

NDS.Live

NDS Conference 2021— Jun 8, 2021



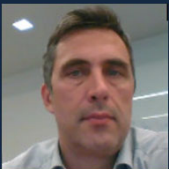
Navigation Data Standard

Speakers



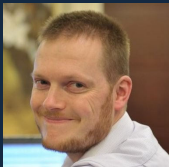
Dirk Spiesswinkel

Product Manager
Elektrobit



Boris Gumhold

Senior Manager, Engineering
HERE Technologies
Technical Chairman of the NDS Association



Nico Glorius

Product Manager
NavInfo (Europe) B.V.
Vice Chairman of the NDS Association



Christian Schneider-Wieland

Product Manager
TomTom



Michael Westphal

Principal Architect
Harman



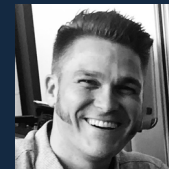
Frank Aurich

Software Engineer
JOYNEXT



Ottó Nyíró

Product Manager
NNG



Fabian Klebert

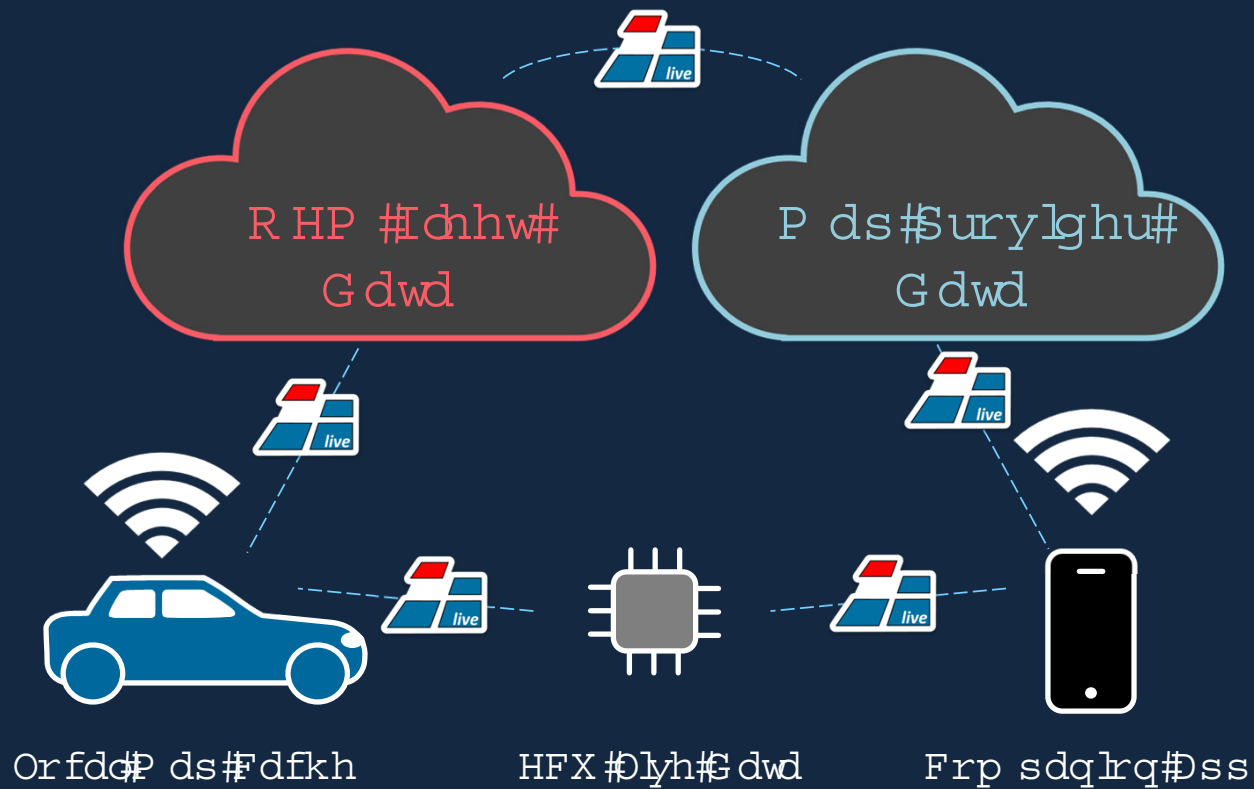
Technical Coordinator
NDS Association

NDS.Live - Basics



*“NDS.Live is not a database,
it is a distributed map data system”*

NDS.Live Design Considerations – One language for the whole ecosystem



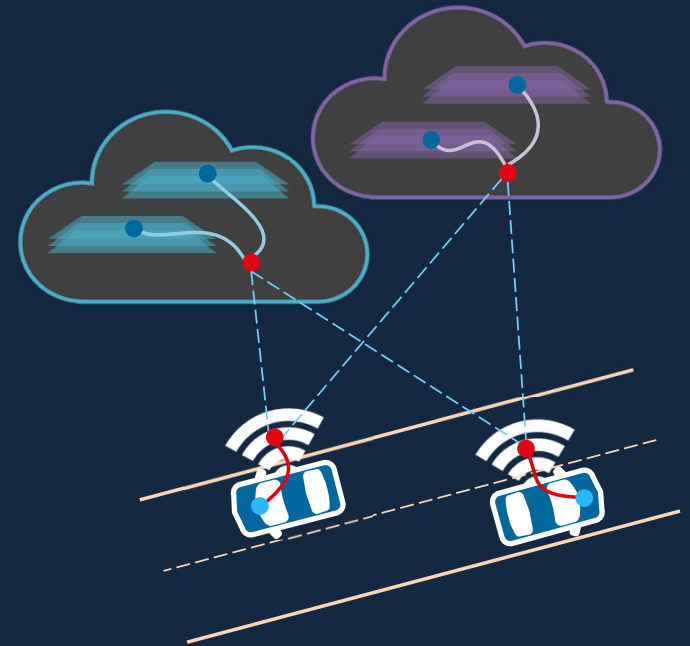
NDS.Live Design Considerations – Services

NDS.Live defines ...

... **service interfaces** to retrieve map data

... from **data layers** in ...

