TUT1314
Autonomous Driving Development Platform powered by SUSE

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Agenda

• Disruptive Market Trends
• Emerging Landscape for Autonomous Driving
• Typical Requirements
• SUSE Solutions
  • Data Analytics Platform / Data Lake
  • Simulation Platform (Container / Physical)
  • Virtualized / Dedicated Compute Platform
  • Mass Storage Platform
  • Software Development Platform
• Solution Summary
• Q&A
Disruptive Market Trends
What’s driving new Business models in Transportation

- Changing Consumer behavior
- Rising Urbanization
- Pervasive high-speed mobile broadband
- Rapid technological leaps in Computing power and Data Center Capacity
- Enablers for new business models in Transportation

Driven by shared mobility, connectivity services, and feature upgrades, new business models could expand automotive revenue pools by ~30 percent in 2030
Welcome to the New Passenger Economy

- Global Autonomous Driving Market - $7 Trillion by 2050

- Shared Mobility Services Contributing to 52.8%

- Race for the first Level 5 autonomous car - Fully functional driverless vehicles expected to hit the road as early as 2020.

- New Technologies are evolving fast to enable full autonomy
  - 5G
  - AI (Artificial Intelligence)
  - V2V (Vehicle to Vehicle)
  - V2I (Vehicle to Infrastructure)

- Race for complete autonomy forcing regulators to deliver Suitable Safety Standards very soon.
Emerging Landscape for Autonomous Driving
## Key Leaders in Autonomous Driving Cars

<table>
<thead>
<tr>
<th>Company</th>
<th>Achievements</th>
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<tr>
<td><strong>Waymo</strong></td>
<td>• Working since 2009.</td>
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<td>• Large-scale fleet of driverless taxis &amp; commercial vehicles</td>
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<td><strong>Ford</strong></td>
<td>• Focused on commercial autonomous vehicles</td>
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<td>• Has patented autonomous police car to hand out tickets</td>
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<td><strong>Daimler</strong></td>
<td>• Partnering Bosch to create Level 4 and Level 5 autonomous cars by 2020</td>
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<td><strong>Toyota</strong></td>
<td>• Autonomous driving Taxis in Japan</td>
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<td>• Designing prototype with Google’s AD Technology</td>
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<td><strong>Volkswagen Group</strong></td>
<td>• Partnered with Aurora Innovation to integrate their self-driving system of sensors, hardware, and software into Volkswagen’s vehicles.</td>
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Typical Requirements: Autonomous Driving Development Platform
## Typical Requirements

<table>
<thead>
<tr>
<th>Infrastructure &amp; Lifecycle Management</th>
<th>Virtualized Compute Platform</th>
<th>Data Analytics Platform / Data Lake</th>
<th>Simulation Platform (Container / Physical)</th>
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- **Physical Infrastructure**
- **Operating System**
- **Storage**
- **Data Analytics Platform / Data Lake**
- **Simulation Platform (Container / Physical)**
- **Software Development Platform**
SUSE Solution:
Data Analytics Platform / Data Lake
OS Requirements for BigData

Big Data OS must provide:

- **High Availability**
  - Control & job scheduling nodes must be highly available

- **Feature Set**
  - Scalability, performance tuning, security, data access

- **Support**
  - Maintenance, security updates, critical issues
Big Data Management Considerations

- **Large-scale** deployment -> from 100’s or 1000’s of nodes
- Traditional workload assignment methods don’t **scale**
- **Distributed** systems installation & management
- **Consistent** node installation is important
- Patch & configuration management should be **centralized**
- **Multi-platform** support
- Many elements to Big Data environment -> Single source of **support** reduces contention
SUSE Linux Enterprise Server is the base

SUSE Linux Enterprise Server as a BigData OS is:

- Robust and Reliable
- Optimized for massively data-intensive workloads.
- Largest lifecycle in the market
- Easy to install and configure
- Cloud ready
High Availability

SUSE Linux Enterprise High Availability Extension provides:

• Most up-to-date open-source HA stack
• Protects against Hadoop Name Node single point of failure
• Nodes can be Physical, Virtual or Mixed
• All HA components included (Filesystem, etc)
SUSE Linux Enterprise Live Patching

Improve business continuity, increase service availability and enhance security and compliance by reducing system downtimes.

- Reduce planned and unplanned downtimes by live patching your systems.
- Increase service availability and enable services to run without interruption.
- Ensure systems stay up-to-date with security patches in real time.

