

Driver Workload Management based on GENIVI Driver Workload Assessor

Yusuke Nakamura
DENSO CORPORATION
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Agenda

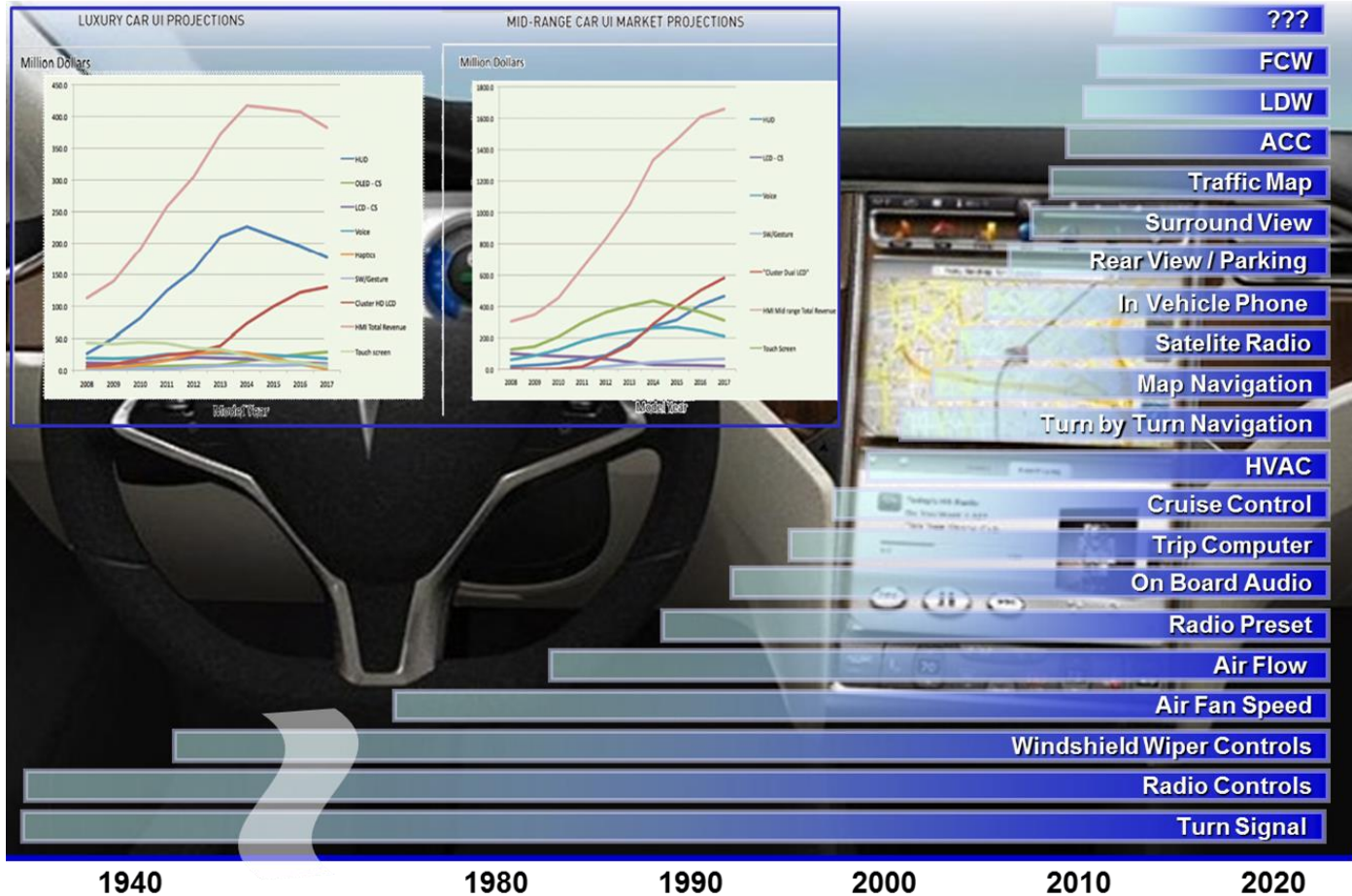
- **The Need To Manage Workload**
- **Workload Management**
- **Workload Management in a GENIVI Architecture**
- **Workload Level Definition of GENIVI Driver Workload Assessor**
- **Workload Management Use Case**
- **Demonstration of GENIVI Driver Workload Assessor**

The Need To Manage Workload

Trends: Increasing Workload

Increasing Workload:

- The vehicle is becoming an increasingly complex environment
 - Rapid increase in the number of systems the driver can control



Trends: Increasing Workload

Increasing Workload:

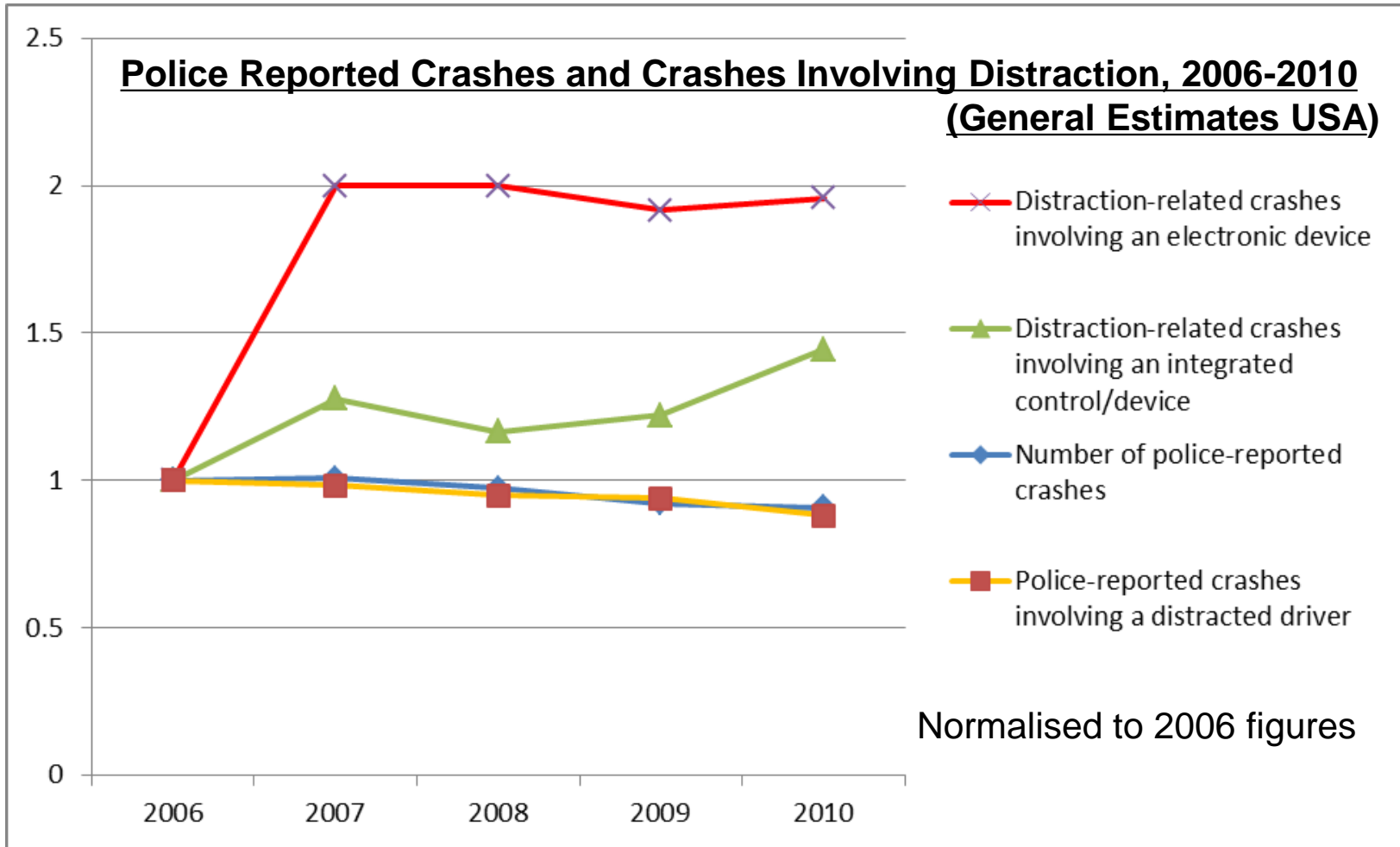
- The vehicle is becoming an increasingly complex environment
 - More devices are being brought into the vehicle with which the driver may interact
 - with access to more services outside the vehicle



Trends: Society's Concern

Society's Concern:

- Society is concerned that Driver Workload and Distraction leads to accidents



Ref: Visual-Manual NHTSA Driver Distraction Guidelines for In-Vehicle Electronic Devices (Federal Register, Feb. 24, 2012)

Trends: Society's Concern

Society's Concern:

- Society is concerned that Driver Workload and Distraction leads to accidents
 - Most regions are introducing guidelines or regulation to counteract Driver Workload and Distraction by limiting driver interaction with HMI & Systems

ESOP: Commission of the European Communities
Recommendation on Safe and Efficient In-Vehicle Information and
Communication Systems (2007)
Update of the European Statement of Principles on Human Machine Interface



Japan Automobile Manufacturers Association Guidelines for
In-Vehicle Display Systems, Version 3.0, 2004

AAM: Statement of Principles, Criteria and Verification
Procedures on Driver Interactions with Advanced In-Vehicle
Information and Communication Systems. June 26, 2006



Informal document WP.29-160-34
(160th WP.29, 25-28 June 2013,
agenda item 2.3)



Voluntary guidelines reduce visual-manual distraction
- the greatest safety risk to drivers in NHTSA's new study

NHTSA's Driver Distraction Guidelines

DOT 37-13

Tuesday, April 23, 2013

Trends: Drivers' Demand

Customer (Driver) Demand:

- People are becoming increasingly used to being Continually Connected and for information to be always available
- Drivers want to be free to use their technology throughout their journey
 - Drivers are NOT always fully occupied with driving – we also have clear roads and low workload situations – **we have variety** - One size does not fit all.



- We have to be able to manage things smartly.

If we don't allow this

- Drivers will be dissatisfied .
- Driver will find ways to over-ride restrictions or use CE devices stand-alone



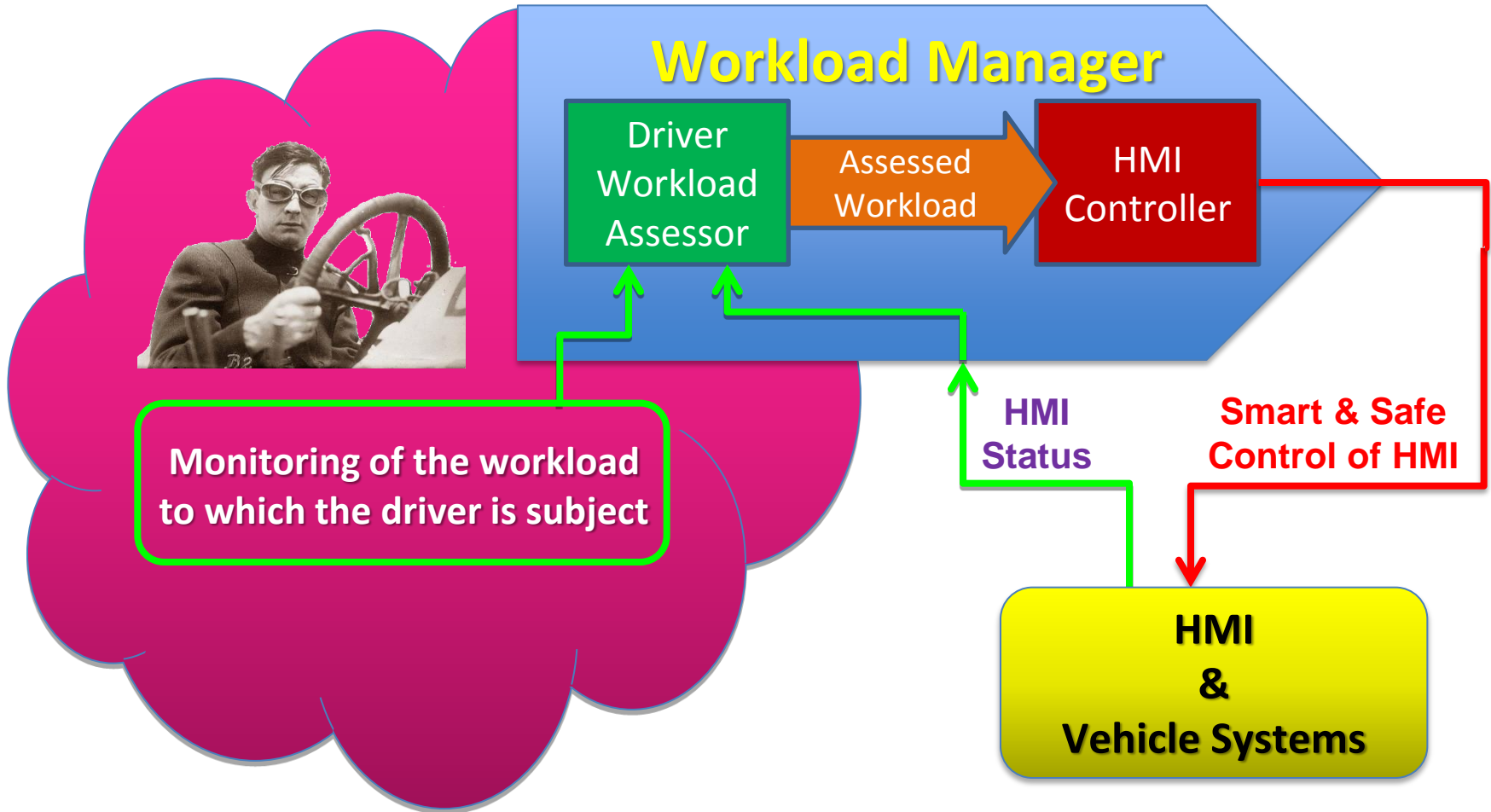
Therefore we need to manage HMI according to the situation.