... data **containers**



NDS.Live SmartLayer - Scalability



ISA only



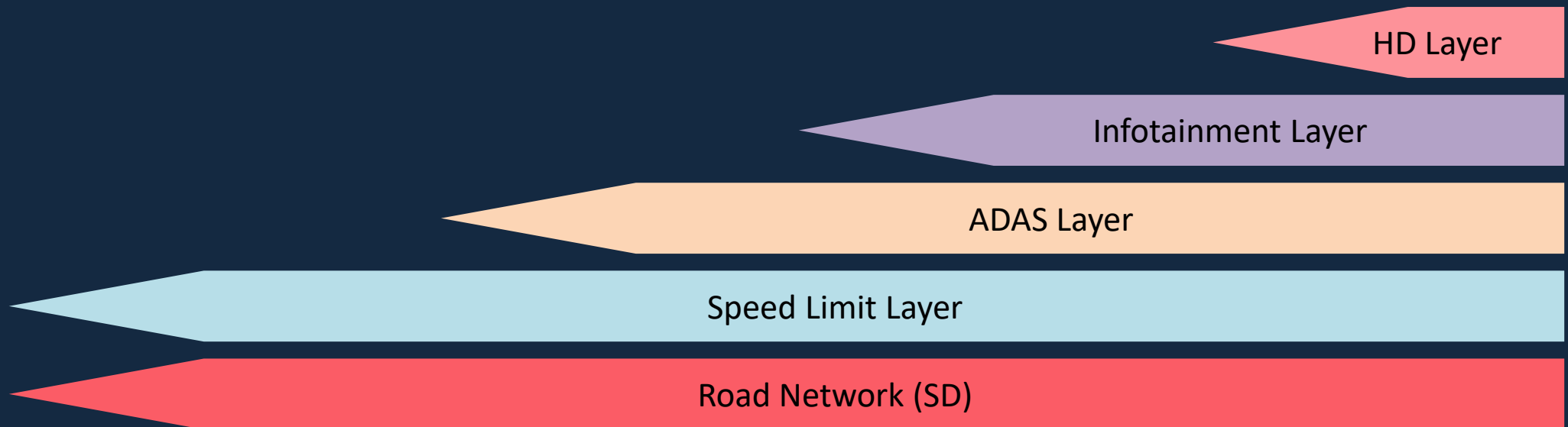
ADAS



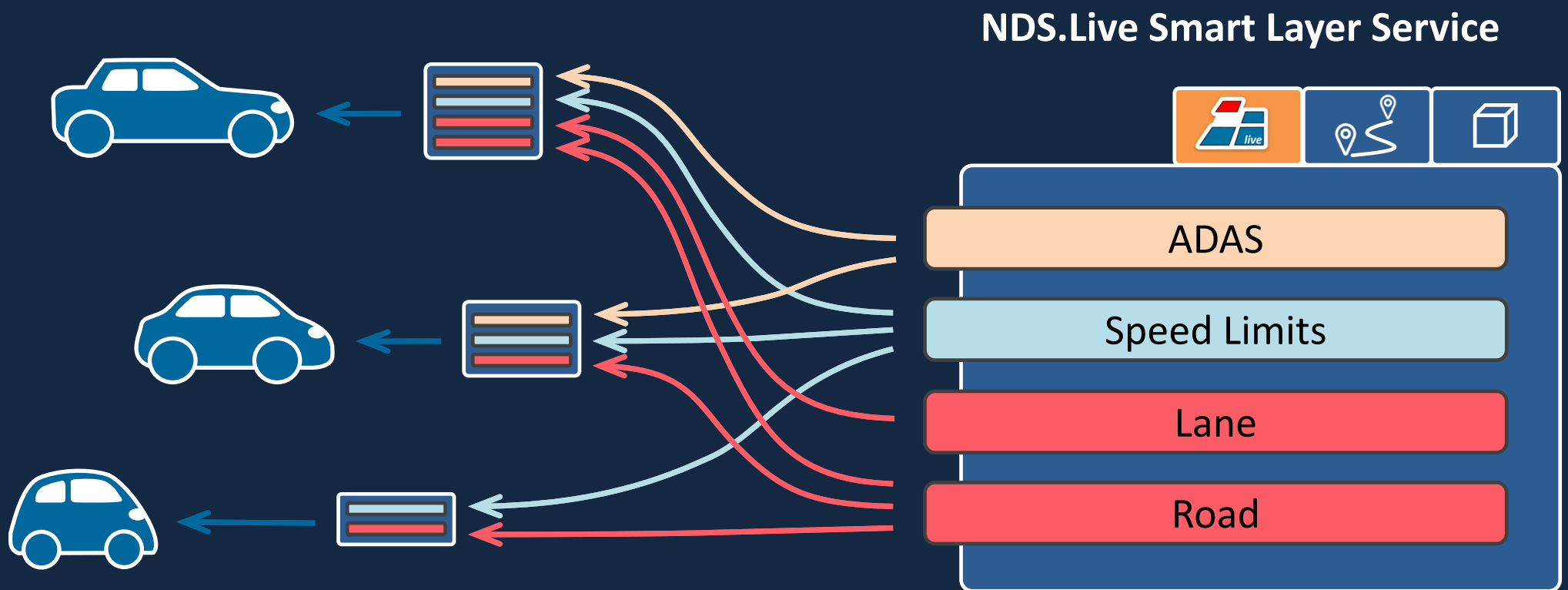
Infotainment



