Red Hat
In-Vehicle
Operating System

Fedora: The Vehicle for Automotive Linux

Stephen Smoogen

Senior Software
Engineer

Allison King

Technical Project Manager

Red Hat

First Things First

Who Are We and What Do We Do

Stephen Smoogen

Senior Lorem Ipsum Engineer

Recovering systems administrator

Project Manager Apprentice, Jr Grade

Red Hat In-Vehicle Operating System

Allison King

Technical Project Manager

Cat Herder Extraordinaire

Agile Practitioner

Red Hat In-Vehicle Operating System

Source:
Random Internet Posts and Blogs

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What We'll Cover

From Customer Needs to Fedora

Bringing Customer Requirements to life through Agile/Lean Practices

Fedora's role in future automotive development

What We Won't Cover

Anything bordering on legal issues.

Installing Fedora on a car's computer.

Source:
https://www.pexels.com/photo/close-up-photo-of-cute-sleeping-cat-416160/

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Getting up to speed

Cars since the 1990s have become more computerized
The workloads of these computers have increased
accordingly.

Electrification of vehicles propels this forward
Car vendors have seen that the push for electrification of
vehicles and more autonomous driving requires larger
computers with more diverse workloads.

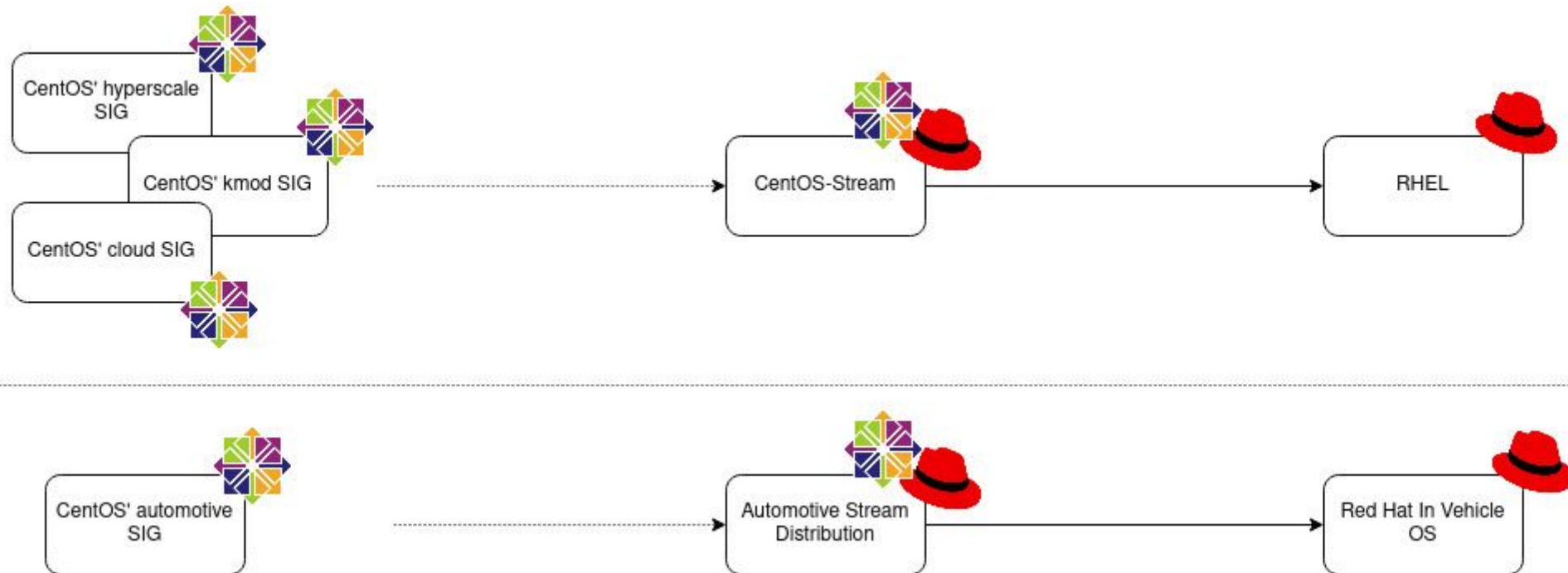**This is Red Hat's answer to this search.**
A pared down operating system to meet specific safety
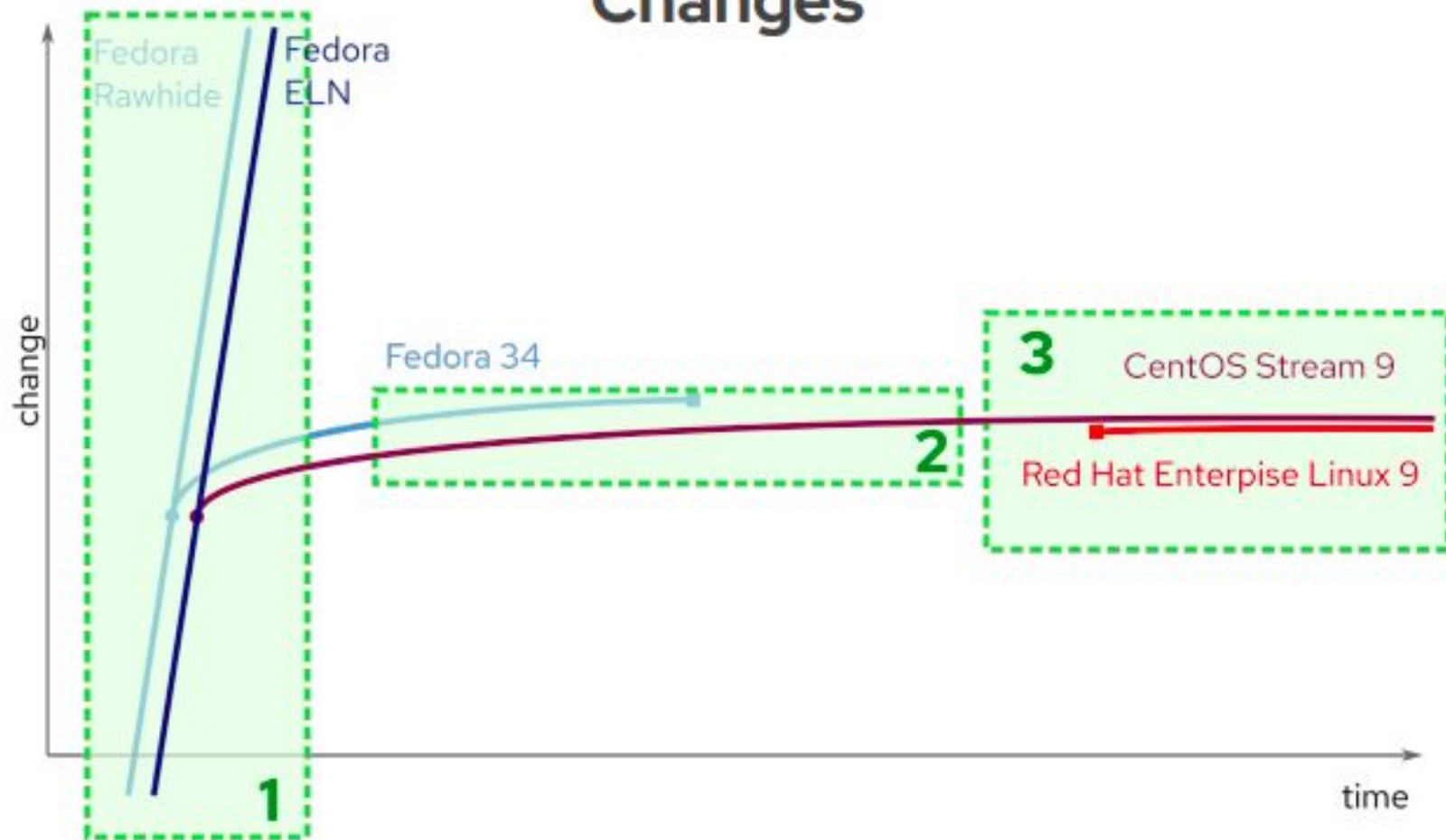requirements.