Workload Management

A Smart Solution

A Smart Solution:

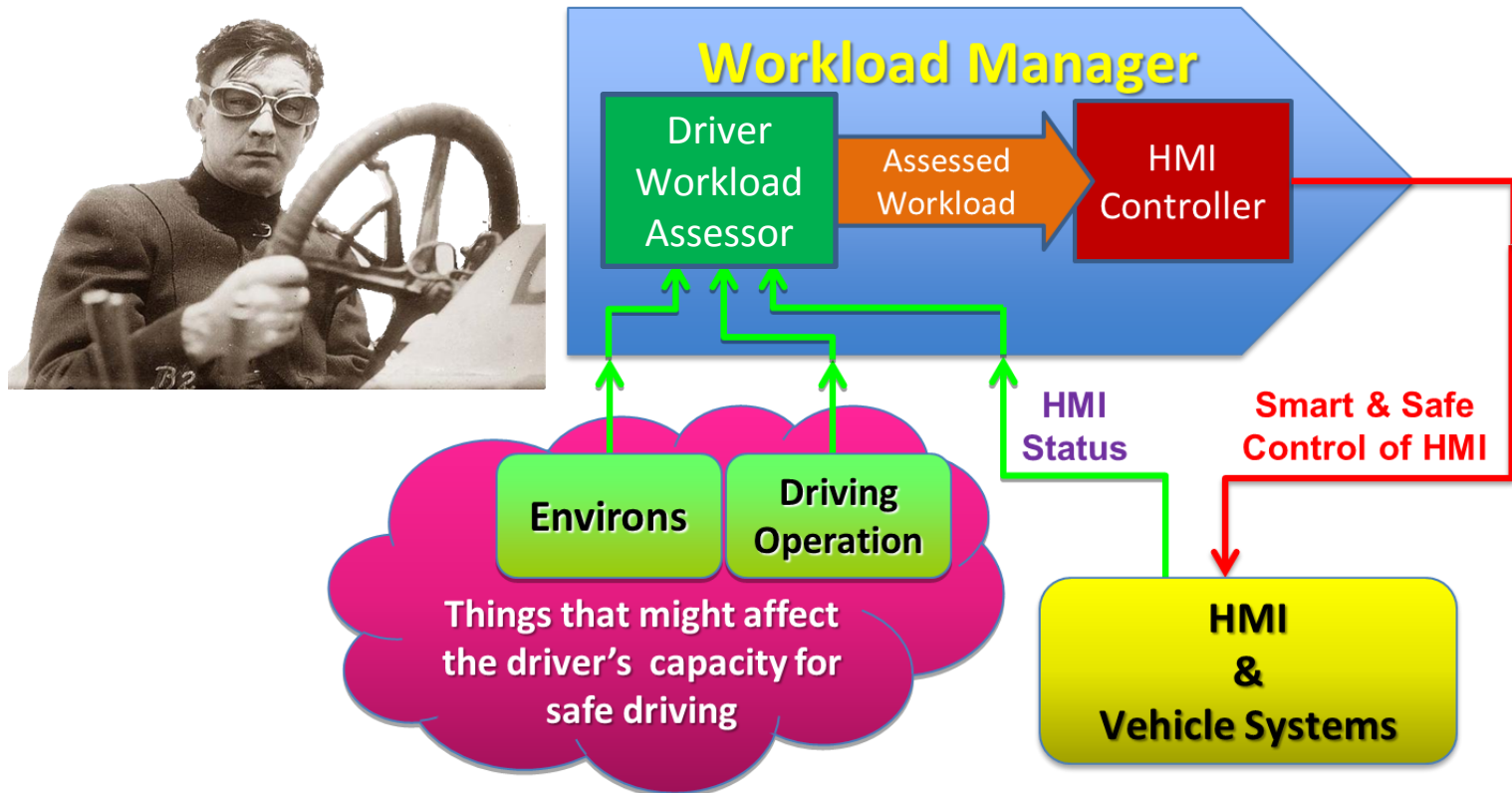
- To maximise Customer Contentment within an ethos of Safe-Use, access to functions must be managed according to Driver Workload



Workload Manager

Workload Assessment:

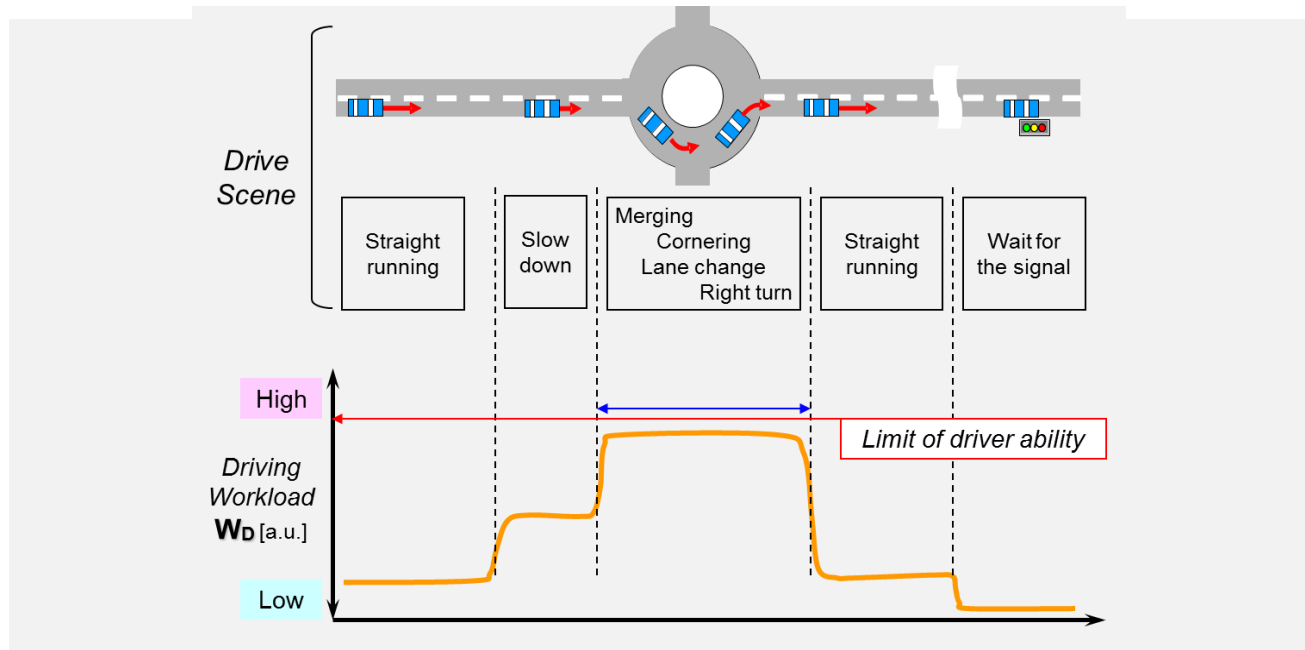
- We don't have a clever device that can directly measure the workload and the capacity to manage additional tasks
- Therefore until technology advances, we must estimate workload from other indicators.



Driver Capacity, Driver Workload & Driver Distraction

Driver Distraction, Workload and a Driver's Capacity:

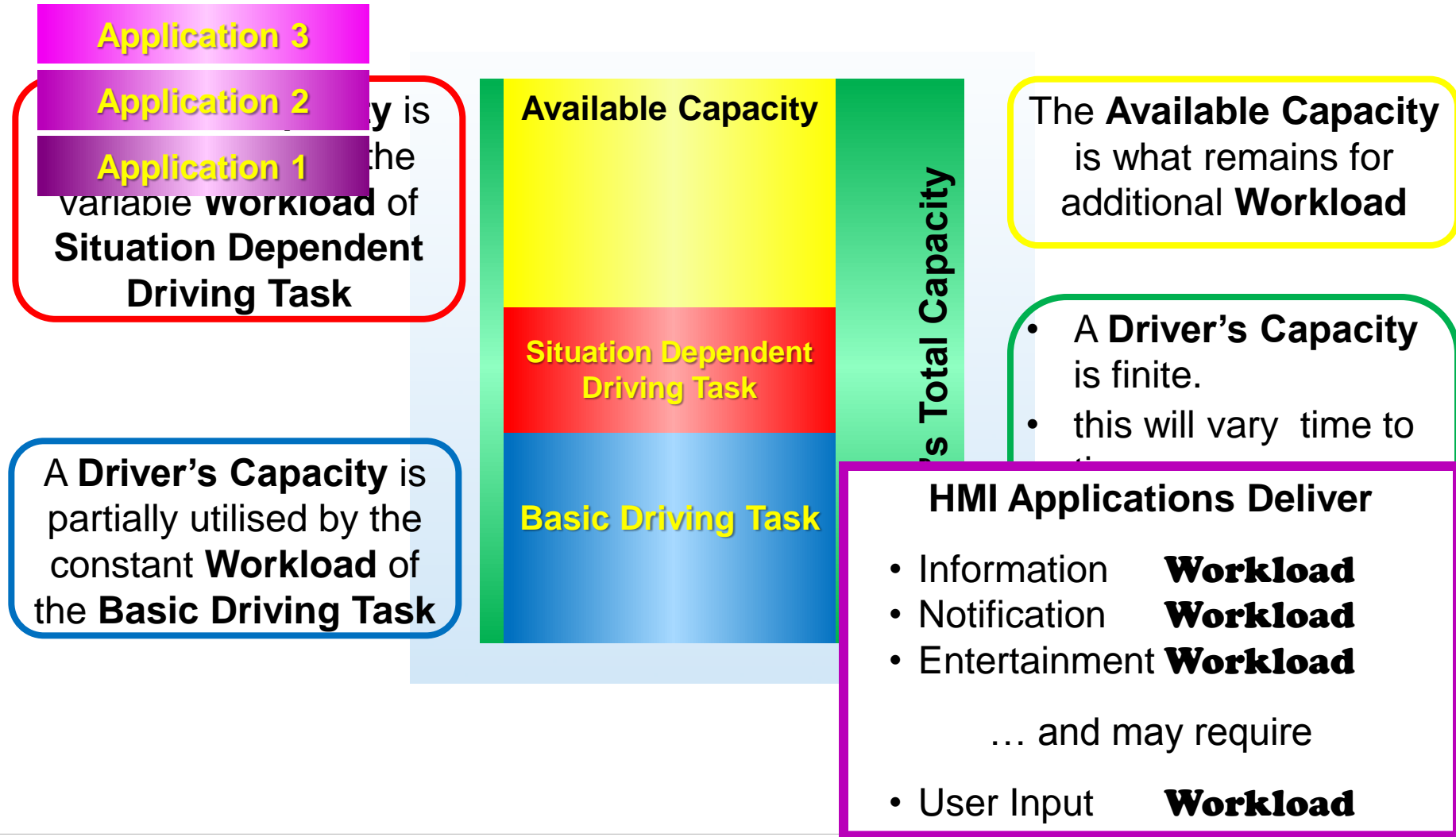
- Driver Distraction and High Workload are often viewed as the same thing.
- They both contribute to the same problem but are different factors.
 - A driver will have a finite **Capacity** to undertake Physical, Visual and Cognitive Tasks
 - A driver's **Capacity** will be partly taken up by the **Workload** of the **Primary Task** (Driving the Vehicle)



