

# Developing Automotive Linux

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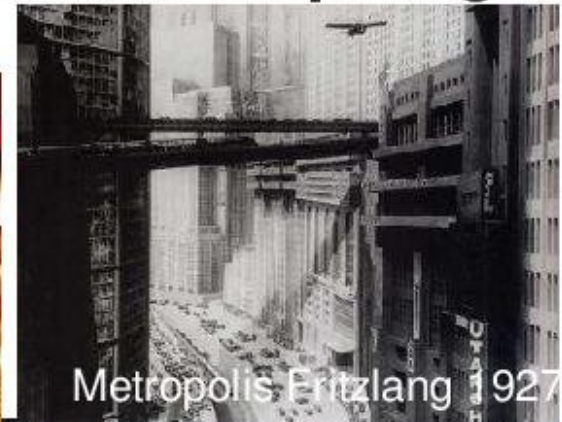
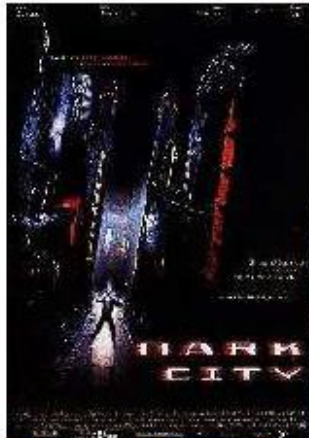
# Who cares? (and Why?)

- 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



Metropolis Fritz Lang 1927



5th Element



Sin City



New Bizance, UChronie(s),  
Corbeyran & Chabert,  
Glénat, 2010



Halo 4

18/06/2013

Courtesy Prof. Eric Gressier-Soudan, [cnam.fr](http://cnam.fr)



# 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 LAVRINC 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

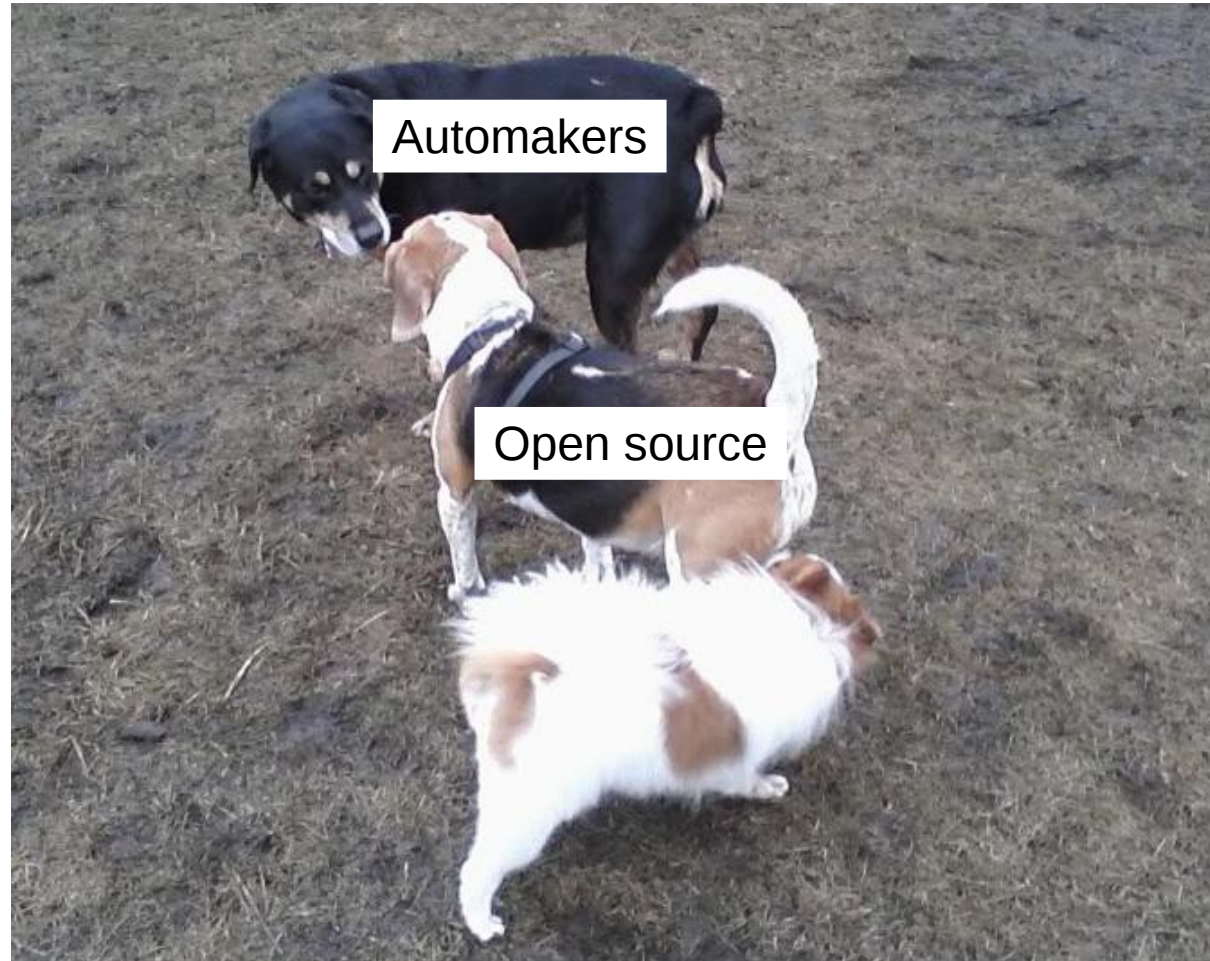
- The most important center of automotive software development is ~~Silicon Valley~~ **Germany**.
- Autonomous vehicles ~~will never be legal in the U.S.~~ are legal in **Nevada, California and Florida**.
- Car companies ~~will never release source code~~ have put up repos for automotive software: *G.M. , 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