HAD



NDS.Live SmartLayer – Configuration flexibility



NDS.Live SmartLayer – Data Containers

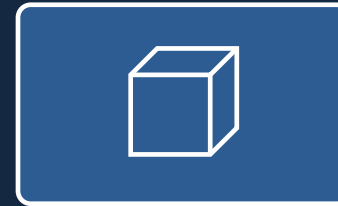
SmartLayer data containers



Tiles



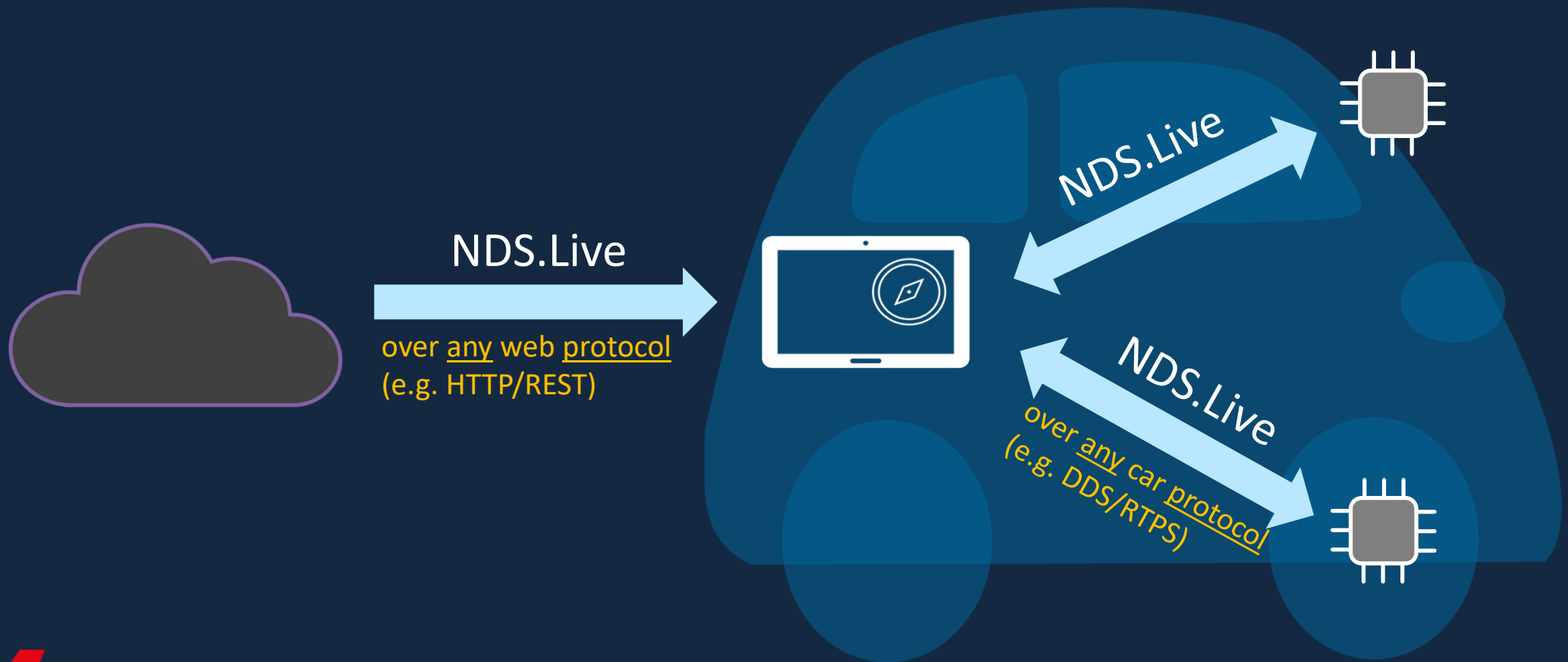
Paths



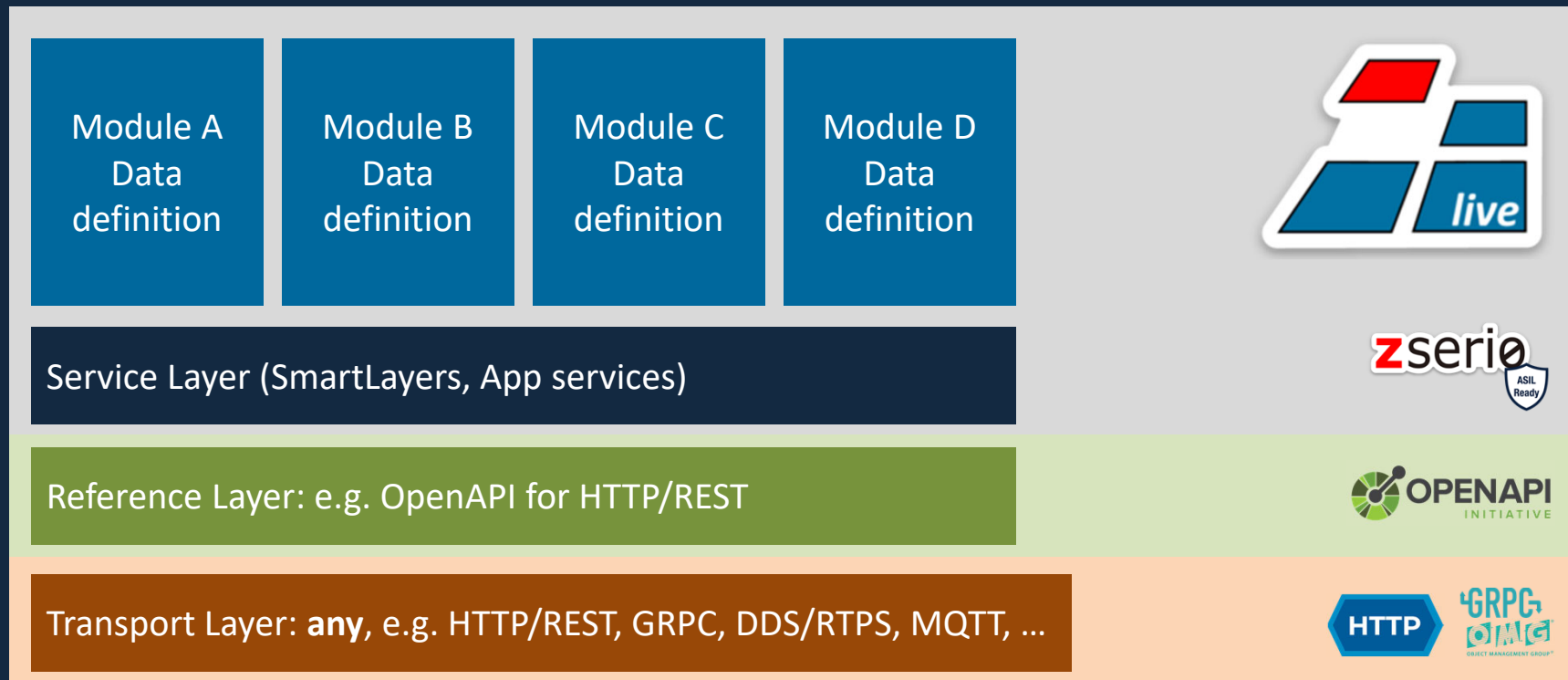
Objects

Application service specific (e.g. Route, Horizon, Metadata, etc.)