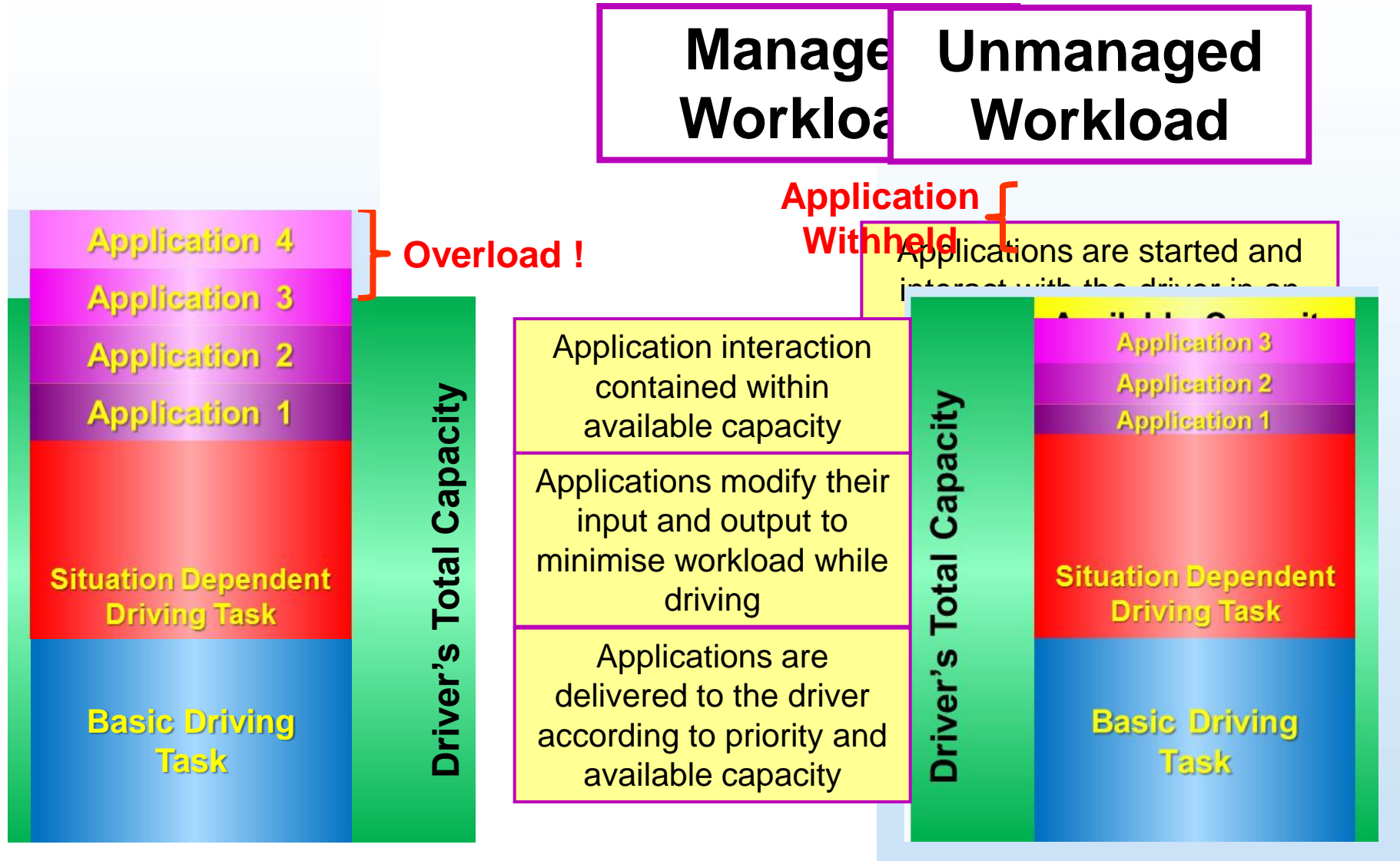
- A driver may be **Distracted** from the Primary Task by **driver distraction** .
 - **Beneficial Distractions** (such as informative warnings)
 - **Unhelpful Distractions** which only distract the Primary Task of Driving (such as texting, using a cell phone)

The Driving Task & Capacity for Distractions

The Driving Task & Capacity for Distractions :



Management of Workload



Workload Management in a GENIVI Architecture

Workload Management in a GENIVI Architecture

- A workload manager has 2 key functions

- **GENIVI Driver Workload Assessor**

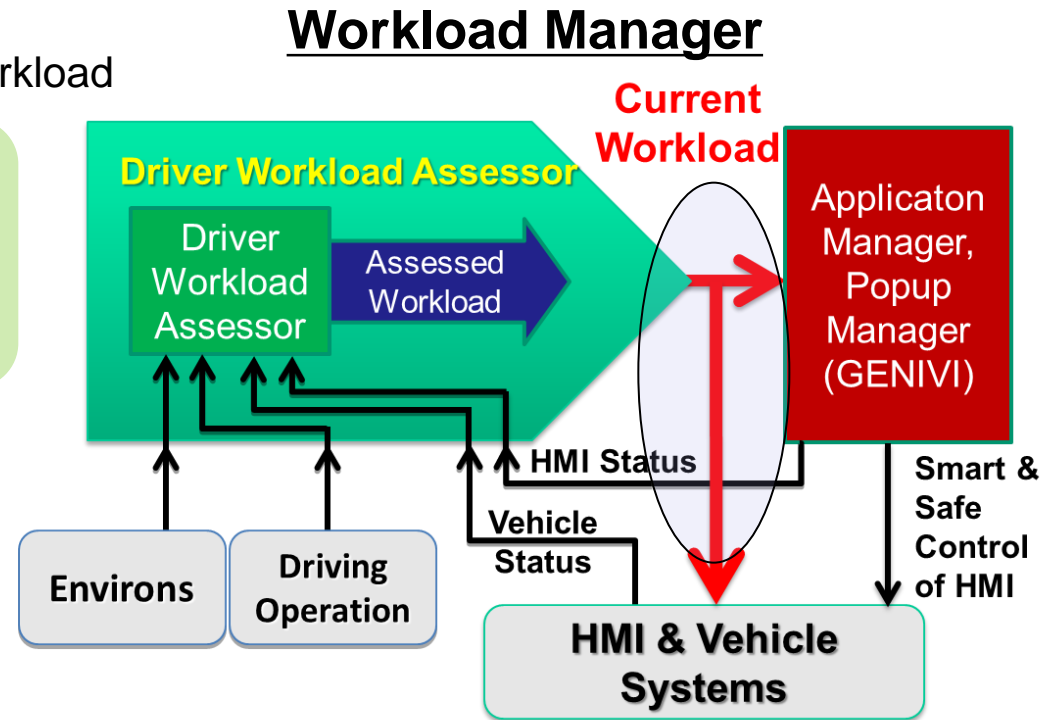
To assess the current level of driver workload