<u>Carmaker</u>	<u>Confirmed Operating system</u>
Fiat-Chrysler <a href="#">Blue&amp;Me</a> , Kia Uvo	Microsoft Windows Embedded Automotive
Ford (all?)	Microsoft MyTouch/Sync (+ OpenXC Android dongle and SmartPhoneLink)
General Motors, Tesla	GNU/Linux
Geely (China); Hawtai (China)	GNU/Linux: Moblin (MeeGo-Tizen precursor)
Renault R-Link	<i>native</i> Android
Jaguar Land-Rover, Tata, Toyota	AGL and Tizen (GNU/Linux)
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)	QNX

**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](http://www.genivi.org))

**OEMs**

BMW Group, HONDA, HYUNDAI, JOHN DEERE, JAGUAR, LAND ROVER, PSA PEUGEOT CITROËN, GM, KIA, SAIC, LAMBORGHINI, VOLVO

**First Tiers**

ALPINE, ALPS, alticast, BOSCH, clarion, Continental, DELPHI, DENSO, DESAY, FUJITSU TEN, HARMAN, Johnson Controls, LEAR, LG Electronics, MAGNETI MARELLI, MOBIS, Panasonic, PATEO, peiker, Pioneer, Valeo, Wipac

**OSV, Middleware, Hardware, and Services Suppliers**

Accenture, ACCESS, AEC, Agero, aicas, Altiq, akhila, AXIKA, (AllGo), altran, ARICENT, ARCOM, ARTEC, AUDIOVOX, AutoNavi, backbase, CANONICAL, CETECOM, cinemo, Colson, COMARCH, coverity, CTAG, CYBERCOM GROUP, digia, dts, electric CLOUD, ENICPOL, ESG, ETRI, Fraunhofer, GARMIN, GTSYSTEM, HCL, htc, i.i. corp., iau, IBM, iGATE, infobank, Infosys, Intica, Ittiam, Green Hills, jambit, GK2L, klocwork, LAISEN & TOUNG, LUXOFT, JUNGO, Livio, Radio, Mahindra Satyam, mapscape, McAfee, mds, Mentor Graphics, MITAC, montavista, MTA, MPHASIS, navmii, Nav M Go, Neusoft, novero, NOMOVOK, OpenCar, openmobile, OPENSNERGY, OTSL, PARASOFT, pelagicore, RECARGO, Red Bend, RIGHTWARE, RTI, sasken, Saveri, SPANION, secunet, SIERRA WIRELESS, SIRIUS, Suresoft, SYBASE, SYMBIO, TATA, TechniBat, symphony teleca, Telechips, Telemotive AG, TOMTOM, T-Systems, TUXERA, TWIDDLE, UNWIRED, vTuner, WIND RIVER, WIPRO, Val XSe

**Silicon**

ANALOG DEVICES, ARM, freescale, FUJITSU, intel, ISSI, MICREL, MEDIATEK, NVIDIA, NP, QUALCOMM, SAMSUNG, Renesas, ST, TEXAS INSTRUMENTS, VITEC, XILINX

Courtesy Matt Jones, Jaguar Land Rover





www.genivi.org/projects

**GENIVI**

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### GENIVI Open Source Projects

The following list represents the GENIVI Alliance's Open-Source Community Projects. The GENIVI Alliance is an automotive and consumer electronics industry association and adoption of an open in-vehicle infotainment (IVI) reference platform.