NDS.Live – Not tied to any transport protocol



NDS.Live – Architecture



More technical details – NDS.Live webinar series

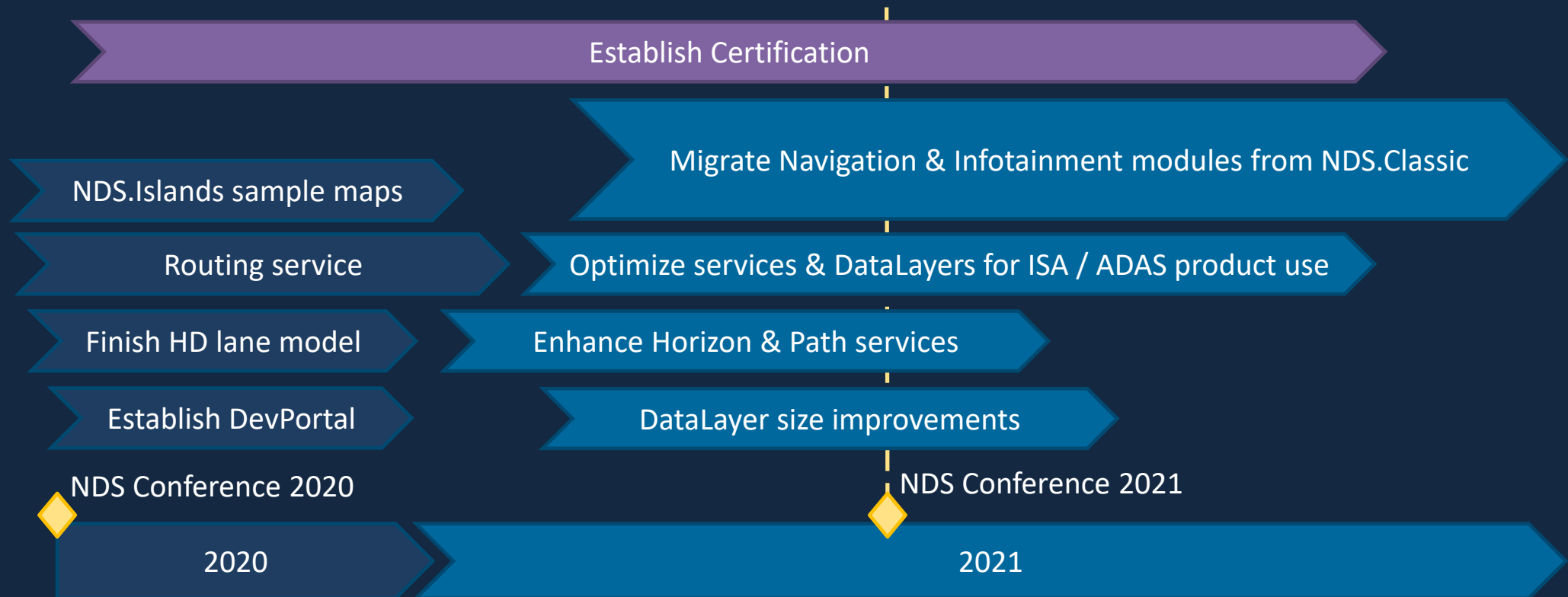
First four editions focused on ISA use case
... and explain technical concepts in more detail

Recordings available on NDS YouTube channel:

<https://nds.to/youtube>



NDS.Live – Progress & 2021 plan



Tools – Supporting NDS.Live development

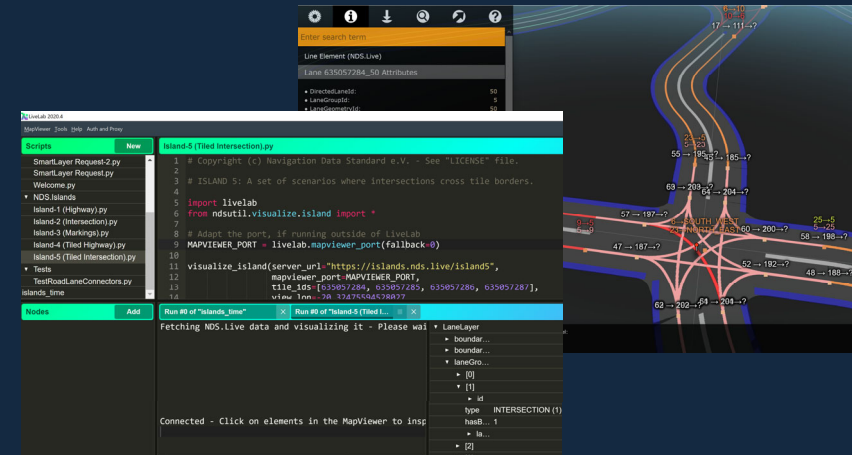
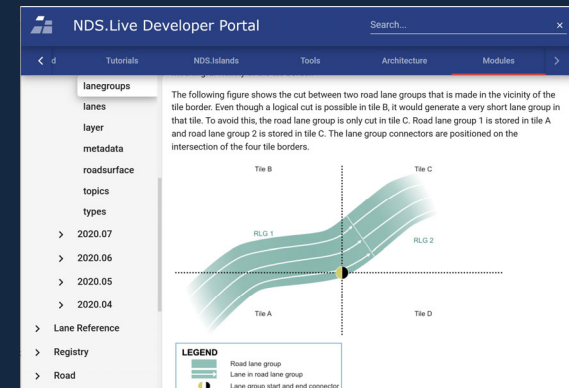
NDS.Live development is supported by

... **LiveLab** (NDS.Live IDE & MapViewer)

... **Developer Portal** (documentation, tutorials)