- Monitoring available input sources
- Assessing current workload
- Providing a rating of current workload to be used by HMI Control and Apps

- **GENIVI Application Manager, Popup Manager**

To control the HMI to support but not overload the driver

- Prioritising Information
- Withholding Applications/Information
- Instructing Applications to adopt a “Driving Friendly” HMI mode



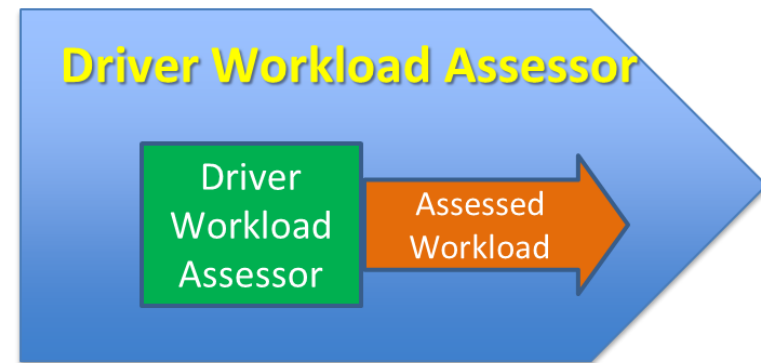
Defined the interface between Driver Workload Assessor and Application/Popup Manager

Workload Level definition of GENIVI Driver Workload Assessor

Assessed Workload

Definition of Assessed Workload Levels:

- In order that HMI may be managed we need to define levels of Driver Workload.
- It is important to make a definition of the levels of workload to which a driver is subject that:



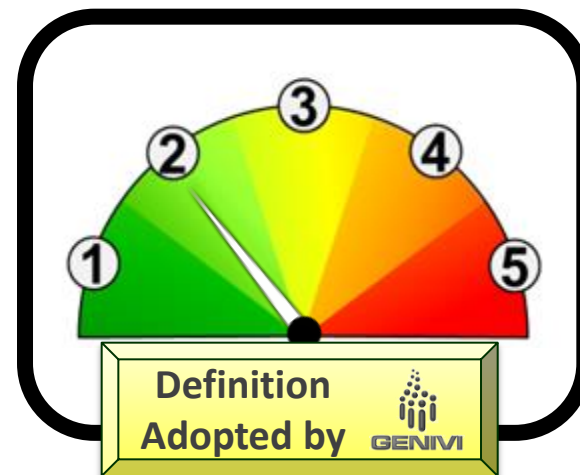
- Offers Consistency of Workload Assessment
- Provides a useable number of Workload Levels
[Enough to discriminate, Few enough to avoid confused HMI control]
- Clear definition of each Workload Level for use by developers of Automotive Apps and HMI Control software

Definition of Assessed Workload Levels

- Definition of Workload Levels that meets these criteria :

5 Levels are considered optimum

- Enough to discriminate
- Few enough to avoid confused HMI control



Workload Level

5

Workload Extremely High: *At or beyond the driver's capacity for safe control of the vehicle. No capacity for any additional tasks.*

4

Workload High: *Little spare capacity. Level of effort allows little capacity for additional tasks without compromising the driving task*

3

Workload Moderate: *Enough spare capacity for some tasks that have been optimised for the driving situation. Unlimited additional tasks cannot be accommodated*

2

Workload Low: *Sufficient spare capacity for attention to additional tasks that do not demand continual concentration*

1

Workload Insignificant : *Zero or almost zero driving workload with enough spare capacity for all desirable additional tasks*

Application Response to Workload

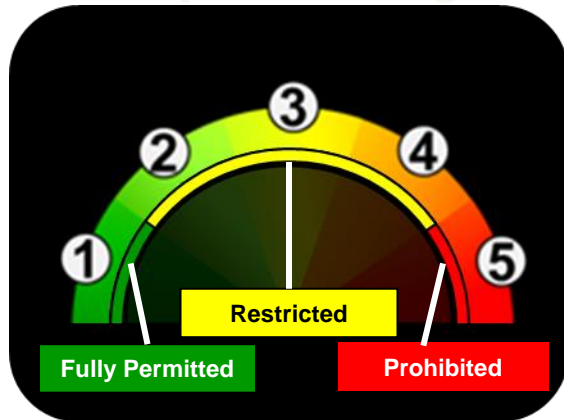
Application Response to Workload:

- Not all applications require the same level of attention from the driver
- Therefore different applications may be permitted or restricted at different levels of workload

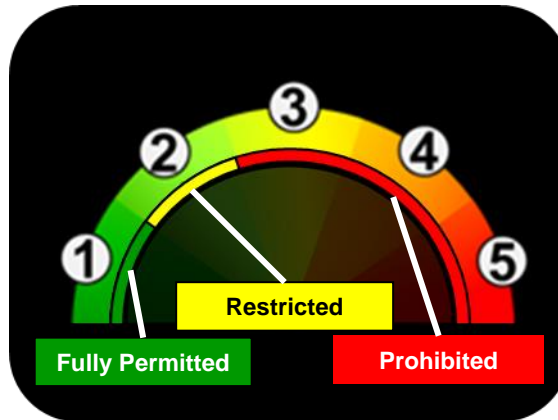
It is envisaged that:

- An application will normally use 3 states for operation / information provision
 - **Prohibited** / Highly-Limited information
 - **Partially Permitted**
 - **Fully Permitted**
- Segmentation of workload level will differ according to application

