

**Accelerating the Design and Deployment of Autonomous Cars Worldwide**

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Autonomous cars are an important technology globally. Vehicles that can

drive themselves will improve automotive safety by eliminating major

causes of accidents, including driver distraction and drowsiness. Smart

vehicles will also be able to address traffic issues by safely operating

more cars on existing roads through coordinated driving to mitigate

traffic. This will be achieved by enabling cars to follow each other

more closely than is safe for independently controlled vehicles relying

on human reaction speeds.

There is tremendous momentum to place autonomous vehicles on the road as

soon as possible. From a technological standpoint, the necessary

hardware is starting to be in place to provide sufficient processing

power for the many layers of real-time artificial intelligence that must

be located in-vehicle. Significant progress is also being made in terms

of the software required to drive these vehicles in a safe and reliable

manner.

At the same time, however, there is increasing pressure to accelerate

the development of autonomous vehicles. Autonomous cars will offer much

more than increased efficiency and safety. They will also help countries

meet pending workforce shortfalls that could have wide-ranging negative

impact on businesses and urban development if not addressed.

**The Pressing Need for Autonomous Vehicles**

Consider the importance of cars for personal and commercial transport in

Japan. The number of newborns each year in Japan continues to drop,

leading to a decrease in the available workforce. Combined with the fact

that young people are choosing careers other than driving, this has led

to a diminishing workforce with fewer new drivers to replace elderly

drivers as they retire.

At the same time, the shift to a modern convenience lifestyle – 24-hour

couriers, delivery services, logistics, and mass transportation – is

increasing the demand for drivers. As the elderly population continues

to rise, this will only put more demand on these types of services.

The current workload is already too much for the existing workforce, and

they are unable to meet even today’s demands. Solutions like overnight

shifts and increased overtime will bolster the available driver pool.

However, they do so at the tradeoff of straining already overworked

drivers. The driving conditions throughout Japan are considered to be

challenging and dangerous, and this added strain will only lead to more

traffic accidents.

The driver shortfall has already begun to impact the nation by forcing

some businesses and services to slow or cease operations. It is clear

that autonomous cars are particularly important for Japan’s future.

However, these trends and cultural factors are not unique to Japan. They

impact every country and every major city in the world. These factors

are also exacerbated by the COVID-19 pandemic. While individuals are

driving less, they are purchasing more goods and services online, adding

further stress and demands on the diminishing driver workforce.

Autonomous vehicles will play an essential role in the evolution of

infrastructure in modern cities. The challenge is how we get there as

quickly as possible.

**Overcoming the Technological Challenges of Autonomous Cars**

To meet market demands, designers of autonomous cars will need to rely

heavily on off-the-shelf technology. There simply isn’t the time to for

OEMs to design everything in-house. Increasing time-to-market pressures

will also require OEMs to focus on technology that is ready and

available today.

For example, the ideal autonomous car is an electric vehicle (EV) that

will also reduce pollution, another important problem for highly

populated areas. Unfortunately, EV technology is still in its infancy.

In addition, the infrastructure required to support cities of EVs are

still years away from being in place. Thus, the first wave of autonomous

cars will be built using traditional combustion engines and other

technology that already exists today.

Complicating the challenge is the limited space within the vehicle to

house computing equipment and cables. To address space limitations,

solutions will have to be highly integrated. In addition, the harsh

operating environment of a car – including high temperatures, vibration,

and rough movement – is nothing like the controlled conditions of a

computer lab or enterprise network server room. Hardware will need to be

able to operate reliably at automotive temperatures.

Performance limitations are also a key consideration. To become

autonomous, each vehicle requires a computer with sufficient performance

to be able to handle real-time data transfer of video to an on-board

artificial intelligence (AI) engine with the ability to process and

control the vehicle in real-time as well. In addition, to be able to

minimize footprint, maintain real-time responsiveness, and avoid signal

incompatibility issues, all computing and video equipment must be able

to integrate into the vehicle’s system infrastructure. This means being

able to communicate with and control the car using a CAN interface.

Another complication is that 5G networks are not ready yet, so

high-speed vehicle-to-control center and vehicle-to-vehicle

communications will be constrained.

Sufficient storage is another concern. There are many capacity issues to

consider, including having enough local storage to perform AI computing

while supporting real-time video backup.

Finally, all of these systems must be able to operate with high

reliability while running off the “dirty” power provided by any battery

connected to an engine.

Each of these issues must be taken into account early in the design

process to ensure high reliability. This is critical in order for OEMs

to make the shift from SAE Level 3 (conditional automation with a human

driver) to SAE Level 4 (high automation without a human driver).

**Integration for Reliability and to Accelerate Design**

To address these challenges and get autonomous vehicles on the road

quickly, a high-level, integrated approach to computing is required.

Rather than building individual subsystems that have to interact

together, a high-level approach focuses on a workstation-grade platform

that is purpose-built to meet the processing requirements of today’s

vehicles with Advanced Driver Assistance System (ADAS) functionality.

From this integrated foundation, more advanced autonomous capabilities

and EV technology can be introduced as they become more readily available.

Taking a high-level approach has several key advantages. First and

foremost, it builds off of existing vehicle technology and enables OEMs

to significantly accelerate their design cycle. In addition, because the

workstation-grade platform is pre-integrated, it become possible to use

best-in-class technologies without compromising reliability or delaying

time-to-market. Since the platform is purpose-built for automotive

applications, it can provide the processing resources necessary for

vehicular AI computing, on the order of 2300+ CUDA cores.

