How to create a consistent connected vehicle user experience with multimodal HMIs

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Agenda

- Introduction
- In-car input modalities and user expectations
- Enabling intuitive multimodal user interaction
- Model-based approach for synchronizing modalities
- Tooling to manage the complexity of creating multimodal HMIs

Our solutions for the automotive world

Infotainment software and services

- Connected navigation software
- **HMI tools for in-dash, digital instrument clusters and head-up displays**
- Global software integration and engineering services

Connected services

- Connected experiences around urbanization and electrification
- Online diagnostics
- Software and content updates

Car Infrastructure software and services

- EB tresos – integrated ECU software and tools, based on AUTOSAR standards
- Complete solutions for: basic software, functional safety, automotive security
- Test & Analyzing solutions
- Functional Safety consulting

Driver Assistance software and services

- Software development for driver assistance functions
- Electronic horizon and test drive recording solutions
- Driver Assistance modules and algorithms

In-car input modalities and user expectations

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Interaction modalities for the driver

- **“Hard” buttons**
- **Push rotary button**
- **Touch screen and touch “soft” buttons**
- **Gesture on screen or in space**
- **Interaction by voice**

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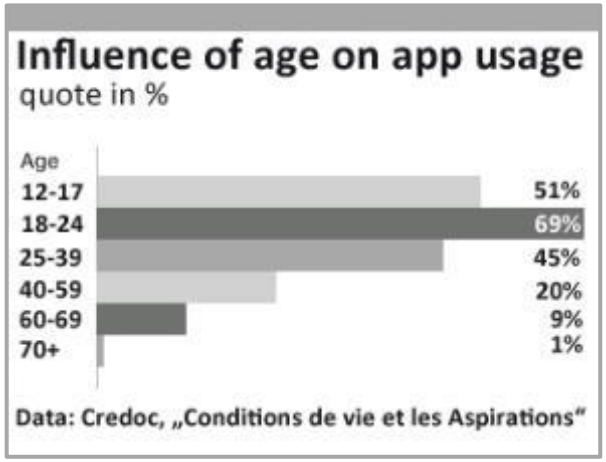
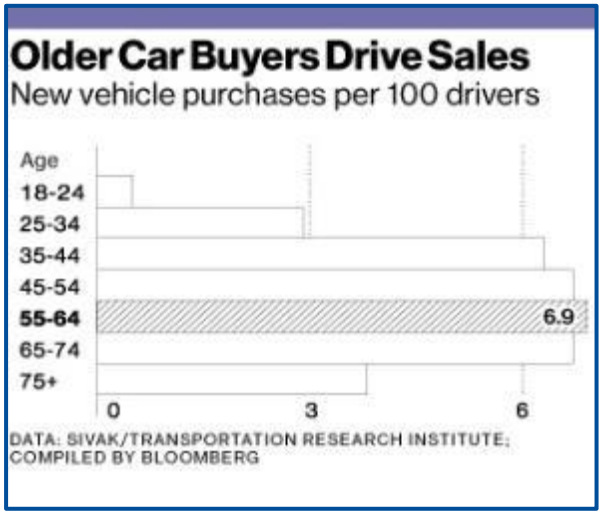
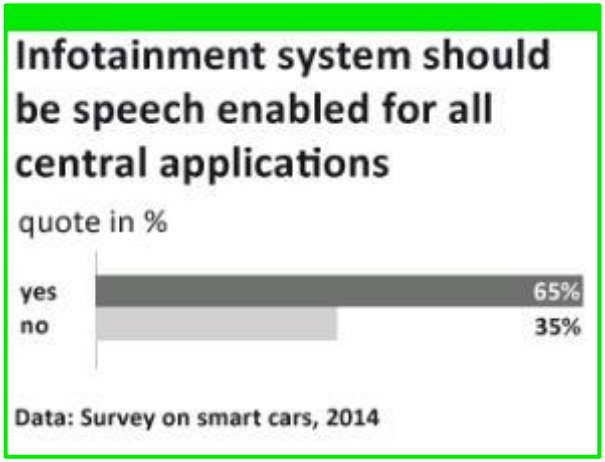
User expectations







Many car buyers have low affinity to technology and expect intuitive interaction (Natural Language Understanding, …)