To learn more about the all-new Alliance-sponsored public open-source community PAG document or explore the current projects listed below.

Want to be notified when the GENIVI Alliance -Project sites are available? Sign up for a notification email. (Note: you should receive a confirmation email after signing up. Have been misused in the junk mail folder.)

**Audio Manager**  
<http://projects.genivi.org/audio-manager>

The AudioManager is a framework that:

- is able to manage audio abstracts hard and software that the business logic can be implemented depending on routing mechanisms
- makes it possible to implement different business logic
- independent from hard and software routing mechanism
- is capable of managing dynamic added sources and
- manages audio routing with the use of audio routing interchangeable
- provides a common and simple API to command control
- uses the standard GENIVI compliant mechanisms for management and lifecycle
- The AudioManager is NOT yet another routing mechanism

+ Read more

**Diagnostic Log and Trace**  
<http://projects.genivi.org/diagnostic-log-trace>

DLT is a reusable open source software component for standardized logging and tracing in infotainment ECUs based on the AUTOSAR 4.0 standard. The goal of DLT is the

**GENIVI**

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### Get your IVI products to market faster

Build your enhancements on GENIVI's Alliance's core services platform and streamline your development process.

**About the Alliance**

GENIVI is a non-profit industry alliance committed to driving the broad adoption of an In-Vehicle Infotainment (IVI) open-source development platform.

The Alliance aims to align requirements, define reference implementations, offer certification programs, and foster a vibrant open source IVI community.

Our work will result in shortened development cycles, faster time-to-market, and reduced costs for companies developing IVI equipment and software.

**News and Views**

08/21/2012  
**GENIVI expands open-source IVI development**  
John Day's Automotive Electronics News

06/13/2012  
**GENIVI adopts full open sourcing strategy**  
www.genivi.org/iv

06/14/2012  
**Alliance leads industrywide infotainment software**  
Automotive News

06/13/2012

**GENIVI Open Source Projects**

The GENIVI Alliance component development will be moving to all new Alliance sponsored public open-source community projects.

International Quick Links:  
Press Release  
Frequently Asked Questions (FAQ)  
Current Community Project Listing