...Service **reference implementations**

... NDS.Islands **sample maps**



NDS.Live Development Team



SmartLayerTile



SmartLayerTile



SmartLayerTile



SmartLayerPath



Routing

Routing



Client Apps



Timeslots

- Fabian: 10 minutes
- Harman: 8 minutes
- HERE: 8-10
- NavInfo: 8 minutes
- TomTom: 10-12 minutes
- EB: 8-10 minutes
- JOYNEXT: 10-12 minutes
- NNG: 15 minutes
- Q&A: 5-10 minutes



JAVA REFERENCE ARCHITECTURE FOR NDS.LIVE

VERSION 1.5

MICHAEL WESTPHAL

NDS PUBLIC CONFERENCE
2021-06-08

JAVA REFERENCE ARCHITECTURE FOR NDS.LIVE



HARMAN supports NDS.Live

HARMAN is a **founding member of NDS e.V.** - represented on all relevant NDS committee levels.

We offer a **rich and mature portfolio of NDS.Classic based premium infotainment solutions**, supporting rawdata-agnostic global coverage, combined with quality acknowledged by dozens of successful customer projects.

This NDS.Classic foundation enables us to seamlessly **connect premium embedded and mobile client SDK with scalable cloud SDK services.**

NDS.Live allows us to utilize an **interoperable and standardized format** for a microservice based cloud solution.

HARMAN is highly motivated to actively support as part of the NDS.Live Joint Development Team in order to contribute to another chapter of the **NDS success story.**

JAVA REFERENCE ARCHITECTURE FOR NDS.LIVE



Why is there need for a Java Reference Architecture?

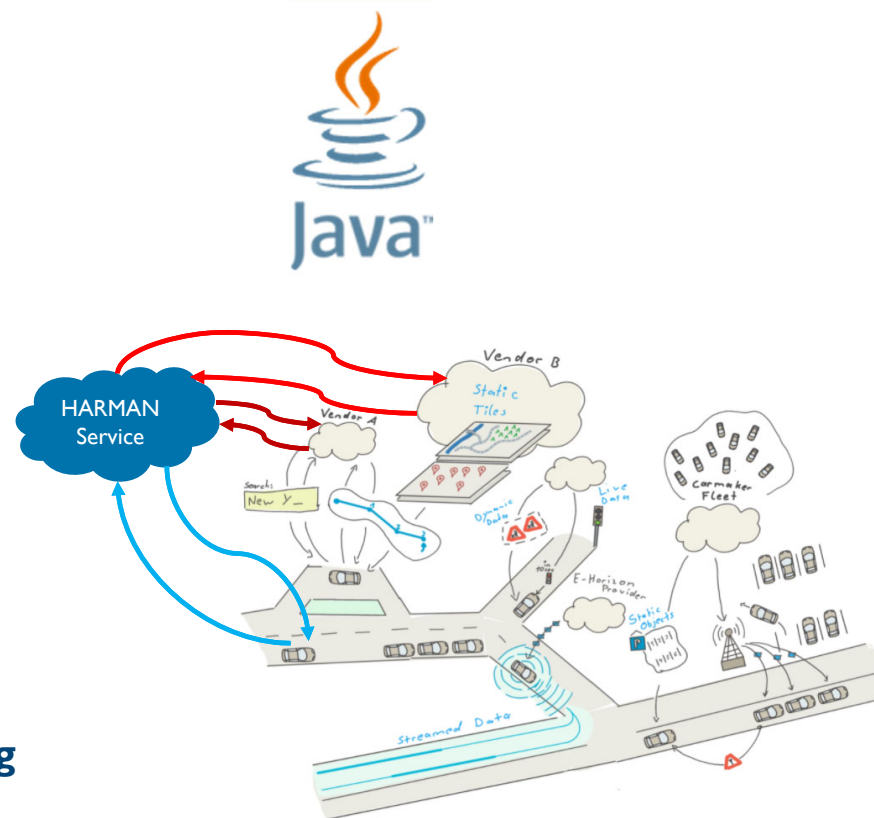
HARMAN has a **broad foundation of NDS.Classic database compiler** frameworks and compiled maps – **based on Java** technology stack.

NDS.Classic and NDS.Live coexist in synergy – leveraging NDS.Classic processing chains as one of our data input paths for HARMAN cloud services.

Those HARMAN **B2B** services are well established, serving multiple customers with **use cases on top of classic B2C**.

Cloud services allow **more freedom** than restricted embedded target devices, hence Java can be a good selection there as well.

We want to support NDS e.V. with our expertise by **contributing for Java infrastructure support** for NDS.Live!