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How Red Hat In-Vehicle Operating System is Developed

The Road to Production

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How Red Hat In-Vehicle Operating System is Developed

Tactical Approach

Red Hat In Vehicle Operating System

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break it up into
smaller bites!

How Red Hat In-Vehicle Operating System is Developed

1 two week sprint at a time

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# How Red Hat In-Vehicle Operating System is Developed

Development Style

Agile is an **iterative approach** to project management and software development that helps teams **deliver value to their customers faster** and with fewer headaches. Instead of betting everything on a "big bang" launch, an agile team delivers work in small, but consumable, increments.

Requirements, plans, and results are evaluated continuously so teams have a natural mechanism for responding to change quickly.

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What Does Agile Mean for Red Hat In-Vehicle OS?

Our Key Tenets and How We Live Them
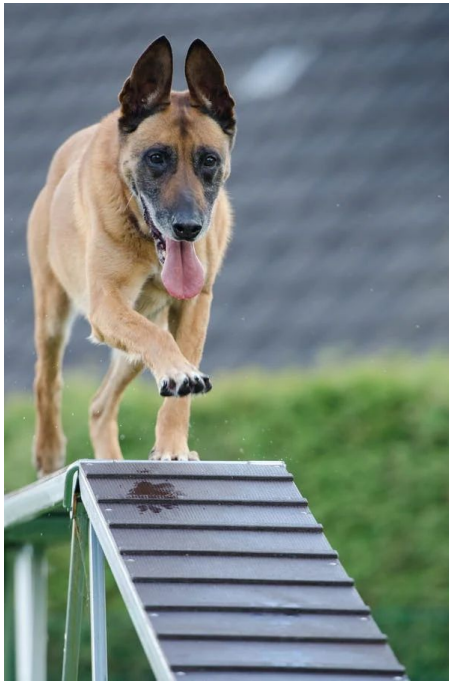
- **Customer-centric** → embedding with customer and partner engineering teams
- **Empirical process** → lots of discovery and room to solve problems
- **Continuous Improvement** → retrospectives and improving on lessons learned
- **Systems thinking and whole-product focus** → Feature Teams work collaboratively with each other, customers, partners, and product management to deliver full solutions, not just pieces

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Right, But Why Do I Care?

The Traditional Approach

Software producers:

Has limited say in what is written. Tooling is completely designed and specified to almost cookie cutter levels by planning which may be outdated.