Enabling intuitive multimodal user interaction

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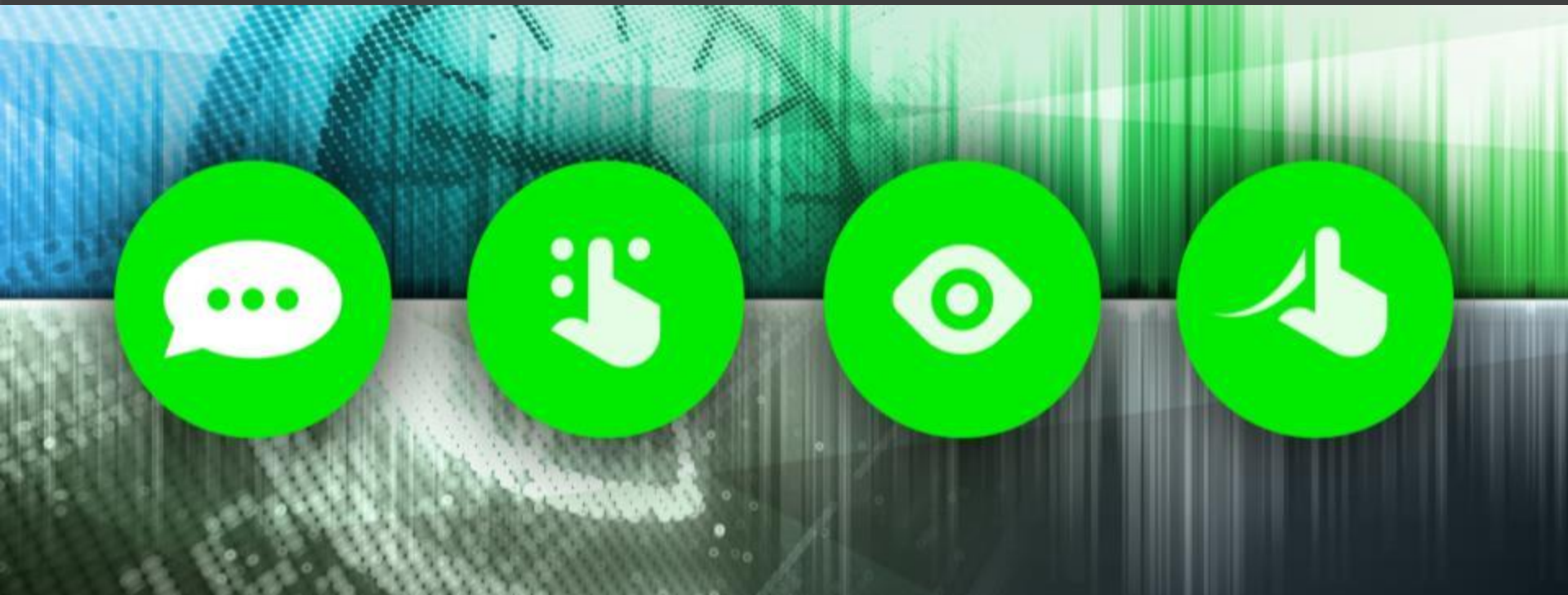


Multimodal User Interaction

Touch/ Haptic only

Multimodality
(each step via speech, touch or haptic)

Speech only

I need to go to an ATM on my way.

Workflow example "Driving to an ATM"

1. Open navigation
2. POI search menu
3. Select "along the route"
4. POI category "ATM" input
5. Select as new destination

Multimodal User Interaction towards NLU

Touch/ Haptic only

Multimodality
(each step via speech, touch or haptic)

Speech only

I need to go to an ATM on my way.