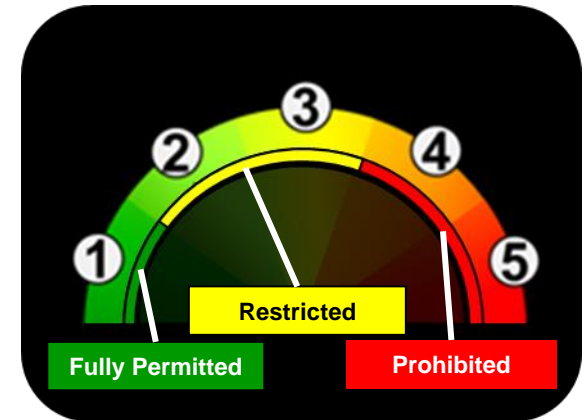
Examples of Segmentation



Application A
Low additional loading



Application B
High additional loading

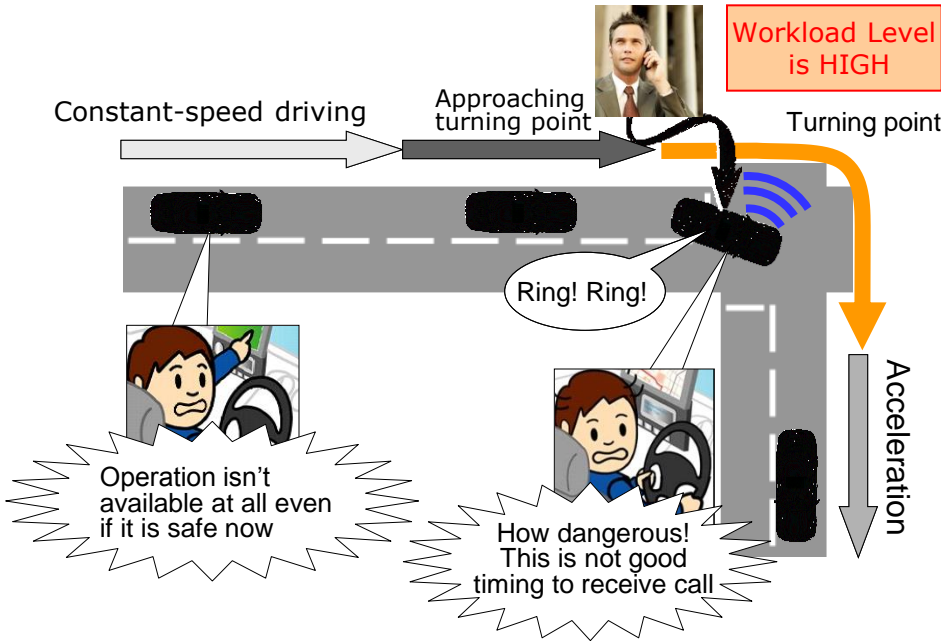


Application C
Moderate additional loading

Workload Management Use Case

Workload Management Use Case

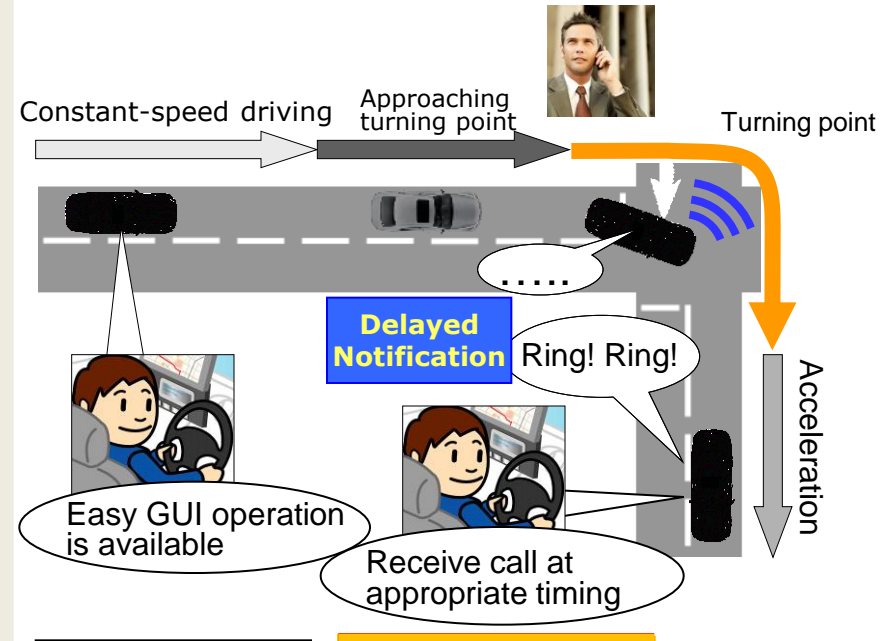
Without Workload Manager



Speed	Moving
Phone App	Fully Permitted
User Input	Prohibited

Conventional HMI operation permission based on state(MOVING / STOPPING)

