



## BOSCH CASE STUDY

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### How Bosch Has Benefited from GENIVI® Adoption

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#### Overview

The GENIVI Alliance was launched with a mission of driving the broad adoption of open source, In-Vehicle Infotainment (IVI) software. The alliance work was to result in shortened development cycles, faster time to market, and reduced costs for companies developing IVI software.

Automakers and their suppliers are now reaping the benefits of the GENIVI open source approach including adopting the open source middleware platform for IVI. In this brief case study, metrics from multiple production programs led by Bosch Car Multimedia (Bosch) will be presented as data points to the success of the GENIVI open model.

Bosch Car Multimedia develops smart integration solutions for entertainment, navigation, telematics, and driver assistance functions used in the automotive original equipment business. Innovations from Bosch have had a decisive influence on the automobile history. As the world's largest independent parts supplier to the automotive industry, Bosch has significantly contributed toward making driving safer, cleaner and more economical using technologies that enhance safety, driving convenience and reduce energy consumption. The Bosch automotive infotainment unit is now in its third generation of Linux and hardware platform production.

A vertical, orange-tinted image of a city skyline at night, with light trails from traffic in the foreground. The image is positioned on the right side of the page, partially overlapping the text area.

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Early on Bosch realized that the latest technological applications from the field of consumer electronics in automobiles would lead to a steady increase in the demands made on their system architectures as well as on the computing power and safety of in-vehicle communication technologies. As a result, their in-vehicle infotainment systems would have to adjust to support innovative multimedia functions and provide updates and upgrades to systems and those applications at any time during the vehicle's lifecycle – even after the purchase of the car.


More specifically, Bosch's requirements for infotainment in the connected car included mandatory features of cloud access; smartphone integration; application frameworks; fast updates of single features along with the related security and privacy requirements. However, traditional requirements for quality, safety, cost, maintainability of variants and time to market were still valid and desirable. Based on the above requirements, a new approach for delivering software was required to enable the connected car.

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## Engagement

When Bosch joined the GENIVI Alliance they had a goal of developing in-vehicle technology solutions quickly and cost-effectively while being innovative at the same time so they could adapt to the changing demands of their customers. They knew that consumers were expecting in-car navigation to be simple – as simple as accessing their GPS software or the maps on their smartphones. They adopted the GENIVI approach making significant use of open source software, a pre-integrated platform, and standard application programming interfaces developed within the GENIVI community. Adoption of this software meant Bosch could refocus their efforts from the noncompetitive portions of the in-vehicle infotainment software to more innovative features for their customers.

Bosch joined forces with Advanced Driver Information Technology (ADIT), an equally shared joint venture with Denso, to develop platform technologies for next generation infotainment systems. They chose a Linux open source operating system that is the basis for the GENIVI platform for future infotainment products.

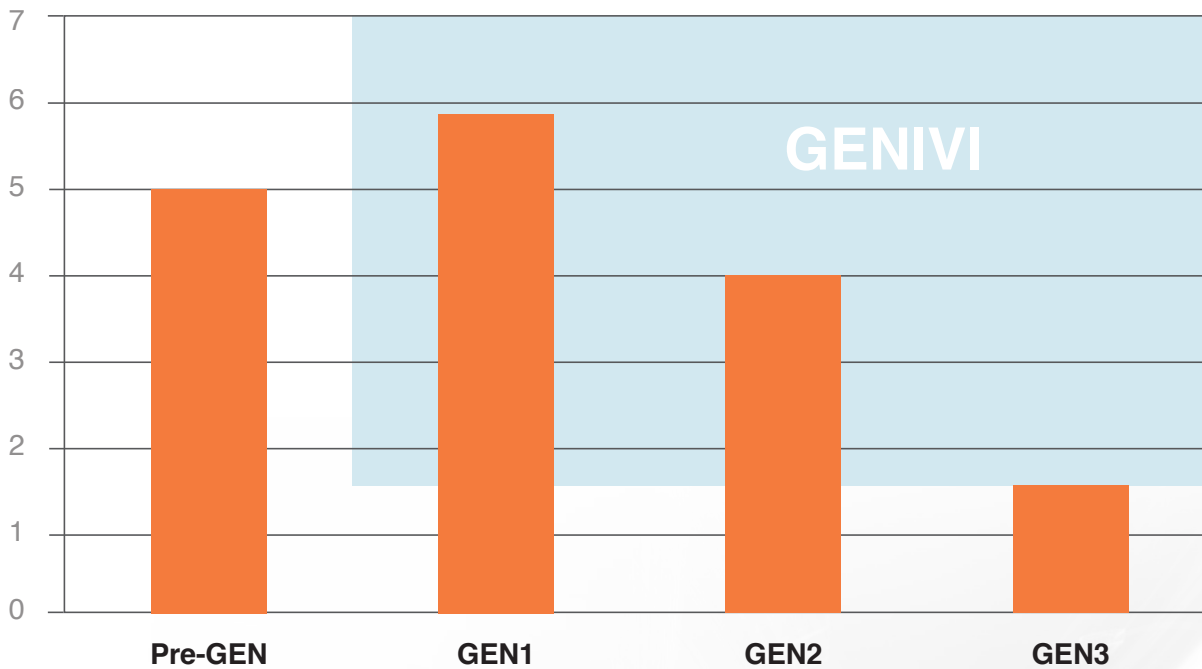


**“Over the past several production programs, Bosch has gathered metrics on time to market, program cost, and cost per device that shows their great success with a GENIVI model.”**

