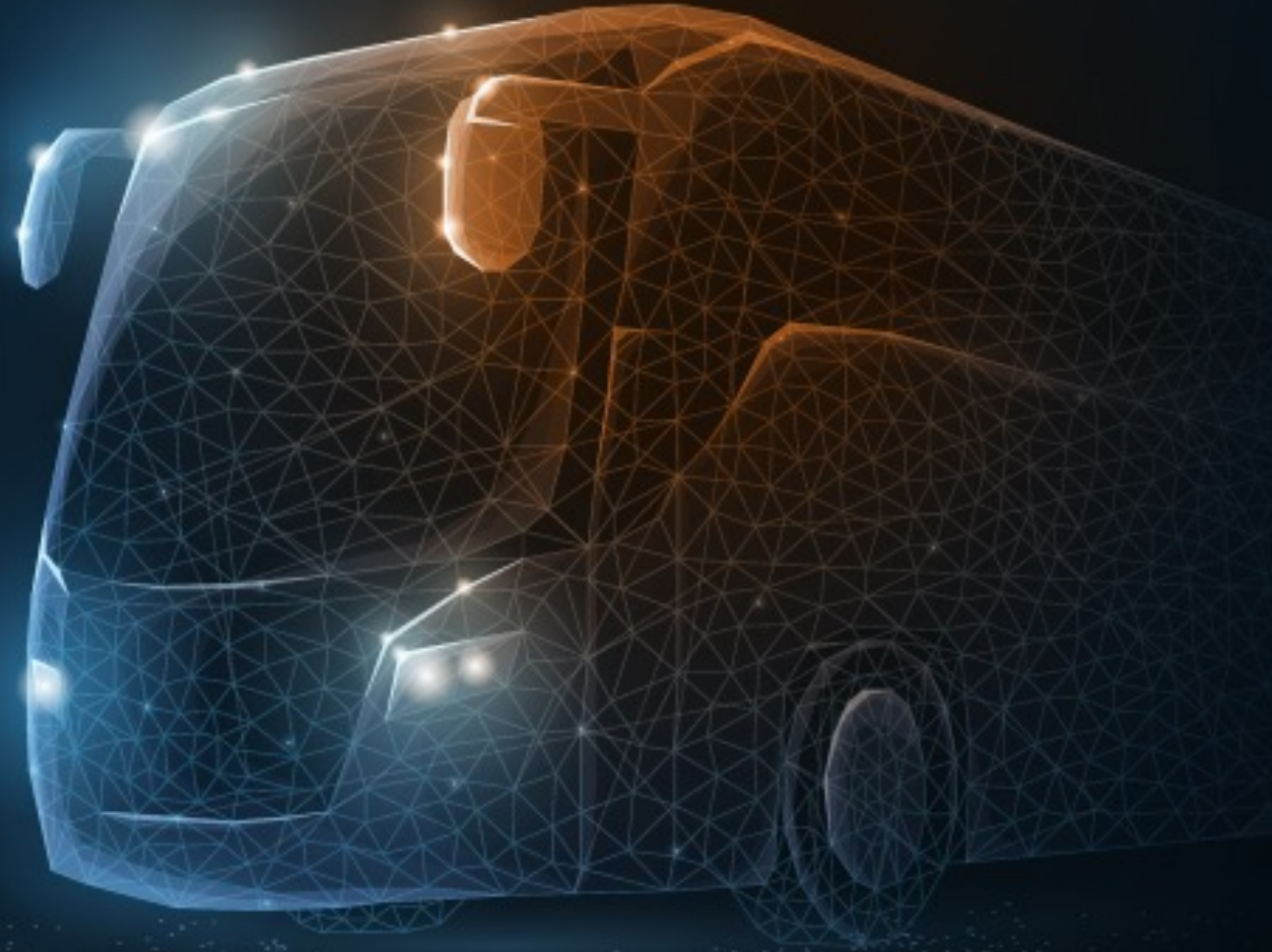


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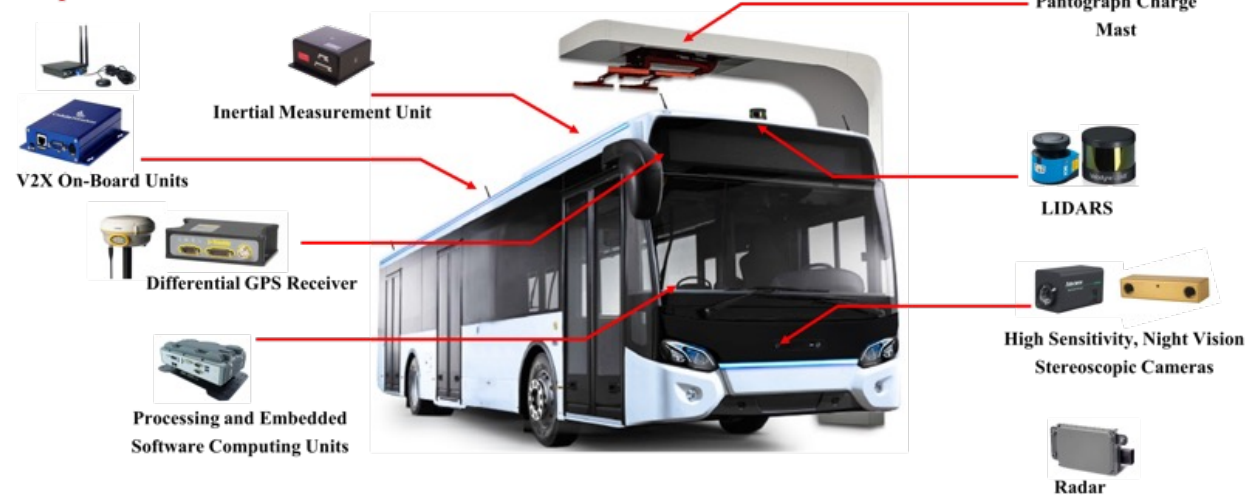
Case Study