JAVA REFERENCE ARCHITECTURE FOR NDS.LIVE

Situation regarding NDS.Live till March 2021

Scope	C++	Java	Python
Zserio code generation	+	+	+
Reference REST server https://islands.nds.live/island1/2/3/4/5 https://github.com/ndsev/zserio-service-http-python	-	-	+
Reference REST client https://github.com/ndsev/zserio-service-http-python	-	-	+
OpenAPI based generic interoperable REST client https://github.com/Klebert-Engineering/zswag	+	-	+

JAVA REFERENCE ARCHITECTURE FOR NDS.LIVE

Activities driven by HARMAN so far

Scope	Java
Zserio code generation	+
Reference REST server (compatible with Python example) https://github.com/ndsev/zserio-service-rest-java	+
Reference REST client (compatible with Python example) https://github.com/ndsev/zserio-service-rest-java	+
OpenAPI based generic interoperable REST client https://github.com/Klebert-Engineering/zswag-java	investigation & development

...continued in the NDS.Live Joint Dev Team

JAVA REFERENCE ARCHITECTURE FOR NDS.LIVE

Technology stack - requirements

Modularity

as small as possible modules with as less as possible dependencies

Easy to deploy and use

usage of well-known common approaches

REST based services

common popular technology as general communication layer for NDS.Live services

Frameworks and Tools with

- active development
- robustness
- reliability
- permissive license
- much documentation
- a big developer community

JAVA REFERENCE ARCHITECTURE FOR NDS.LIVE



Technology stack - proposals

Modularity

Apache Maven™ based modules

started 2004, Apache License 2.0, huge community and much documentation and tutorials, huge amount of 3rd party libraries available at Maven Central <https://repo1.maven.org/maven2>

<https://maven.apache.org>



Easy to deploy and use

Spring Boot  base for standalone Java applications and Docker images out of the box

born 2013 out of the Spring Framework which started 2002, Apache License 2.0, fits well into the Spring based ecosystem with many components available, one of the most popular frameworks for Java based microservices (and Java applications in common, especially for enterprise applications), huge community, much documentation and tutorials

<https://spring.io/projects/spring-boot>



REST based services

Spring Web Reactive  modern responsive web framework - providing the classical approach as well

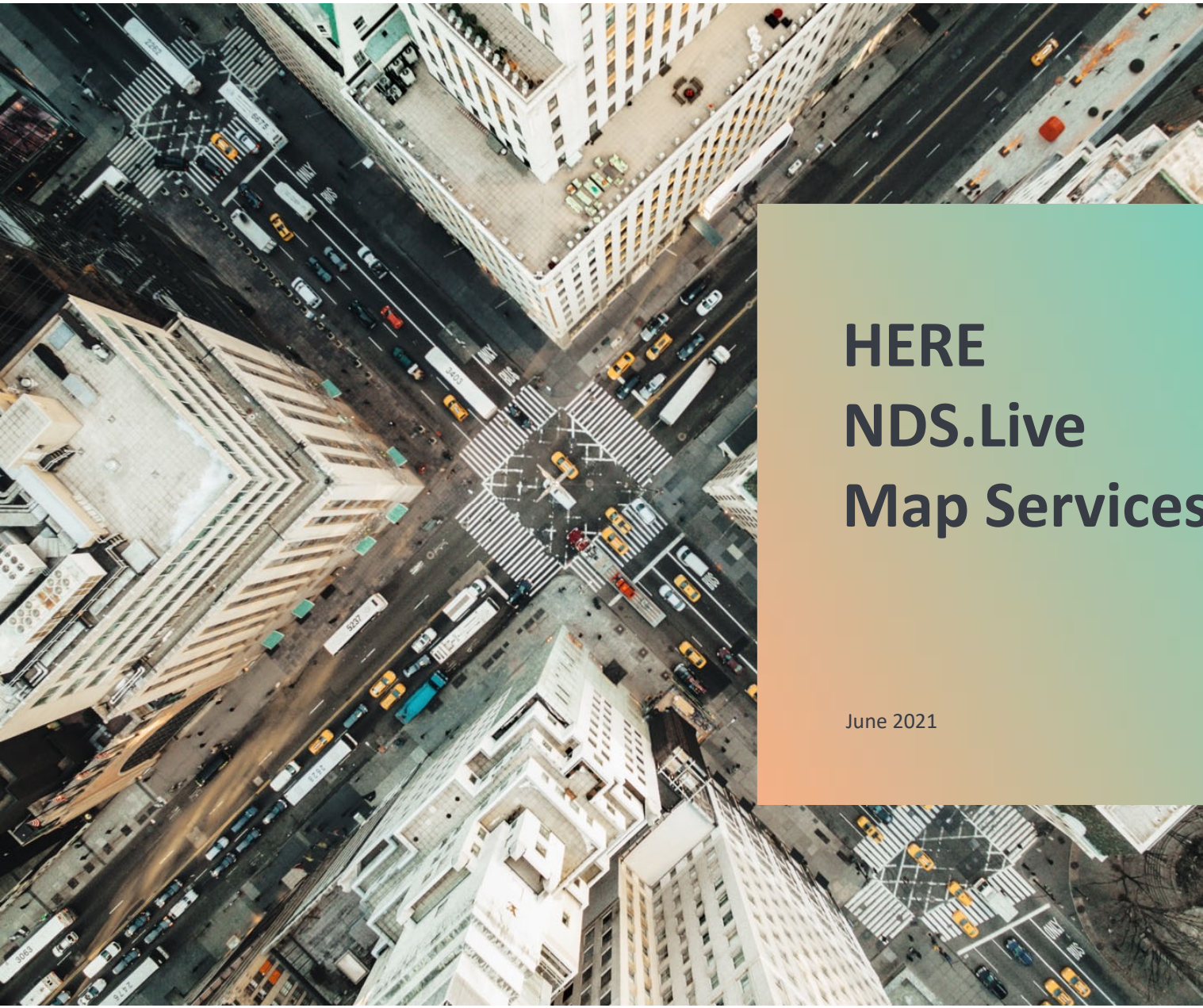
part of the Spring Framework, optimized for multi-core next generation processors and able to handle massive number of concurrent connections (in contrast to Spring Web which has a synchronous blocking I/O architecture with a one-request-per-thread model)