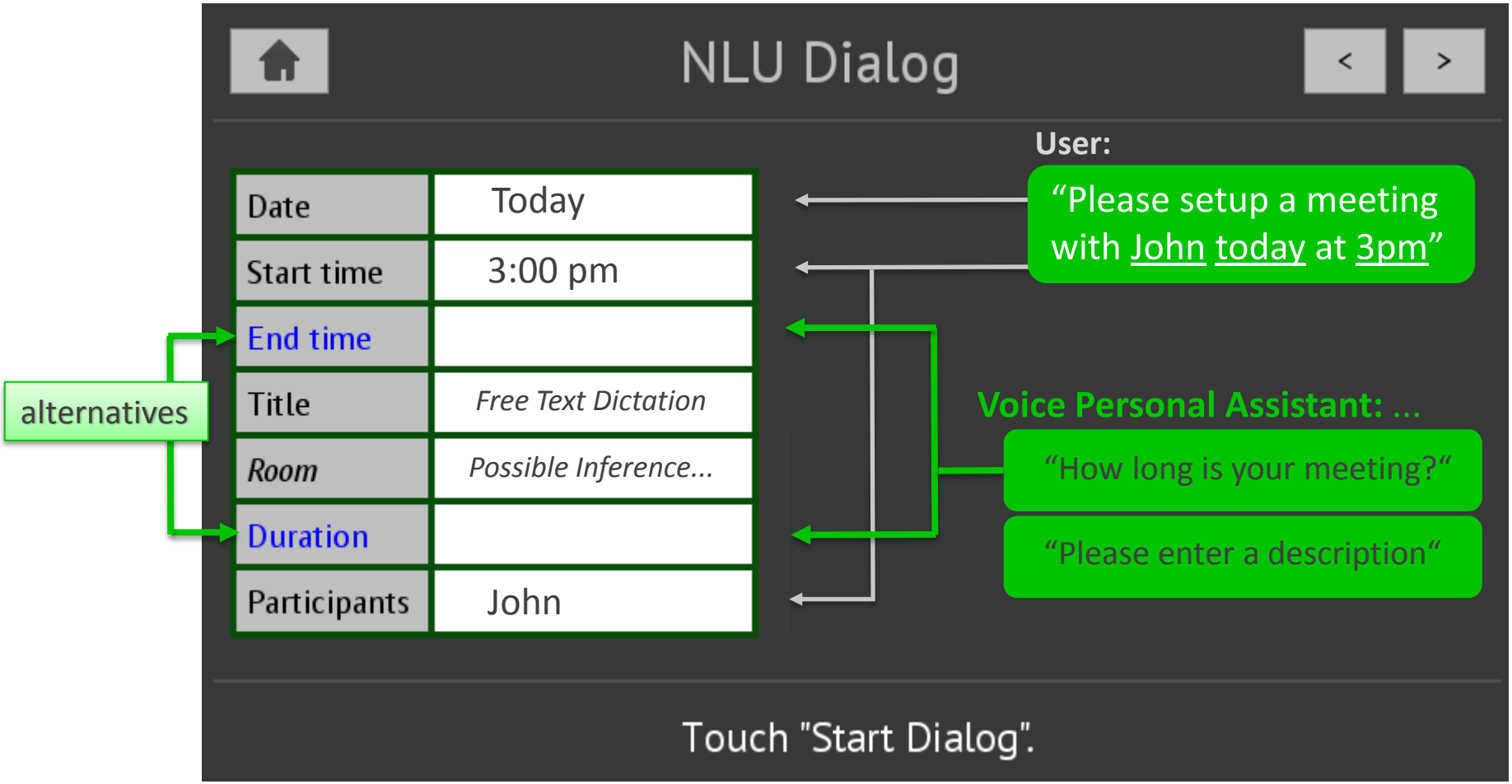
NLU Workflow "Driving to an ATM"