Why Become a GENIVI Member?  
Media and Analysts  
Current GENIVI Members

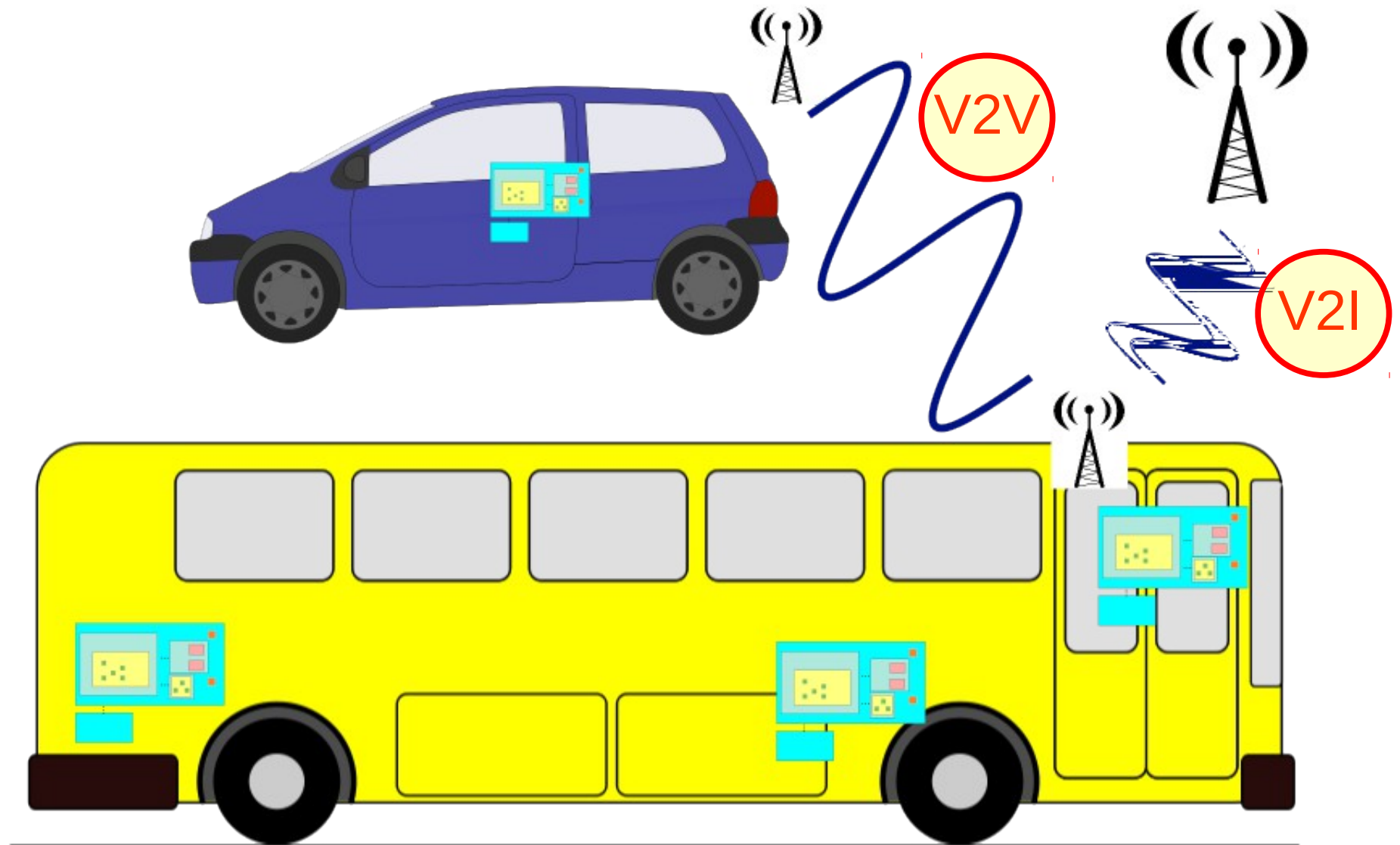
Courtesy Matt Jones, Jaguar Land Rover

# 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.



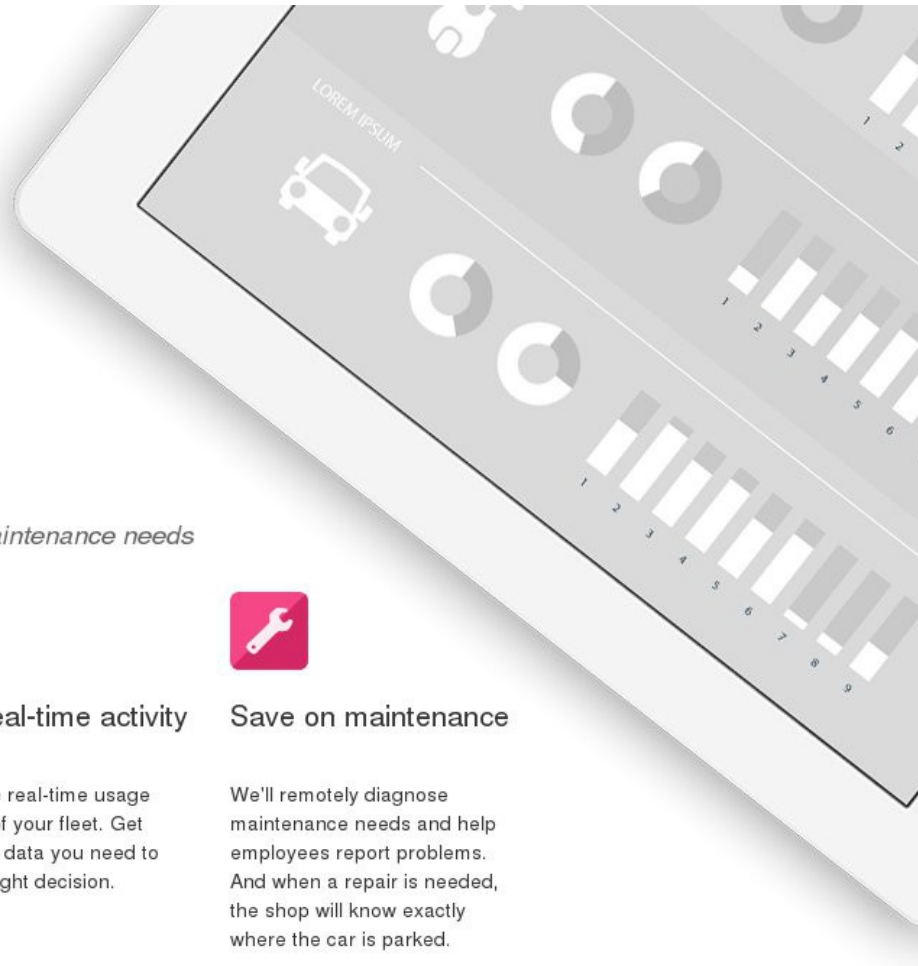