Reduce
Planned and unplanned downtimes

Zero
Interruption when patching systems

Minimize
Exposure to malicious attacks

www.suse.com/products/live-patching/
Systems Management

SUSE Manager provides:

• Centralized management solution
• Patch & configure compute nodes
• Heterogeneous software environments
• Support multiple enterprise Linux distributions
• Hardware & virtualized platform agnostic
• VM’s & physical treated alike
SUSE Solution:
Simulation Platform (Container / Physical)
HPC in Automotive & Transportation

- Automotive Modeling and Design
  - Aerodynamic designs
  - Engine performance and timing
  - Fuel consumption
- Self driving, Autonomous Vehicles
  - AI driverless operations
- Safety systems
- Image/Facial Recognition
- Logistics and Mapping
HPC Customer Pain Points

**Complexity**

“Composing a working HPC environment is difficult, time-consuming, requiring experts.”

- Clusters are hard to use and manage as they become more complex in heterogeneous environments
- Storage access time and data management are becoming new bottlenecks

**Maintenance**

“My IT staff doesn’t have time to update and test all the different software components.”

- Better management software is needed, and deployment approach needs to be updated to leverage HPC and cloud infrastructure
- Stack components provided by multiple vendors, making it more challenging to maintain

**Time to Solution**

“I need to maximize application performance, scale workloads, and minimize overhead.”

- Parallel software is lacking with many applications needing a major re-design
- Stack components provided by multiple vendors, making managing more challenging
- Segmented into commercial and scientific, and there is not enough collaboration
SUSE Linux HPC

- All packages supported by SUSE via SUSE Linux Enterprise HPC
- Available for x86 and Arm
- Flexible release schedule
- SLE 12 and SLE HPC 15
- Docker CE bundled
SUSE PackageHub

Community Supported Packages for SLES

- High-quality, up-to-date packages delivered by openSUSE Factory
- Easy to install via zypper or yast
- Built and maintained by the community of users
- Approved and curated by SUSE
- No additional charge

About 1000 packages available for X86-64
More than 500 packages available for ARM

<table>
<thead>
<tr>
<th>Package</th>
<th>Category</th>
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<tbody>
<tr>
<td>clustershell</td>
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<td>robinhood</td>
<td>Administrative</td>
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<tr>
<td>singularity</td>
<td>Runtime</td>
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</table>
SUSE continues to work with NVIDIA to enable support for the latest NVIDIA GPU cards – important in HPC modeling and simulation

NVIDIA’s expertise in programmable GPUs has led to breakthroughs in parallel processing which make supercomputing inexpensive and widely accessible
SUSE Solution:
Virtualized / Dedicated Compute Platform
Requirements for Compute Platform

Autonomous Driving Development Platforms require:

• Flexibility to respond quickly & easily to new demands
• Increased agility, speed and efficiency
• An elastic platform for increased innovation
• Lower costs, faster ROI
• Greater control and security
• Self-service capabilities
• High quality services
With OpenStack

SUSE OpenStack Cloud bridging the “Old” and the “New”

- Increased agility
- Easier and faster to innovate
- Faster time to value

- Maximize the value of existing IT
- Reduce costs
- Improve efficiency
SUSE OpenStack Cloud
Reducing the complexity of OpenStack

“OpenStack requires a high degree of know-how to deploy.”
451 Research Market Monitor, OpenStack Overview August 2017

SUSE OpenStack Cloud makes OpenStack easier to deploy, use and manage.
SUSE OpenStack Cloud
Delivering quantifiable benefits

ROI
380%

Payback
<6 months

Reduced staff to manage OpenStack: 2 FTEs

Improved productivity of development teams: 2.5 FTEs

1% revenue boost (on $120 million base) from increased demand from business units and developers

The Total Economic Impact™ Of SUSE OpenStack Cloud – A Forrester Total Economic Impact™ Study Commissioned By SUSE; October 2017
Solution Details:
Mass Storage Platform
Storage Requirements

Storage solution for Autonomous Driving Development Platform should provide:

• Unlimited Scalability
• Reliability & Robustness
• Cost Effective – Low CapEx & OpEx
• Agility
• Support for multiple Storage Protocols
• Non-disruptive Expansion
SUSE Enterprise Storage

An intelligent software-defined storage management solution, powered by Ceph Technology that enables IT to transform their enterprise storage infrastructure to:

- **Deliver a highly scalable and resilient environment with no single points of failure**
- **Reduce IT costs** by using off-the-shelf servers and disk drives
- **Automatically optimize** and add storage when needed without disruption
Powered by Ceph Technology
SUSE Enterprise Storage Reference Architecture

RADOS
(Common Object Store)
Solution Details:
Software Development Platform
Containers Help Enterprises Accelerate IT

Accelerate application development and delivery

Build and deliver new cloud native applications

Modernize legacy applications
Cloud Foundry Application Runtime adds functionality for developers:

- One step command to **containerize, deploy, and manage an application**
- Automatically identifies and pulls in language libraries, frameworks, and other dependencies via **buildpacks**
- **Open source service brokers** automatically create and bind services to applications
- **Automates application lifecycle management** by assigning appropriate resources, managing routing, load balancing, scaling, and more
SUSE Application Delivery Platforms
Support multiple approaches to speed application delivery

Cloud Foundry
Productivity

Kubernetes
Flexibility

SUSE Cloud Application Platform
• Accelerate end-to-end application development and delivery at scale
• Maximize productivity with abstractions, patterns, and full lifecycle automation

SUSE CaaS Platform
• Simplify deployment and management of containers and containerized applications
SUSE Cloud Application Platform Overview

Cloud Foundry CLI

Stratos Web UI

CI/CD Plugins

kubectl

CF API

App AutoScaler

Job Scheduler

Enterprise Applications

SUSE Cloud Application Platform

kubernetes

SUSE CaaS Platform

Public Cloud

On Premise

Multi-tenancy
Multi-language
Multi-cloud

User Auth

Open Service Brokers

SUSE OpenStack Cloud

SUSE CaaS Platform

SUSE Cloud Application Platform

CI/CD Plugins

K8S API

Dev

Ops
Time-to-market is accelerated by enabling developers to deploy apps with single action – everything else is automated.

**Before**

< -> Install server  
  |      |              |                          | Install middleware  
  |      |              |                          | Install database  
  |      |              |                          | Network  
  |      |              |                          | Tests  

> cf push
Maximize Developer Productivity
with proven technology

Powerful developer abstractions
Brokered 3rd party service connectivity
Automated application lifecycle management
Solution Summary:
Autonomous Driving Development Platform
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Backup Slides
### Key Leaders in Autonomous Driving Cars

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| **GM**              | - Inclined to Design and build the car and develop the software.  
- In January 2018, GM started testing autonomous technology on Cadillac cars in Israel.  
- Targets to create and operate a large-scale fleet of driver-less commercial ride-hailing service in 2019 |
| **Waymo (formerly Google's self-driving car project)** | - Working on autonomous vehicle technology since 2009.  
- Completed >4 million self-driven miles on public roads.  
- January 2018 – signed a deal to buy thousands of self-driving minivans from FCA  
- Dec 2018 – Launched its first commercial self-driving car service "Waymo One" |
| **Daimler-Bosch**   | - Daimler has partnered with supplier Bosch to create Level 4 and Level 5 autonomous cars by 2020 |
| **Ford**            | - More focused on commercial vehicles as opposed to consumer ones.  
- Leveraging different partners in different industries about potential applications for Ford’s first self-driving vehicle in 2021, including ride-sharing and delivery services.  
- In Dec 2017, Ford patented autonomous police car to hand out tickets. |
| **Volkswagen Group** | - Partnered with Aurora Innovation to integrate Aurora's self-driving system of sensors, hardware, and software into Volkswagen's vehicles. |
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# Leaders in Autonomous Driving Cars

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| **Aptiv (formerly Delphi Automotive)** | • Recently purchased NuTonomy, a leading developer of autonomous driving software.  
• Recently paired with Lyft at **CES 2018** to offer Level 4 autonomous rides down the Las Vegas strip to attendees.  
• Believes its system should be **scaled for production** by next year. |
| **Renault-Nissan-Mitsubishi Alliance** | • Planning to tie up with Waymo to develop self-driving taxis  
• Renault planning to launch a pilot public transportation program |
| **Volvo-Autoliv-Ericsson-Zenuity** | • Developing an end-to-end autonomous platform that integrates in-vehicle software and systems with connected safety data from other vehicles and infrastructure.  
• Recently launched an **innovation lab** for easier collaboration with startups. |
| **PSA** | • Developing a new electronic architecture to improve safety of autonomous vehicles for both passengers and data.  
• In 2017, became the first automaker allowed to test autonomous cars with non-expert drivers on French public roads. |

Semi to fully autonomous cars have been set to the short-term objective of 2020 by the auto industry. OEMs, Tier 1 Suppliers, Tech companies and new entrants are all aligning their strategies with the evolution of autonomous cars.