1. Intent: navigate
2. When: now
3. Location: ATM (POI)

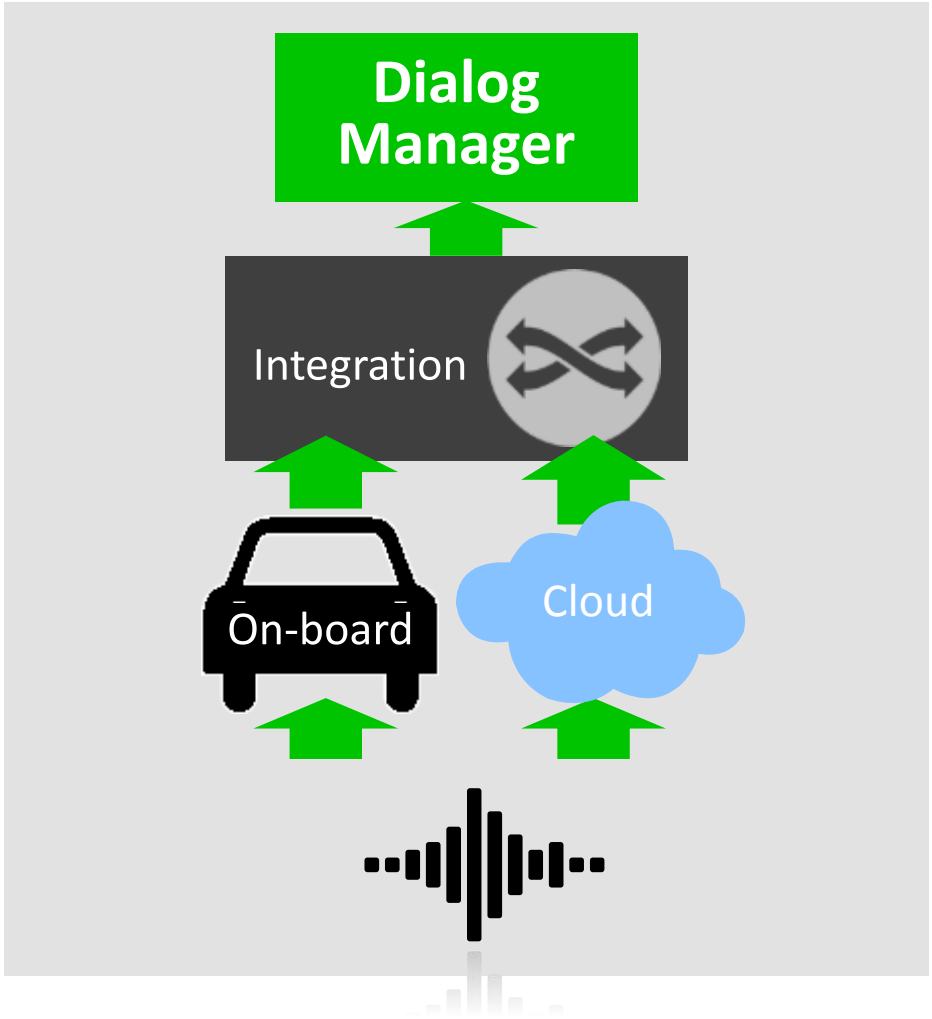
→ React on intent

Personal Voice Assistant – user view

Personal Voice Assistant – behind the surface



Hybrid NLU Speech Dialog Systems



- **Best of both worlds - embedded & cloud-based results integrated**
- **Guarantees recognition availability**
- **On-board can be fallback solution in case cloud is not available**
- **Cloud can supplement the onboard functions**
- **Smartphone - third factor handled per voice**