Cybersecurity for  
NTU-LTA-Volvo  
Autonomous Bus in  
Singapore



# NTU-LTA-Volvo Autonomous Bus: The project

## Components of AV Robotics Kit



Nanyang Technological University, Singapore (NTU Singapore) and Volvo Buses have launched the world's **first full size, autonomous electric bus**. The single-deck Volvo Electric bus is **12 metres long** and has a full capacity close to **80 passengers**.

The autonomous bus is a combination of a **GPS system** and a **laser system** that builds up a digital map of the surroundings of the bus. When the bus drives, you compare reality with the digital map.

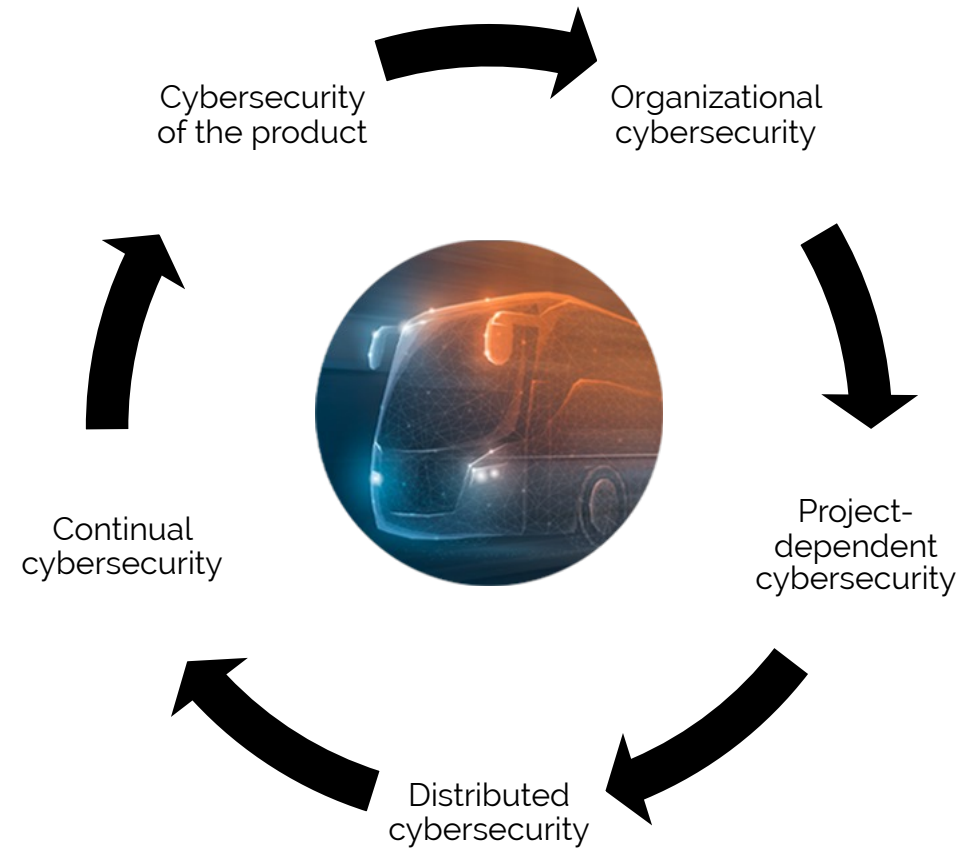
It is the first time we see the use of autonomous vehicles as public transport and shared transport. The bus is a clean vehicle that is 80% more **energy-efficient** than a conventional diesel bus.

This bus operates **autonomously, safe** and **operationally very efficient**.

# Elevated risks for autonomous vehicles and cybersecurity measures

Autonomous vehicles are increasingly connective, which in turn makes the vehicular IT components more vulnerable to attacks. These systems must be secured against unauthorized access by intruders who may attempt to tamper with their configuration or operation.

There is a risk that criminals may exploit such vulnerabilities to perform targeted manipulation of the vehicle's behavior, which represents a serious safety threat to the public.