# PROGRAM RESULTS

Over the past several production programs, Bosch has gathered metrics on time to market, program cost, and cost per device that shows their great success with a GENIVI model. In the below chart, one can see the consistent reduction in time to market for their GENIVI programs measured in years from start of concept to first Start of Production (SOP).

## Time to Market/Years



## Start Concept to 1st SOP

**Pre-GEN** is based on the Real Time Operation System T-Engine. Linux is not used nor does GENIVI compliance apply.

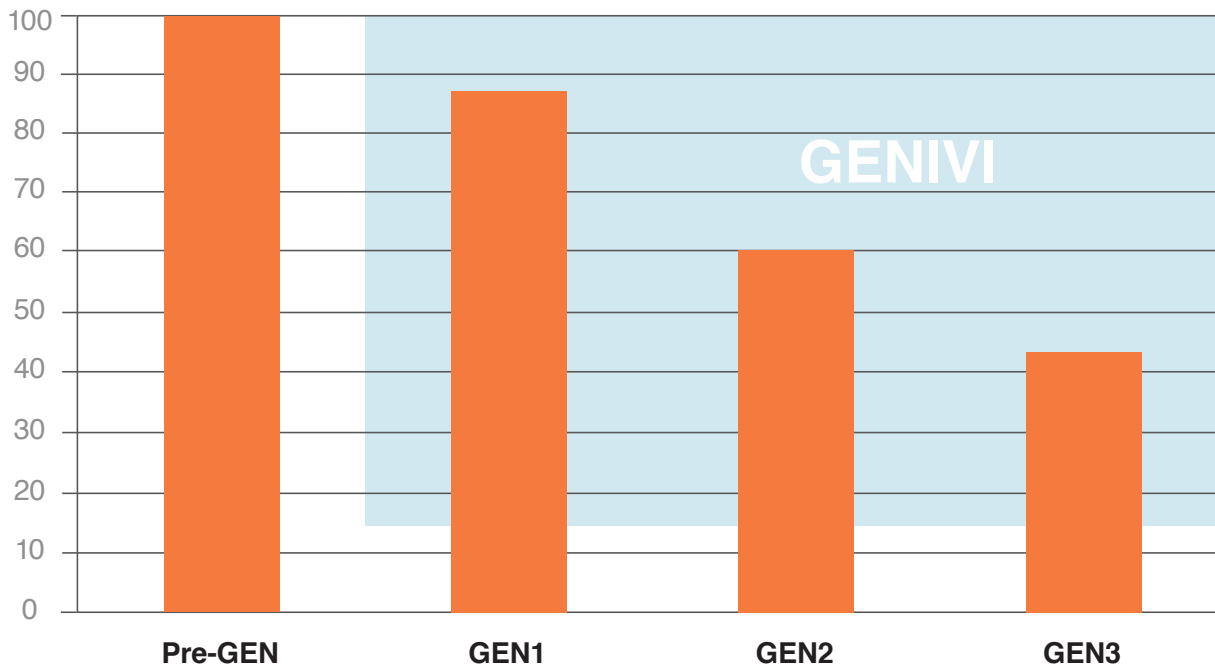
**GEN1** comprises two operating systems in parallel, T-Engine and Linux for the Multimedia Domain. Early GENIVI 2.0 compliance achieved.

**GEN2** is based on Linux and complies with GENIVI 5.0.

**GEN3** is the evolution from GEN2 with additional hypervisor technology running GENIVI 7.0 complaint Linux.

In addition to speeding time to market, Bosch's goal of reducing program costs was also realized as the below chart shows.