Using a platform also allows for a more compact solution. An integrated

system reduces the amount of cabling required and the need to run cables

through the vehicle where there is little space available. From an

interface standpoint, with a CAN interface, a platform can consolidate

communications through a single point of entry for the entire autonomous

computing engine, simplifying communications and minimizing the impact

on the vehicle’s infrastructure. This, in turn, reduces the overall cost

of installing an autonomous system inside a vehicle.

To provide sufficient storage capacity in a compact size as well, Solid

State Drives (SSD) are available, which are more resilient to vibration

and movement than traditional hard disk drives (HDD). SSDs are built for

rugged applications and are lockable and hot-swappable for

mission-critical data protection. They can further increase reliability

through RAID data protection technology.

Consolidating all computing resources in a single platform also

simplifies power management. Ignition control is essential for computer

equipment operating off a car battery, as is support for a wide range

power input with surge protection. A platform can “clean up” power,

filtering out engine noise and other disruptions, to provide reliable

and consistent power to all sensitive electronics essential for reliable

operation.

The result of all these benefits of taking a platform approach is faster

time-to-market and lower project cost, both important factors to help

accelerate the deployment of reliable autonomous vehicles. A platform

also gives OEMs the flexibility to customize the resources available to

the AI system. For example, a platform can house additional memory

drivers and/or higher performance computing boards/AI accelerators to

match the requirements of the particular application.

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Architecture (CUDA) core technology (see Figure 1). The NVIDIA RTX and

Turing GPU architectures provide up to 6X performance for AI computing,

at up to 8K resolution. The fanless system was designed to support an

independent graphics card to provide maximum flexibility while keeping a

compact form factor.

\*Figure 1. \*The ECX-1400 PEG AI Computing + NVIDIA GeForce RTX 2070

graphics card is a compact, full AI system solution that provides

workstation-grade AI performance with an eight-core 9^th Gen Intel

Coffee Lake Refresh processor and Intel C246 backed by NVIDIA’s

revolutionary Computer Unified Device Architecture (CUDA) core technology.

The platform has 4 lockable and hot-swappable 2.5 inch SSD trays to

provide up to 32 TB of reliable storage for mission-critical data

protected with RAID 0, 1, 5, or 10. It also supports the high-speed

communications required for autonomous car applications, including up to

7 independent HD displays (VGA, HDMI, DVI, DP), USB 3.1 Gen 2 (10 G),

PCIe 3.0 (8 GT/s), SATA1 III (6G), and USB 3.0 (5G). The availability of

4 PoE+ interfaces reduces cabling requirements, and a customized

mechanical design supports CAN bus ports in current vehicle systems.

From a power perspective, the ECX-1400 PEG AI Computing platform is

well-protected. With an optimized power design capable of providing a

300 W power budget for the graphics card, the platform has 32 isolated

device input/output (DIO), ignition power control, smart circuit

protection, 80 V surge protection, and 12 V to 36 V DC power input.

Smart power management capabilities include ignition mode management,

iAMT 12.0, TPM 2.0, PXE, Wake on LAN, and remote power switch. The

system is also designed with anti-shock and anti-vibration protection

and can operate from -20 °C to 45 °C.

Autonomous Cars in Action

The ECX-1400 PEG AI Computing + NVIDIA GeForce RTX 2070 graphics card

has undergone numerous field trials. Two cases are shared here. The

first is for a convoy of autonomous trucks (see Figure 2) driving goods

from a central warehouse to various destinations in Japan.

\*Figure 2. \*Autonomous trucks delivering goods to various destinations.

Controllers placed in the lead and rear trucks manage high-level tasks

like fleet communication, speed/distance control, route planning, sensor

identifying, ambient surveillance, and fleet video/data sharing for the

entire convoy (see Figure 3).

\*Figure 3. \*With the ECX-1400, two controllers can manage a convoy of

autonomous trucks from warehouses to destinations across Japan.

The second case is an autonomous shuttle bus for transporting passengers

from the airport to various stations around Japan (see Figure 4).

\*Figure 4. \*Autonomous shuttle buses transport passengers across Japan.

The bus is managed remotely from a dispatch center, and its sensor

system utilizes magnetic markers on the road for navigation (see Figure 5).

\*Figure 5. \*With a platform like the ECX-1400, autonomous shuttle busses

can transport individuals from the airport to stations around Japan.

This video <https://www.youtube.com/watch?v=-Gt4UVmRtx8> shows how a

flexible real-time computing platform can proving the AI processing

capabilities necessary to enable autonomous vehicles today.

The ECX-1400 PEG AI Computing + NVIDIA GeForce RTX 2070 graphics card is

a highly flexible platform and can be customized for specific

applications. Although purpose-built for autonomous vehicles, it can be

used for other applications including automatic license plate (LPR)

recognition, robotic control, telemedicine, and public surveillance.

With the capabilities of the ECX-1400 as a single platform solution, it

is possible to overcome many of the challenges associated with

integrating autonomous car AI equipment into vehicles. This technology

simplifies the design of autonomous cars and will accelerate their

deployment throughout the world to help make our roads safer and address

increasing driver workforce shortages.