td>
<td>NXP</td>
</tr>
<tr>
<td></td>
<td>QUALCOMM</td>
</tr>
<tr>
<td></td>
<td>Renesas</td>
</tr>
<tr>
<td></td>
<td>Texas Instruments</td>
</tr>
<tr>
<td></td>
<td>Texas Instruments</td>
</tr>
<tr>
<td></td>
<td>UCLL</td>
</tr>
<tr>
<td></td>
<td>XILINX</td>
</tr>
</tbody>
</table>

Courtesy Matt Jones, Jaguar Land Rover
www.genivi.org/projects

Courtesy Matt Jones, Jaguar Land Rover
Automotive Grade Linux

- Initiated September 2012.
- An installable distro like Android (unlike GENIVI).
- Development in open (unlike Android or GENIVI).
- No CLA, but no GPLv3 (like Android and GENIVI).
- Mailing lists available but very quiet.
- So far, based entirely on Tizen.
Vehicles are a “network of networks”
What connectivity enables

What does your fleet need, right now?

Control your fleet

*Cloud-based real-time activity and maintenance needs*

- **Instant setup, worldwide access**
  Our management platform is web-based, no setup or training required. We'll keep improving our features to meet your needs.

- **Track real-time activity**
  Monitor the real-time usage and need of your fleet. Get every bit of data you need to make the right decision.

- **Save on maintenance**
  We'll remotely diagnose maintenance needs and help employees report problems. And when a repair is needed, the shop will know exactly where the car is parked.

**Local Motion**: Cloud-based fleet management
What connectivity enables

In Automotive First, Tesla Pushes Over-the-Air Software Patch

BY DAMON LAVRINC 09.24.12 5:54 PM

Source: Wired Autopia
**Must watch:** Chaos Computer Club 2012 video

Christie Dudley, Santa Clara University Law School

http://tinyurl.com/crbazg9
Mixture of time-critical and best-effort networks
Diverse IPC mechanisms, Legacy Protocols


or maybe

FlexRay EthernetAVB EtherCAT J1939 . . .

FPD-Link

rear-seat display (LVDS)

Board

Sensor

I2C

Actuator

PWM

MCU

SPI

ECU

 Backup or "Mirror" video

Driver webcam

platform devices

SoC

AMBA/AXP

Electronic Control Unit

Diverse IPC mechanisms, Legacy Protocols
What automotive Linux really looks like!
A typical automotive data center

Get Involved: you already know how!

Source: RTKL blog
Resources

- IETF-ITS mailing list; Telematics News, Thinking Highways, Wired Autopia
- GENIVI open-source projects and Automotive Grade Linux, Tizen-IVI mailing lists
- Developer outreach programs: Ford, AGL
- SAE and IEEE publications
- Car hackers: scantool.net, mp3car.com, diyefi.org, righttorepair.org
- #linuxice and #genivi on freenode IRC
- LWN and H-Online (as always!)
Silicon Valley Automotive Open Source

San Jose State Students Build Formula-1 Style Racecars
SJSU, College of Engineering
One Washington Square, San Jose, CA (map)
Wed Jul 24
7:00 PM
Presenters: Vince Daneri and Kevin Krakower. San Jose State University students discuss the methods in designing, building, testing, & competing with formula style... LEARN MORE
Hosted by: Alison Chaiken (Organizer)

Discuss "Reinventing the Automobile" book
ATTIC Restaurant and Lounge
234 S. B Street, San Mateo, CA (map)
Mon Aug 12
7:00 PM
The event is full please organize a second dinner or lunch to discuss the book... Since there will be no presentation and no food audibly, there is nothing special... LEARN MORE
Hosted by: Alison Chaiken (Organizer)

Self-Driving Carsharing and Smart Mobility
Toyota Innovation Hub
335 Bay St 4th Floor, San Francisco, CA (map)
Fri Aug 23
7:00 PM

Free and non-commercial monthly meetup group
Conclusion

- Automotive software is a boom area for Linux.
- Almost any Linux-related skill is pertinent.
- Status: technological promise, but legal uncertainty.
- Developers can impact urban planning, environment and public safety.
MA “Right to Repair” is now Law

Key provisions of Massachusetts Right to Repair bill include:

• Immediately, car companies are required to make available to independents on “fair and reasonable terms,” the same tools, software, and repair information that they make available to dealers.

• By model year 2018 (translates into 2017) manufacturers required to establish web sites or “clouds” that will contain the same information and software that dealers have access to as part of their proprietary tools.

Source: Aaron Lowe, Automotive Aftermarket Industry Association
2018 Model Year System

Source: Aaron Lowe, Automotive Aftermarket Industry Association
Free software has new allies

meet the free software gang

AAIA® Automotive Aftermarket Industry Association

ScanTool.net

LM LOCAL MOTORS

Right to Repair Massachusetts

DiY EFI
802.11p = Vehicular WiFi

- Safety messages via dedicated short-range communication (DSRC) protocol (IEEE 1609)
- Allocated spectrum at 5.9 GHz.
- New protocols, e.g. DNS Geocasting.
- New use cases, e.g. mobile routers
- VIN == MAC? or is VIN private?
- Field trials underway in Ann Arbor, MI and Germany (simTD)

**Linux won:**
- on servers and on handsets.

**Linux lost:**
- on desktops.

**Linux could lose in automotive:**
- QNX and Windows have the largest automotive base.
- QNX has fast IPC and works well on smaller MCUs.
- Most car CPUs run proprietary RTOSes.