With Workload Manager

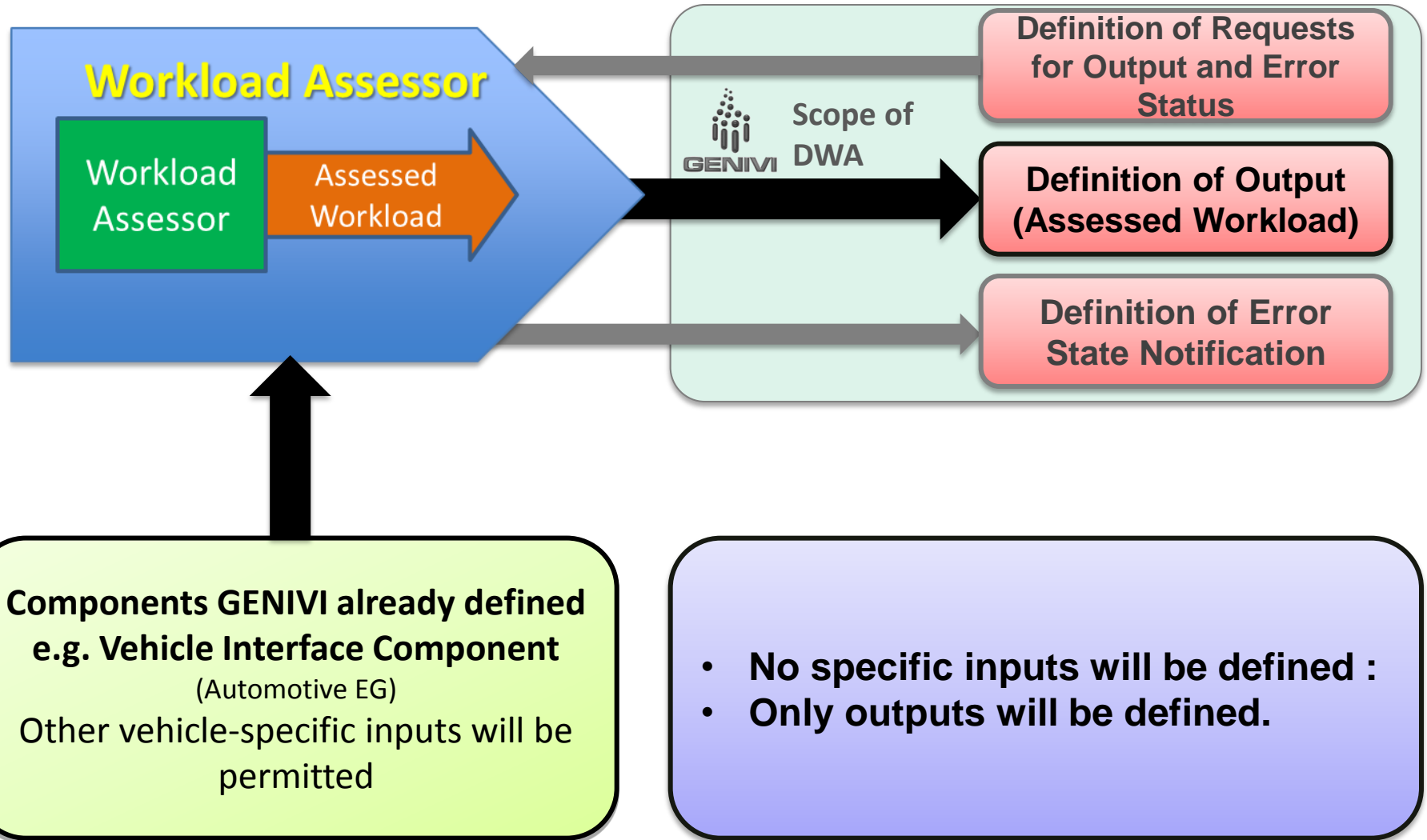


Workload Level	3 Mid
Speed	Accel
Phone App	Fully Permitted
User Input	Partially Permitted

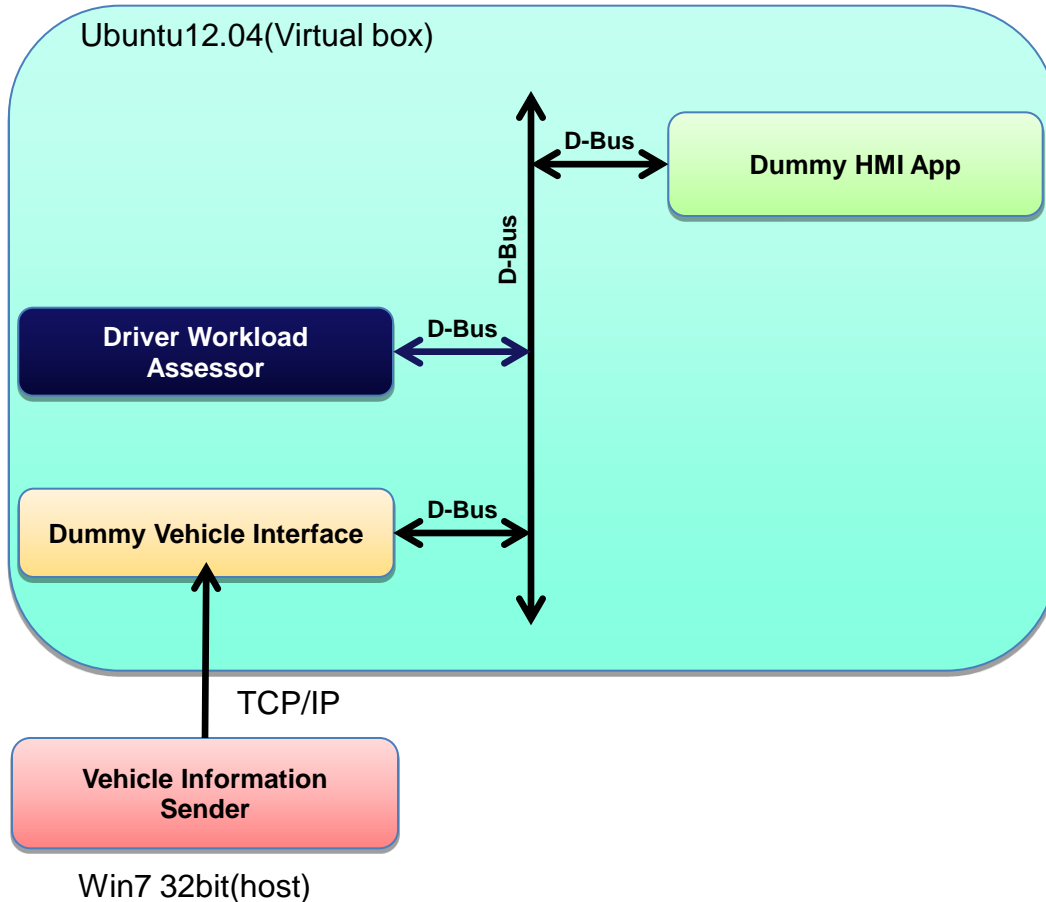
Flexible HMI behaviour control based on driver's workload level

GENIVI Driver Workload Assessor Demonstration

Scope of GENIVI Driver Workload Assessor



Architecture of Driver Workload Assessor Demonstration



Driver Workload Assessor

Simple Workload Assessor Component to demonstrate output of workload in response to input. **GENIVI Compliant**

Ubuntu12.04 (Virtual box)

Linux Environment to run Workload Assessor

Dummy Vehicle Interface

Dummy Component to act as GENIVI Vehicle Interface Provides vehicle signals to DWA

Vehicle Information Sender

Vehicle Information Sender Simple application to simulate vehicle signals used in Simple DWA algorithm

Dummy HMI App

Dummy HMI Application {for this demonstration of the POC} to visually demonstrate App response to DWA output

Demonstration

The screenshot displays a virtual machine environment with the following components:

- Ubuntu12.04 [Running] - Oracle VM VirtualBox**: The main window title.
- Machine View Devices Help**: The menu bar.
- DWA_Dummy_App**: The application title bar.
- DriverWorkloadLevel**: A central application window featuring a gauge with levels 1-5. The needle points to level 4. Text below the gauge reads: "Level: 4", "ErrorState: Initial state", and "Speed: 84". An "Update" button is at the bottom.
- Vehicle Information Sender**: A utility window on the right with "Connect" and "Stop" buttons. It shows "Sending the Vehicle Info..." and controls for "Vehicle Speed (km/h)" (set to 84) and "Steering Angle (deg)" (set to 0). It also has "Turn Signal L" and "Turn Signal R" buttons, both set to "ON". A text area at the bottom displays "Data being sent to the receiver" with hexadecimal data for VehicleSpeed, SteeringAngle, LeftTurn, and RightTurn.

Conclusions

- **To safely manage HMI, IVI should be controlled according to Driver Workload.**
- **GENIVI adopted 5-level definition of driver workload.**
- **GENIVI Driver Workload Assessor allows the application developers to provide “safer” applications.**

Thank you
Questions?

DENSO