The operating system manufacturer

Generally delivers a highly minimal toolkit which talks to the hardware. The manufacturer needs to work with other vendors for other software.
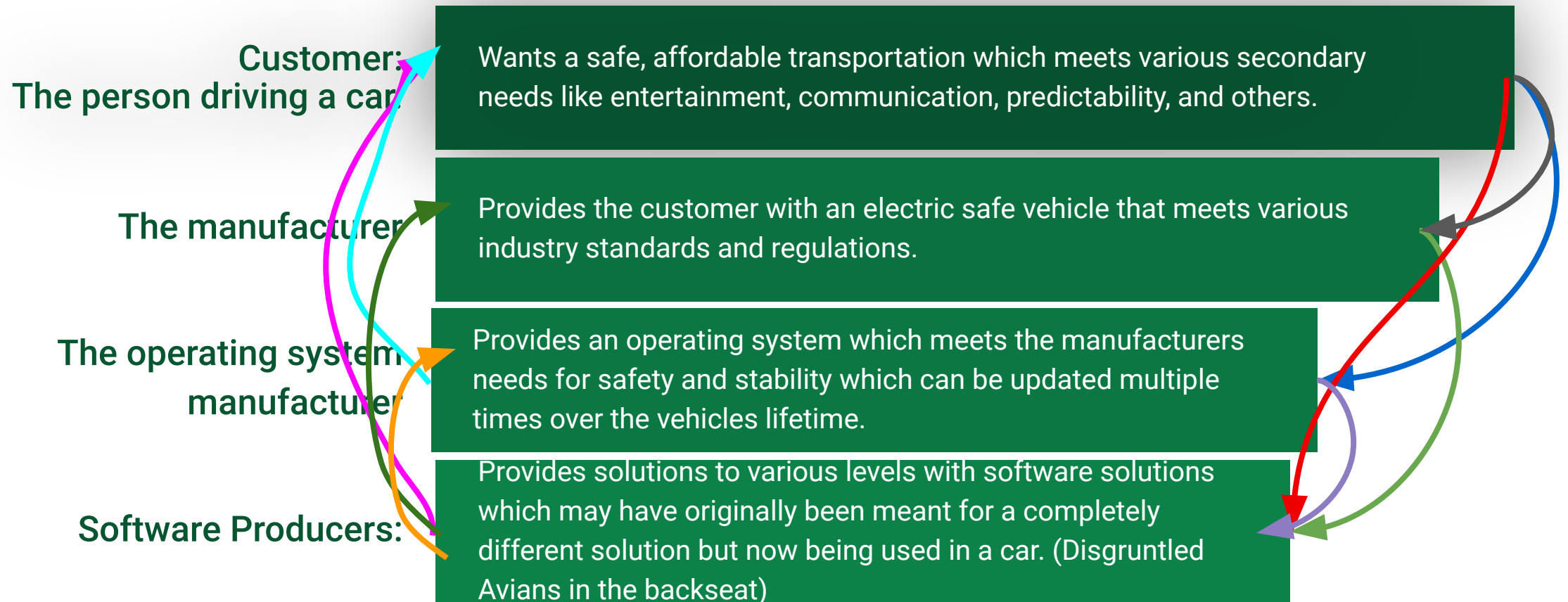
The manufacturer.

Wants solutions which meet customer needs but deals with computers which are shipped and rarely updated. This requires unchangeable decisions which percolate down.

Customer:
The person driving a car.

Want safe, affordable transportation which meets various secondary needs like entertainment, communication, predictability, and others.

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Right, But Why Do I Care?

The Agile Way

Customer:
The person driving a car:

Wants a safe, affordable transportation which meets various secondary needs like entertainment, communication, predictability, and others.

The manufacturer:

Provides the customer with an electric safe vehicle that meets various industry standards and regulations.

The operating system manufacturer:

Provides an operating system which meets the manufacturers needs for safety and stability which can be updated multiple times over the vehicles lifetime.

Software Producers:

Provides solutions to various levels with software solutions which may have originally been meant for a completely different solution but now being used in a car. (Disgruntled Avians in the backseat)

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Agile, Fedora, and Automotive Development

How do these all tie together?

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From Customer Needs to Fedora

Requirements

Red Hat team learns of requirements through customer interactions.

Customer/Partner development teams regularly embed with Red Hat engineering teams for ultimate communication and collaboration.

From Customer Needs to Fedora

Requirements	Solutions

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Teams work either with customer/partner development teams or internally to devise solutions to complex problems.

The work is broken down into manageable "chunks" to fit within 2 week sprints, which helps us bring value sooner and avoid headaches.

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From Customer Needs to Fedora

| Requirements | Solutions | Fedora |

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Solutions are then fed back up into Fedora at a regular cadence due to the 2 week sprint cadence.

From Customer Needs to Fedora

Requirements	Solutions	Fedora	CentOS Stream/RHEL/RHIVOS

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Changes from Fedora land in CentOS Stream as well.

The set of packages for RHEL will be brought into Red Hat for hardening.

Ultimately, curated set of packages destined for automotive will become RHIVOS.

From Customer Needs to Fedora – an example

2 second boot for rear view camera

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2 second boot for rear view camera

Requirements

Rear view camera must boot within 2 seconds of the vehicle being turned on.

2 second boot for rear view camera

Requirements

Potential Solutions

Rear view camera must boot within 2 seconds of the vehicle being turned on.

Integrating external-command plugin with plymouth

In Progress: remove unnecessary functionality from initramfs to speed up boot

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What else might land in Fedora?

Controller Area Network bus (CANbus) utilities and libraries.