**Autonomous Driving : Major Tech Players:** Intel, Google, Apple, Microsoft, Cisco, IBM
Why SUSE for BigData?

SUSE provides:

- Enterprise Linux Server with features that optimize Big Data deployments
- Systems management tools for full control of deployment infrastructure
- Perfect-match provisioning architectures for compute, container and storage resources
- Partnership with leading Big Data ISVs to ensure SLES is a supported OS
- Partnership with leading IHVs on reference architectures and integrated solutions for Big Data
Deploy and manage Hadoop with SUSE Manager
On physical, virtual or cloud environments
HPC Customer Pain Points

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SUSE Linux Enterprise High Performance Computing

Simplifying access to supported HPC software

All packages supported by SUSE
- Support included in the SLE HPC Subscription

Easy installation via zypper or Yast

Available for X86 and ARM platforms beginning with SLES 12 SP2

Flexible release schedule. Releases are independent of Service Pack schedule

<table>
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<tr>
<th>Package</th>
<th>HPC Module 1Q17</th>
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</tr>
<tr>
<td>slurm</td>
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<td>17.02.09</td>
<td>17.02.10</td>
<td>17.02.10</td>
<td>17.11.5</td>
</tr>
</tbody>
</table>

* Note: A separate support agreement is required for Icinga2
Key HPC Partnerships

- Hewlett Packard Enterprise
- Microsoft
- Cray
- Arm
- Lenovo
- NVIDIA
- Marvell
- Univa
- Bright Computing
- Altair
SUSE is considered a leader in HPC software systems …

- **Experience**: Long history and experience in HPC, many loyal customers
- **Modularity**: HPC module for x86 and ARM with on-demand updates
- **OpenHPC**: Founding member and major contributor
- **Innovation**: HPC as a Service using SUSE OpenStack Cloud
- **Industry**: Strong in automotive, plus growing adoption in others
- **Supercomputers**: Strong 13.4% share of Top500 (37% of top 100 and 50% of top 50)
- **Intel**: First partnership with Intel for OpenHPC initiatives
- **ARM**: First with commercial support for ARM
- **Lenovo**: HPC Module is an integral part of LiCO
- **HPE/SGI**: Catalyst initiatives along with ARM
- **Cray**: CLE includes SLES, Cray contract for SLES on ARM
- **Microsoft**: Available via Microsoft Azure Marketplace
- **Pricing**: Discounted HPC pricing and updated terms & conditions
SUSE OpenStack Cloud
The enterprise open source private cloud solution

• Improved **agility**, **innovation** and **faster time to value** help you react swiftly to changing market demands

• **A robust, production-ready private cloud** ready to run business-critical workloads

• **Maximize the value** of IT investments and enjoy **reduced costs** with improved **efficiency**
Deliver a Highly Scalable and Resilient Environment with no Single Points of Failure

Unlimited scalability with a distributed storage cluster designed to scale to thousands of nodes and from terabyte environments and beyond to meet your growing data requirements.

Highly redundant storage infrastructure design maximizes application availability with no single points of failure.
Reduce IT Costs by Using Off-the-shelf Servers and Disk Drives

Utilize commodity off-the-shelf hardware that is at minimum 30 percent less expensive than average capacity optimized solutions, priced by node not capacity, equals significant CAPEX savings.

Reduces IT operational expense with a single storage management tool managing a single storage cluster for your heterogeneous server environment.
Automatically Optimize and add Storage when Needed Without Disruption

Automatically respond to changing demands with self-managed and self-healing storage that optimizes system performance.

Easily provisions and seamlessly delivers – no need for a forklift upgrade – with the ability to easily add additional cost-efficient and highly scalable storage, without disruption, to meet the explosive data demands.
Native protocol support includes

- RBD (Block)
- RADOS (Object)
- CephFS (With multiple active MDS Servers)
- S3 and Swift

SUSE hasn’t left the traditional data center behind

- NFS is provided for both file and S3 objects. File is a re-export of CephFS
- NFS for S3 provides a mechanism to bulk load existing data to an S3 repository
- SMB/CIFS Microsoft client access is a requirement for almost every data center environment!
- ISCSI provide access mechanisms to bridge your data center to the future
SUSE Cloud Application Platform

A modern application delivery platform that brings an advanced cloud native developer experience to Kubernetes. SUSE Cloud Application Platform increases business agility by helping enterprises to:

- **Boost developer productivity** with easy one step deployment of cloud native applications using the language and framework most appropriate for the task.

- **Reduce complexity and increase IT efficiency** with a lean platform for rapid application delivery at scale.

- **Maximize ROI** with industry leading open source technologies that leverage your existing investments.
Deployment via API (CLI, web, or IDE)

$ cf push
Using manifest file /home/troyt/src/git/tt/go-env/manifest.yml

Creating app go-env in org demo / space dev as ttopnik...
OK

Creating route go-env.paas.example.com...
OK

Binding go-env.paas.example.com to go-env...
OK

Uploading go-env...
Uploading app files from:
/home/troyt/src/git/tt/go-env
Uploading 1.1K, 4 files
Done uploading