Model based approach for synchronizing modalities

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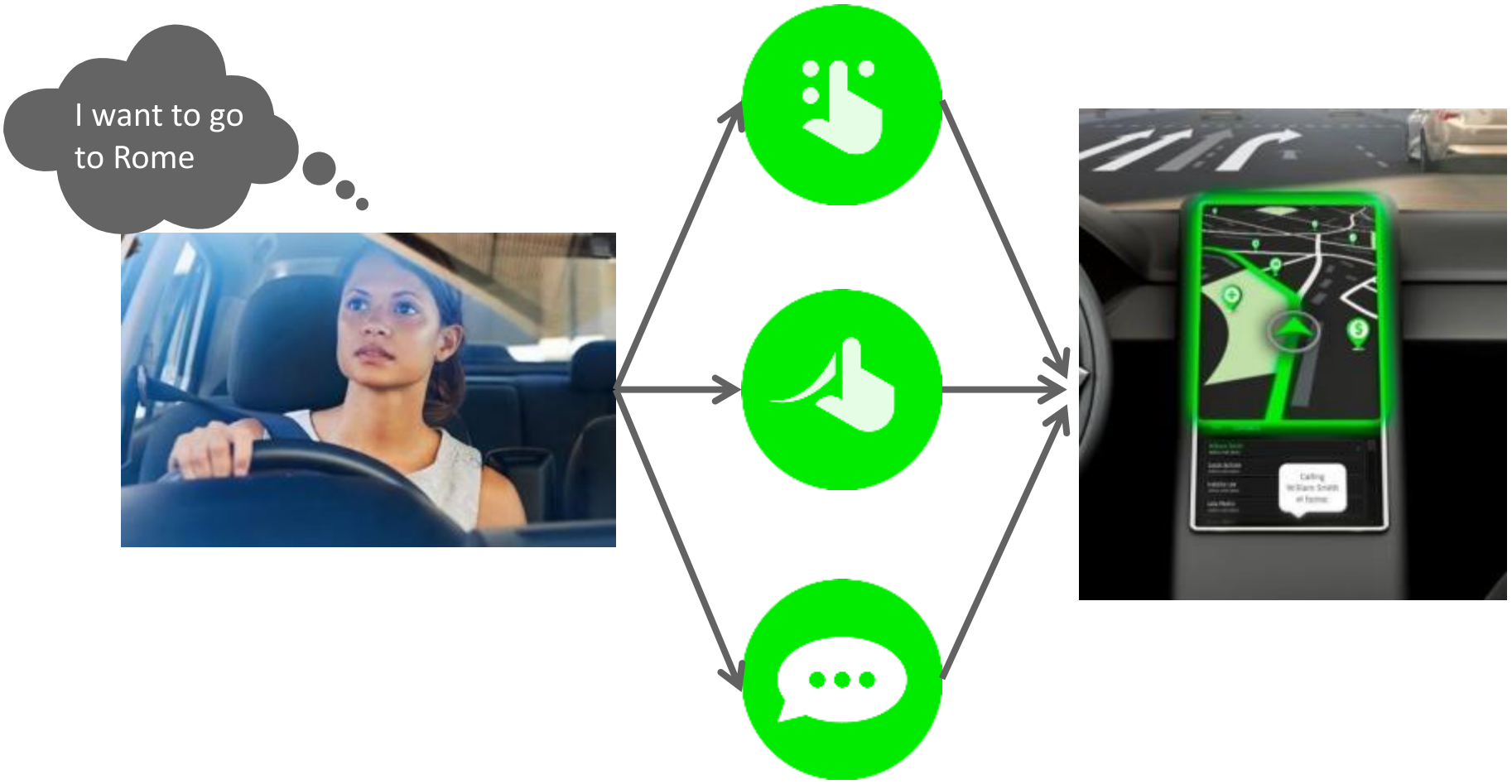
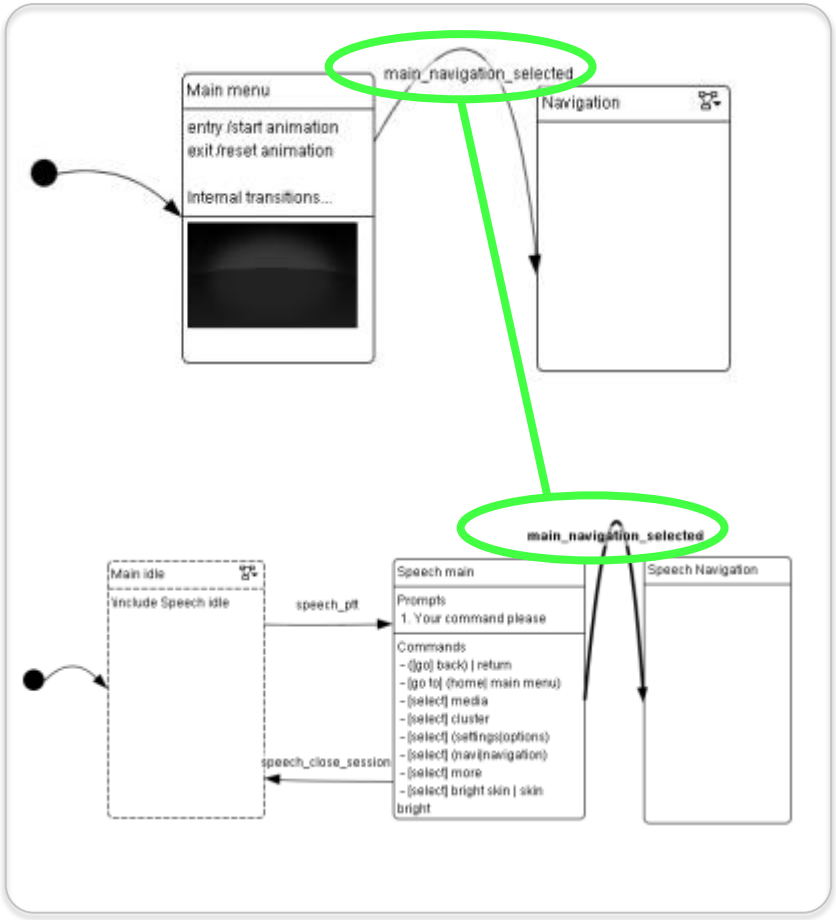
All modalities lead to Rome