### Track real-time activity

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

**TALK/ID-5095**

**2.9-C/3**

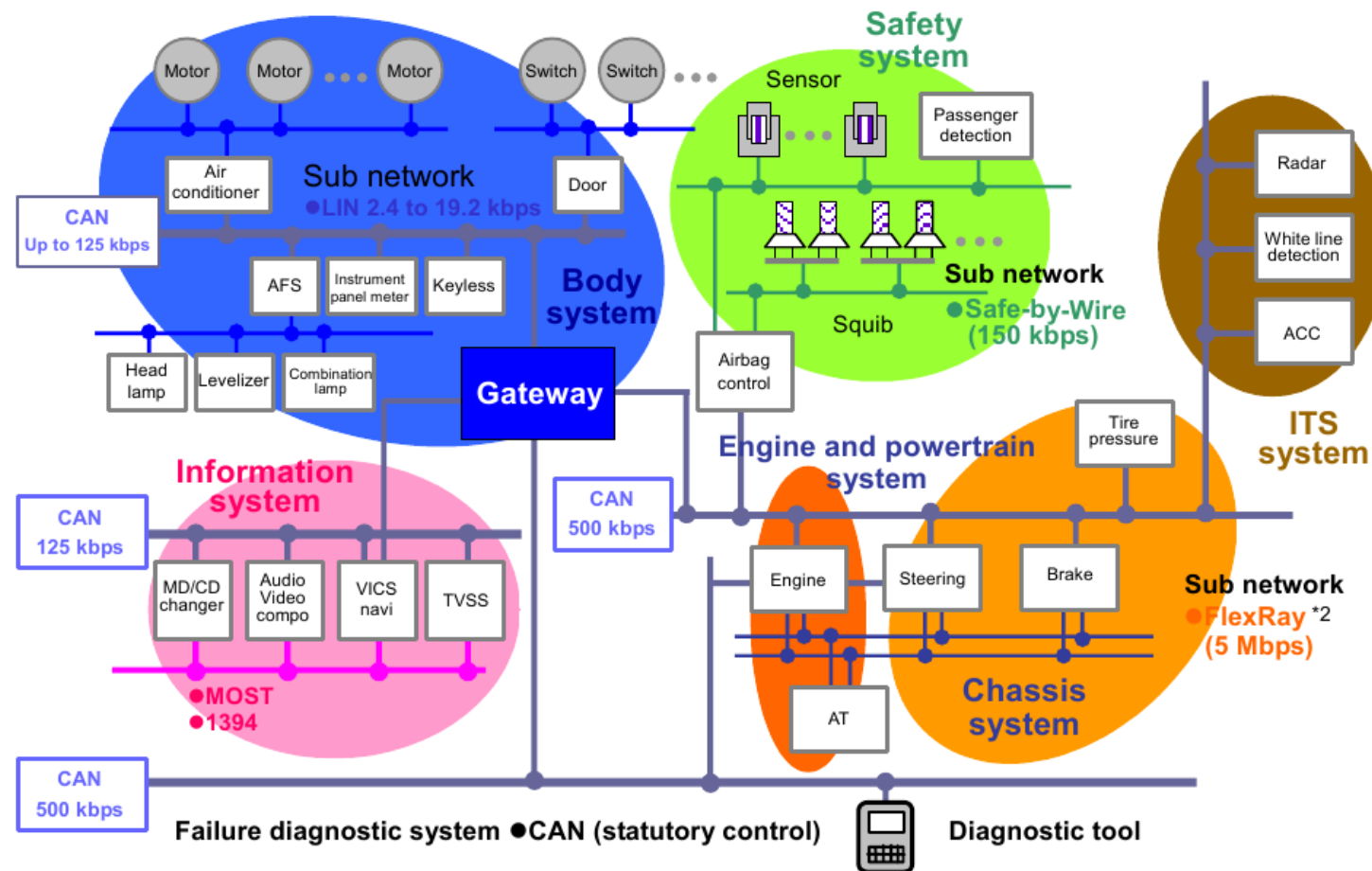
**PRIVACY AND THE CAR OF THE FUTURE**

CONSIDERATIONS FOR THE CONNECTED VEHICLE