Invented in the early 1980s by Robert Bosch GmbH & began implementation in vehicles in the early 1990s. By current standards it is a low bandwidth network (1 Mbit is a high speed version) but is built into so many existing parts that it is ubiquitous.

Connected Vehicle Systems Alliance tooling.

Newer vehicles have found the limited bandwidth & speed to be too small with older technologies. Various forms of fiber and heavily shielded copper ethernet cables are used for these tools. Protocols like vsomeip and tooling like the dlt-daemon are samples of tooling used in this.

SAE J1939 utilities and libraries

The industrial big brother to CAN-bus. Used in heavy industrial equipment & heavy duty truck equipment. While it is an aged system, it has been used in equipment for 20+ years & will exist for many more.

QT GENIVI

Various additional QT libraries written towards GENIVI which is now merged into COVESA.

HTTP over UDP libraries.

Various QUIC solutions which are used between car computers.

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From Customer Needs to Fedora

So what Hardware did we do a lot of development on ?

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What can be said about our target platform...*

"

It is really slow.. I switched to using containers on a newer phone and was able to get 4 times the compile speeds.

—

Justin Case
Red Hat Developer

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What we're using is not the target chipset for many of these manufacturers. Going from various press releases, most seem to be looking at Qualcomm or Nvidia ARM chips, but we chose something totally different to develop on.

Eileen Dover
Red Hat Engineer

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Kernel and graphic stack support has been 'lackluster' with many features only available in 32 bit mode running very old kernels due to closed source drivers.

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🔴 Red Hat

*Fake quotes from Red Hat team members

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Yes, we're talking about the RaspberryPi 4, but why the Pi?

Did someone say chip shortage?
It was available when many other boards were not. It is still available at only an arm and a leg versus a kidney and lung as those boards.

Quantity
It was available in large enough shipments that various automobile companies could order a large number for their engineers or to run other things inside of their labs.

GPIO plug
It has a very useful GPIO plug which can wear many different "hats" which can connect to CANBUS, SAE-J1939 or other devices.

Community Support
Large community of support beyond the Pi foundation to get kernel and software fixes.

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How & why do we work so closely with Fedora?

Isn't Red Hat In-Vehicle OS going to be based on RHEL...

▶ **Partners were using tooling they had mostly used for embedded systems on outdated operating systems**
  - This process resulted in the need to cross compile binaries as we pulled in our EL8 aarch64 OS.

# How & why do we work so closely with Fedora?

A Taste of the Good Life

▶ The partners really liked the translation layer and wanted to move further, so we quickly transitioned to using EL8 and osbuilder.

▶ **BUT!** There were issues with the EL8 system. It had been designed around 2019 using Fedora 29 which was much newer than the end of life software the partners were used to.
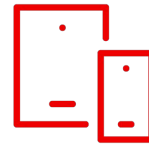
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The Path Forward with Fedora

Working together in sprints to take multiple paths to partner needs
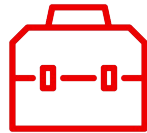
Recompiled Tools

Various QT libraries, compilers and other tools were recompiled for EL8.

Booting on Test Hardware

Work was done to get ELN and then CentOS Stream 9 working on the test hardware we had.

Upstream Collaboration

Work with the upstream and Fedora ostree teams to get tooling and fixes in place

Beyond Fedora: Where Else is Red Hat Involved?

Eclipse SDV Edge WG

Industry consortium to develop a scalable architecture for software-defined vehicles

Founding member

Arm SOAFEE SIG

Industry consortium to develop a scalable open architecture for cloud-native in-vehicle computing

Founding member

CentOS Automotive SIG

CentOS Special Interest Group for collaborative distro-based automotive Linux development

Founding member

Automotive Grade Linux

Collaborative embedded-based automotive Linux development

ELISA

Enabling functional safety within the Linux kernel and ecosystem

Board chairship

CUNA / ISO-PAS

Standards process within ISO to update ISO 26262 for Linux in automotive safety applications

Initiative leader

Linaro LEDGE & Automotive

Arm-based edge platform, automotive special interest group

Board chairship

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Questions?

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Stephen Smoogen

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