Synchronizing modalities using state machines



State machines for modeling workflow

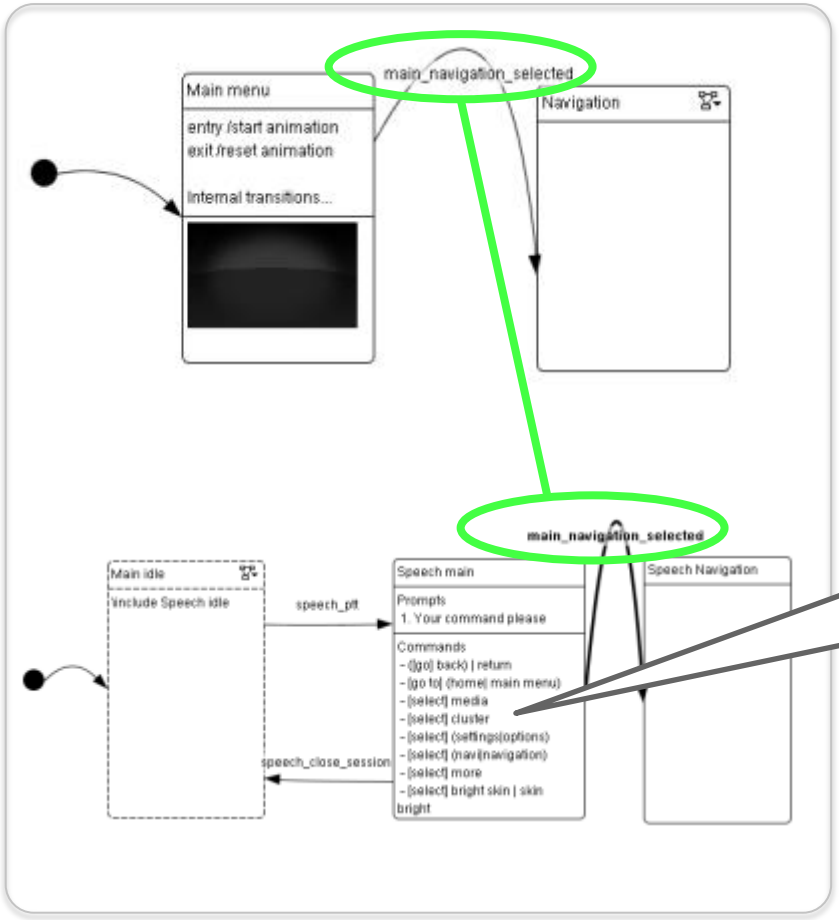
Support of multiple state machines, one for every modality

Same concepts for graphical and voice user interface can be used

Graphical and voice user interface synchronized via events

Events trigger transitions in the state machines

Synchronizing modalities using state machines



State machines for modeling workflow

Support of multiple state machines, one for every modality

Sa… d vo… d

Graphic… …nterface synchronized via events

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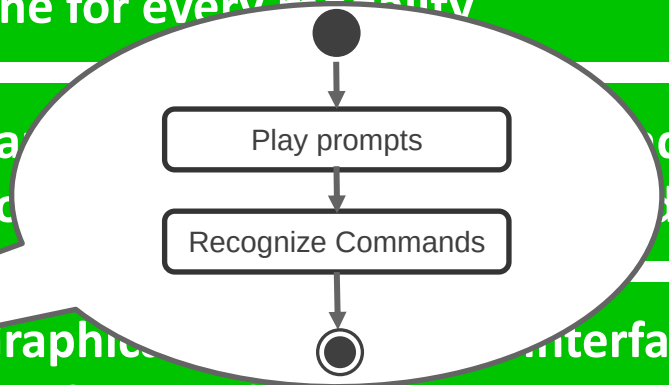