CHRISTIE DUDLEY

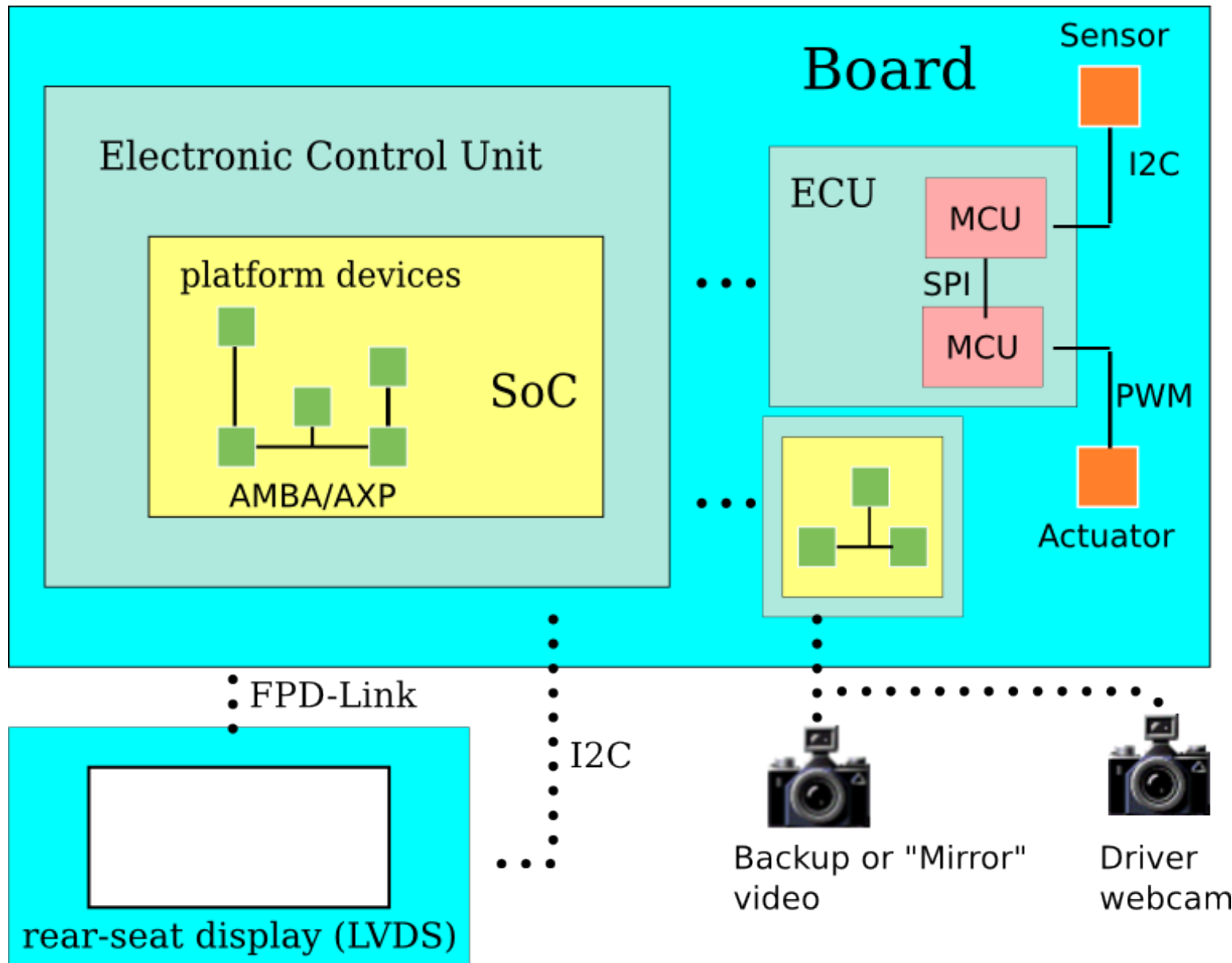
<http://tinyurl.com/crbazg9>

# Mixture of time-critical and best-effort networks



Copyright Renesas, "Introduction to CAN", with permission.