### Cost as Percentage of Pre-GENIVI



### Platform Development Costs

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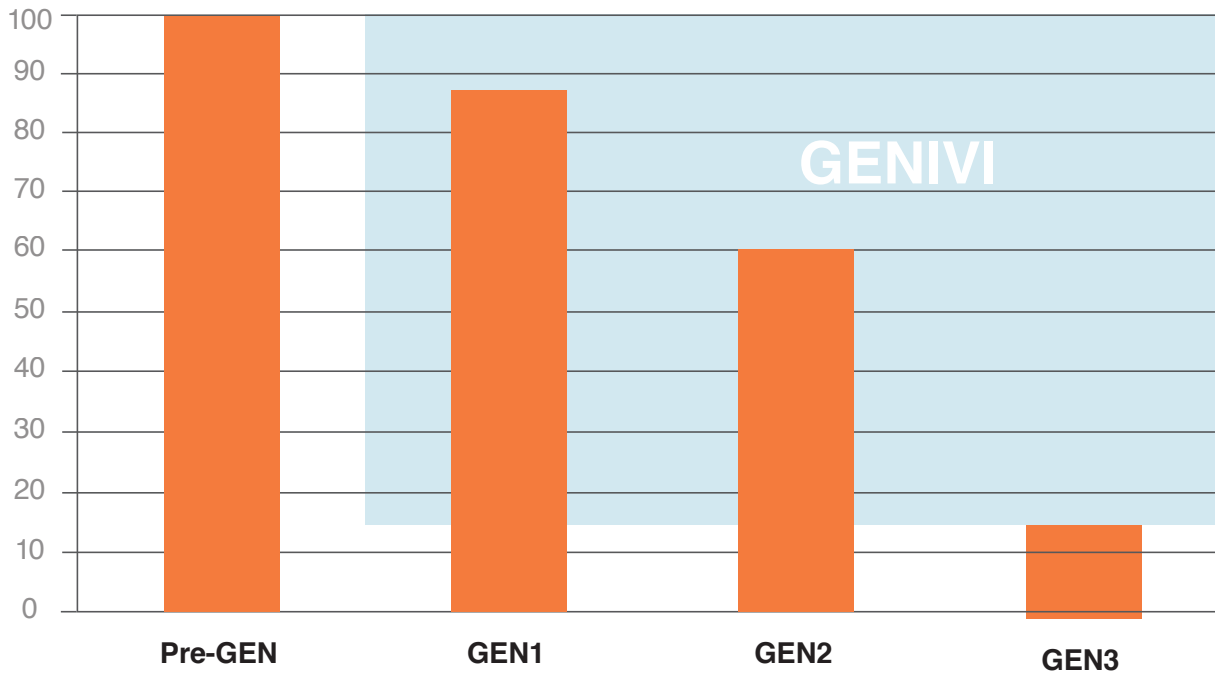
GEN1, the first Bosch/ADIT product using the GENIVI platform, shows the typical transition to any new technology, resulting in slightly longer time to market than previous, legacy systems. However, the trend toward speed to market was turned around in GEN2, compliant with GENIVI 5.0, and GEN3, compliant with GENIVI 7.0, suggests close to a two-and-a-half year savings from legacy programs. This less than three year program length goes a long way toward closing the gap between a historically long automotive program and the rapid delivery programs of smartphones and consumer electronics devices. Closing this gap in the development cycle was one of many measurable success indicators of the GENIVI, open source software approach.

**“...with the transition to a new technology base (i.e., Linux) immediate program cost savings were experienced in the GEN1 solution over the legacy offering.”**

One can conclude that even with the transition to a new technology base (i.e., Linux) immediate program cost savings were experienced in the GEN1 solution over the legacy offering. And, the cost has rapidly decreased with each subsequent program to the point that GEN3 expectations are roughly 40 percent of legacy solution costs.

Finally, Bosch measured cost per unit in their GENIVI deployments since their move to the new technology and approach. The below chart indicates a rapid decrease in platform development cost per device in the platform development of the various generations of their GENIVI solution.

### Cost as Percentage of Pre-GENIVI



### Platform Development Cost per Device

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While these three charts don't show other measurements that have benefited Bosch such as redeployment of development resources to customer-facing functions and innovation, they do show that Bosch is significantly benefiting from the GENIVI, open source approach in terms of time to market and cost.

**Modern infotainment systems using Bosch's infotainment unit are now being rolled out around the world in various automakers and models.**

## Bosch Infotainment Units in Use Today

Modern infotainment systems using Bosch's infotainment unit are now being rolled out around the world in various automakers and models. In a recent Suzuki deployment, various models were equipped with GEN2 head units running a GENIVI Compliant™ (V5.0) IVI platform. The infotainment system developed by Bosch includes MirrorLink™ and Apple CarPlay® as well as an integrated Bluetooth hands-free kit. Audio streaming and Digital Audio Broadcast in Europe brings music into the car. Additional features include a 7" touch screen, steering wheel controls and voice control.

"The project has clearly shown the benefits of using certified open-source software," said Manfred Baden, President of Bosch Car Multimedia. "Suzuki can now offer its customers around the world a high-performance infotainment solution for connected content and services." Visit Bosch Media Service, Mobility Solutions <http://bit.ly/1HwNbke> for more information.



- Now already with the third generation of Linux and hardware platform in production, Bosch has reached mass-market, selling about 3 million GENIVI devices this year and rising.
- Since developers relied on the GENIVI platform and open source approach, Bosch has seen rapid and measurable decrease in development costs and cycle time. The outcome is that they can now deliver an in-vehicle solution in two years versus the four to five years historically achieved.
- Bosch's adoption of GENIVI has enabled them to meet their customers' needs faster, with greater flexibility and with the internal cost containment they were looking for.