Tooling to manage the complexity of creating multimodal HMIs

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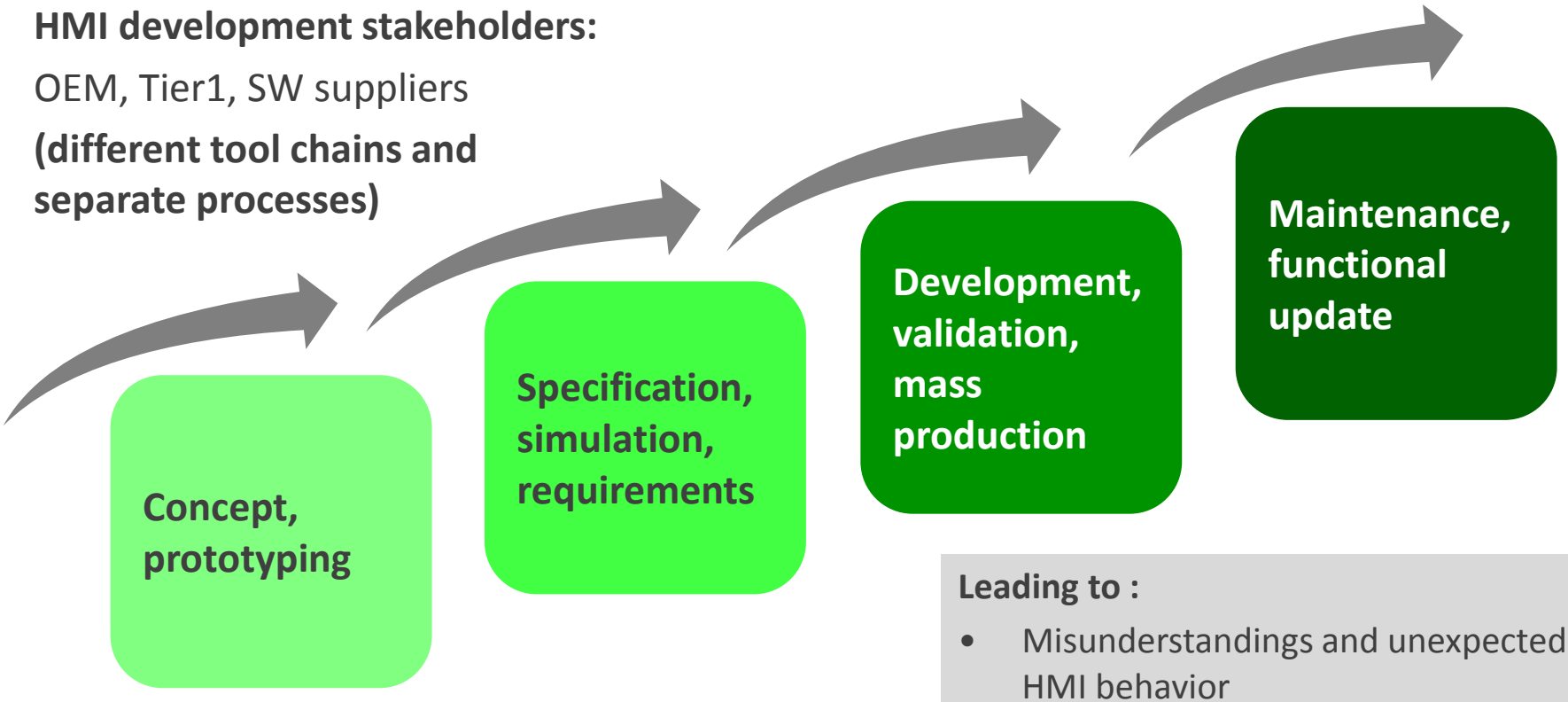
Mastering HMI development – traditional approach

HMI development stakeholders:

OEM, Tier1, SW suppliers

(different tool chains and separate processes)



Leading to :

- Misunderstandings and unexpected HMI behavior
- Time-consuming development loops and challenging optimization cycles
- Performance troubles

Mastering HMI development – tool-based approach

HMI development stakeholders:

OEM, Tier1, SW suppliers

(different tool chains and separate processes)

HMI development from user-concept to series product with a

continuous tool chain and an integrated process.

=> reuse of working results/complete HMI for other models and brands

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