ISO/SAE 21434:2021

# NTU ERI and CYBERCRYPT partner up on the security of future mobility

*"CYBERCRYPT guided us to develop world's first cybersecurity package for the NTU-VOLVO autonomous bus based on their unique security technology CYBERCRYPT D1. Their expertise and experience in automotive security formed the basis in developing cyber safe maneuvering of the bus in a simulated attack prone environment.*

*CYBERCRYPT's contribution has been instrumental in us achieving critical to operation milestones.*

*We are excited to collaborate with CYBERCRYPT to extend the technology to diverse fleet of vehicles deployed for public transport."*



**Dr. Anshuman Tripathi**

Programme Director Future Mobility  
Solutions  
Energy Research Institute (ERI)  
Nanyang Technical University (NTU)

*"We are thrilled to work alongside NTU Energy Research Institute and its mobility experts on the frontline of securing the future of transportation solutions like the NTU-VOLVO autonomous bus. Our portfolio of in-house built software technologies in the area of application security are there to help customers develop secure digital products and solutions like autonomous vehicles."*



**Dr. Andrey Bogdanov**

CEO and Founder  
CYBERCRYPT Group

## Energy Research Institute @ NTU (ERI@N)

Established in 2010, the Energy Research Institute @ NTU (ERI@N) distinguishes itself through research excellence directed towards outcomes of industry relevance, with focus on systems-level research for tropical megacities. The Institute integrates research across NTU as a whole in the context of the energy challenge, and then helps translate outcomes into industry and practice.

Apart from Interdisciplinary Research Programmes and Flagship Programmes that cover energy value chain from generation to innovative end-solutions, the Institute hosts the EcoLabs Centre of Innovation for Energy, which accelerates deep-tech energy innovation capabilities in Singapore to support the nation's future energy transition. The Institute has also setup the Smart Grid & Power Electronics Consortium Singapore, and the Standards Development Organisation under the Singapore Standards Council's Electrical and Electronic Standards Committee.



Energy Research Institute @ NTU

# CYBERCRYPT.

## CYBERCRYPT

CYBERCRYPT is a technology-based solution provider in the area of secure digital products and services.

Security is our heart. We provide expert services and solutions, so our customers can deliver their products to market.

To ensure that our customer's products integrates the best protection, we leverage our knowledge and expertise of cryptography and security design. Over the decades, our experts have established the foundations of cryptography and software security.

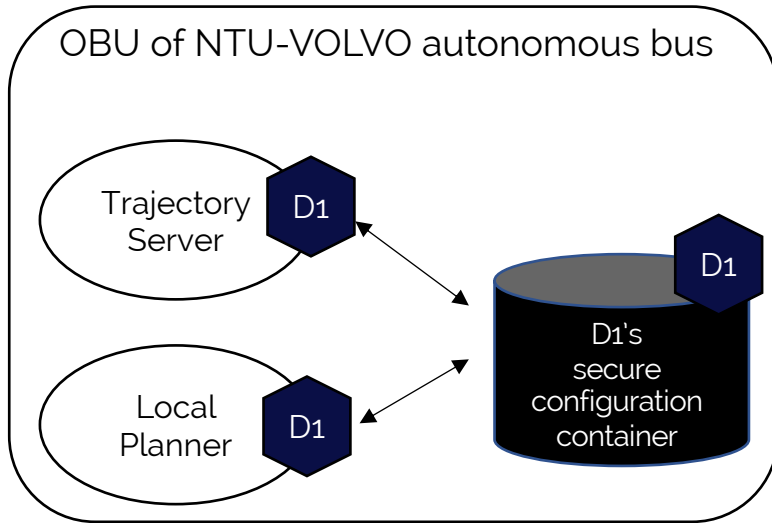
Our work is anchored in an understanding of the customer technological needs and of the best way to fortify their product with the latest cryptography and security. By implementing the proper cryptography and following the finest cyber resilience paradigm, we ensure that the products meet the highest protection standards throughout their lifecycle.

# CYBERCRYPT.



# CYBERCRYPT delivers a full cybersecurity package for the AV bus

## How is CYBERCRYPT D1 deployed inside NTU-VOLVO AV bus?



- A. Applications like Local Planner and Trajectory Server inside the On-Board-Unit of NTU-VOLVO AV bus integrate D1.
- B. Sensitive configuration of those applications is managed safely inside D1's secure container



## What is D1?

**D1** is CYBERCRYPT's product for data and configuration protection in the application layer.

The product integrates with:

- file systems
- databases (MySQL, MongoDB, etc)
- object storage (e.g., S3 and Ceph)
- message streaming (e.g., Kafka and AMQP), etc.

D1 works in edge and IoT settings like automotive as well.

It builds strong defence in depth around sensitive data by following the most up-to-date zero-trust principles and provides fine-grained access and authorization controls.

# CYBERCRYPT delivers a full cybersecurity package for the AV bus

On top of CYBERCRYPT D1 for configuration protection, CYBERCRYPT executes a complete cybersecurity package for the VOLVO-NTU autonomous bus that includes:

- Mapping of attack surface on organizational, application, OS and hardware levels
- Security evaluation incl. the compute rack and interfaces to sensors, vehicle motion management, OLIVE, etc.
- A cybersecurity plan towards protection of critical assets, organizational protective actions, technical protective mechanisms and breach recovery plan

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