# Diverse IPC mechanisms, Legacy Protocols





# What automotive Linux really looks like!

```
lachaiken@sb-ubuntu-1204-64bit buildJ$ bitbake systemtap
Parsing recipes: 100% |#####| Time: 00:00:50
Parsing of 1468 .bb files complete (0 cached, 1468 parsed). 1837 targets, 66 skipped, 3 masked, 0 errors.

Build Configuration:
BB_VERSION      = "1.16.0"
TARGET_ARCH     = "arm"
TARGET_OS       = "linux-gnueabi"

meta-yocto      = "(nobranch):T/dc991689c0b648899008ce5cb5907498740c25b"
meta-networking = "(nobranch):f00028caf257e386c0f3ae46bd4b3ba53dd0729d"
meta-fsl-arm    = "(nobranch):b93c40348cdcb0022f4315edc1b9cb7474253b1e"
meta-oe         = "(nobranch):f00028caf257e386c0f3ae46bd4b3ba53dd0729d"

NOTE: Resolving any missing task queue dependencies
NOTE: Preparing runqueue
NOTE: Executing SetScene Tasks
NOTE: Executing RunQueue Tasks
WARNING: /build/meibp-2013/build/tmp/work/armv7a-vfp-neon-mel-linux-gnueabi/systemtap-1.8+gitrelease-2.2-r1/git/COPYING could not be copied for some reason. It may not exist. WARN for now.
ERROR: Function failed: systemtap: LIC_FILES_CHKSUM points to an invalid file: /build/meibp-2013/build/tmp/work/armv7a-vfp-neon-mel-linux-gnueabi/systemtap-1.8+gitrelease-2.2-r1/git/COPYING
ERROR: Logfile of failure stored in: /build/meibp-2013/build/tmp/work/armv7a-vfp-neon-mel-linux-gnueabi/systemtap-1.8+gitrelease-2.2-r1/temp/log.do_configure.9426
Log data follows:
| DEBUG: Executing python function sysroot_cleansstate
| DEBUG: Python function sysroot_cleansstate finished
| DEBUG: SITE files ['endian-little', 'bit-32', 'arm-common', 'common-linux', 'common-glibc', 'arm-linux', 'arm-linux-gnueabi', 'common']
| DEBUG: Executing shell function autotools_preconfigure
| DEBUG: Shell function autotools_preconfigure finished
| DEBUG: Executing shell function do_configure
| NOTE: nothing to configure
| DEBUG: Shell function do_configure finished
| DEBUG: Executing python function do_qa_configure
| NOTE: Checking autotools environment for common misconfiguration
| DEBUG: Python function do_qa_configure finished
| ERROR: Function failed: systemtap: LIC_FILES_CHKSUM points to an invalid file: /build/meibp-2013/build/tmp/work/armv7a-vfp-neon-mel-linux-gnueabi/systemtap-1.8+gitrelease-2.2-r1/git/COPYING
ERROR: Task 5 (/build/meibp-2013/poky/meta/recipes-kernel/systemtap/systemtap_git.bb, do_configure) failed with exit code '1'
```

# 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



✓ I'M ATTENDING

Presenters: Vince Donatini and Kevin Krakauer. San Jose State University students discuss the methods in designing, building, testing, & competing with formula style... [LEARN MORE](#)

10 attending  
50 spots left  
6 comments

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



✓ I'M ATTENDING

The event is full: please organize a second dinner or lunch to discuss the book. Since there will be no presentation and no food subsidy, there is nothing special... [LEARN MORE](#)

12 attending  
No spots left  
5 comments

Hosted by: Alison Chaiken (Organizer)

## Self-Driving Carsharing and Smart Mobility

Toyota Innovation Hub  
315 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

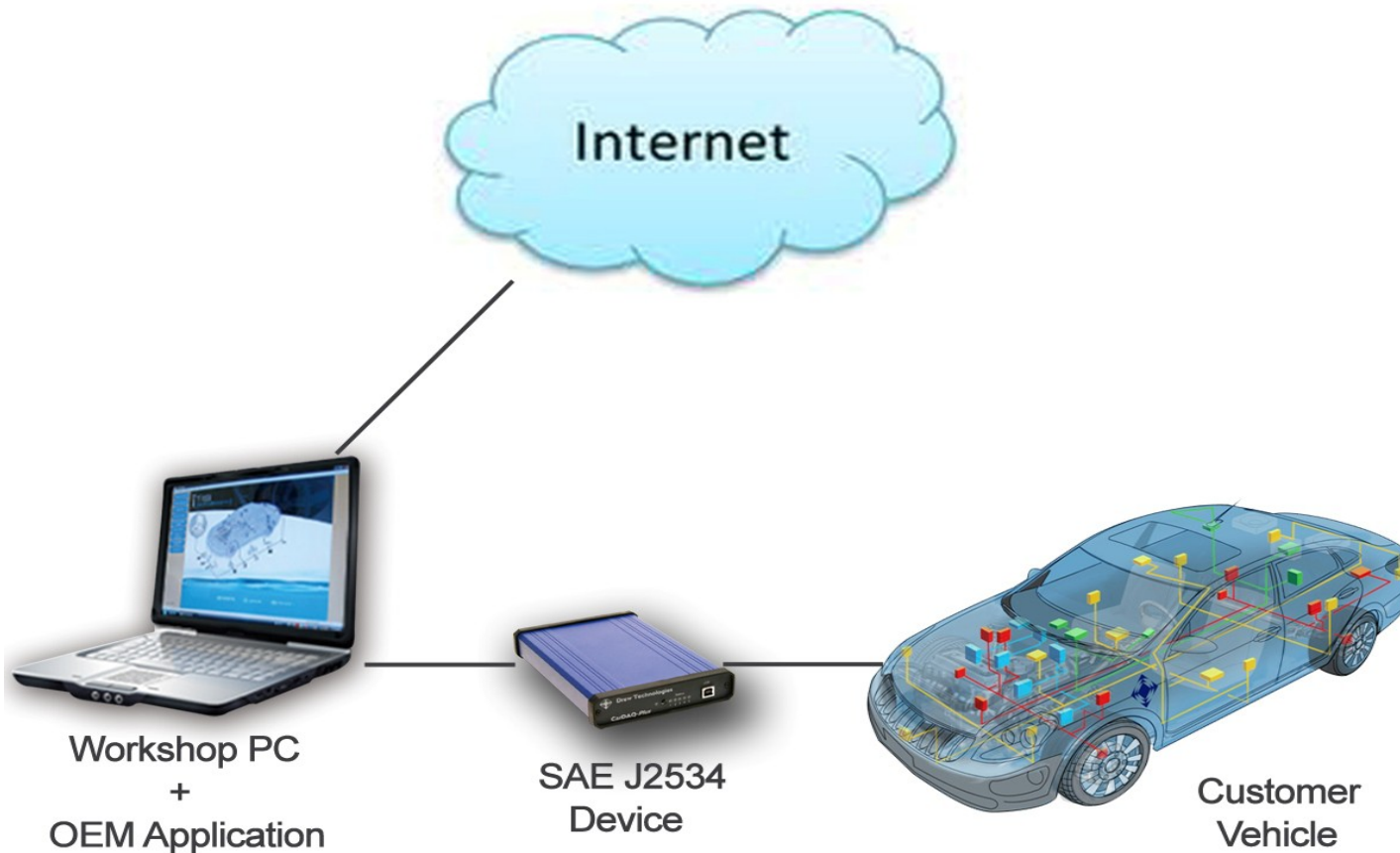


Key provisions of Massachusetts Right to Repair bill include:

- 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

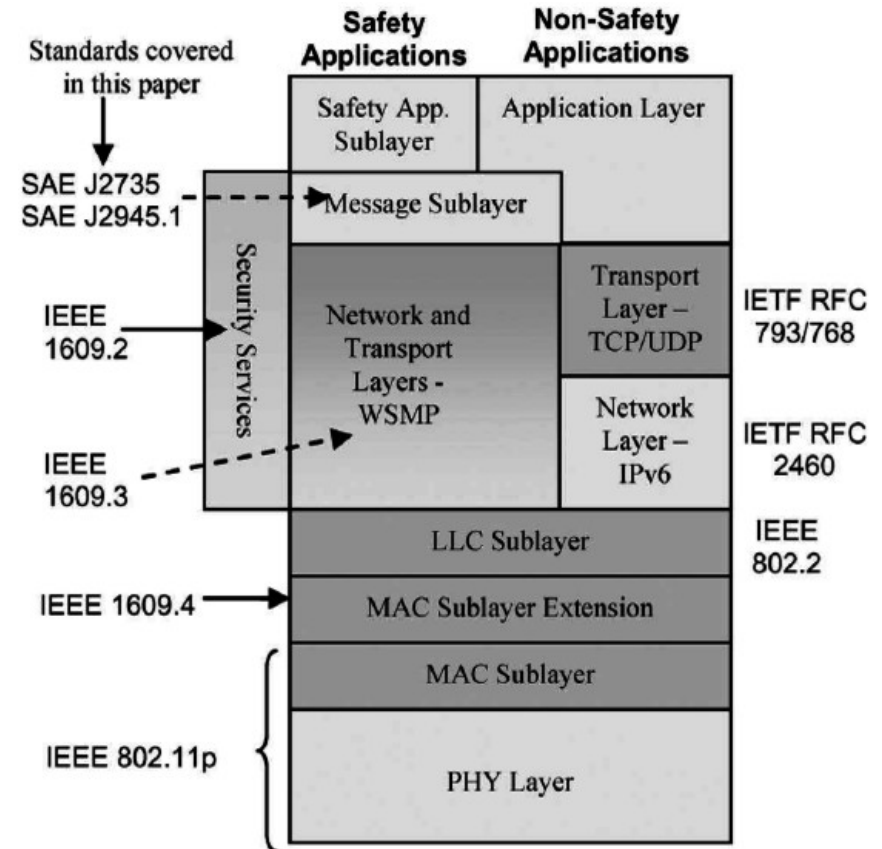


**ScanTool.net**



# 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)



J.B. Kenney,  
Toyota ITC,  
Proc. IEEE 99,  
2011.



## *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.