<https://spring.io/reactive>



THANK YOU

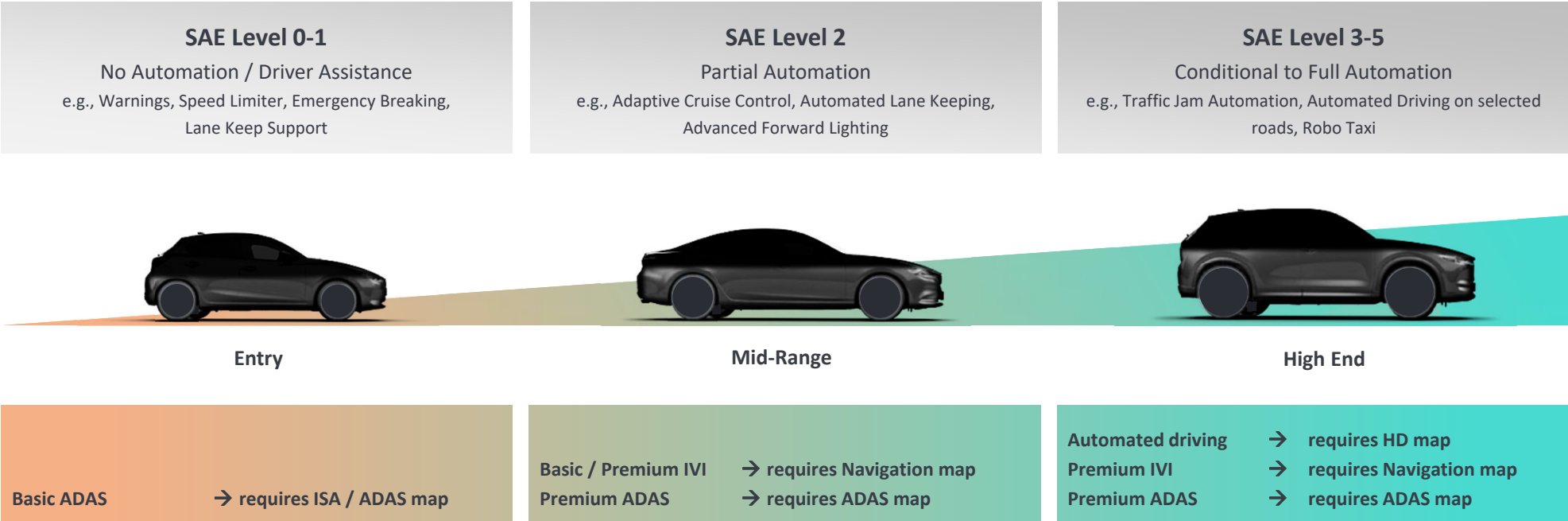
HARMAN INTERNATIONAL.
CONFIDENTIAL COPYRIGHT 2021



HERE NDS.Live Map Services

June 2021

From basic ADAS to Automated Driving

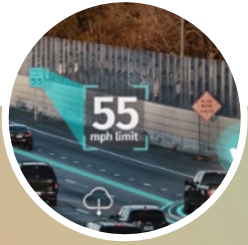


Map Content Layers

From Basic ADAS to Automated Driving

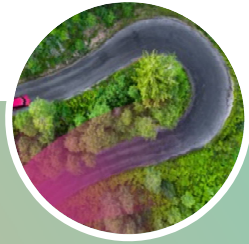


Automotive Map Products



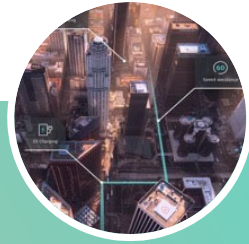
HERE ISA Map

For Intelligent Speed Assist



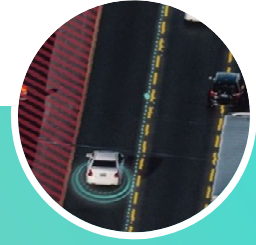
HERE ADAS Map

For ADAS/electronic horizon



HERE Navigation Map

For premium IVI/embedded navigation



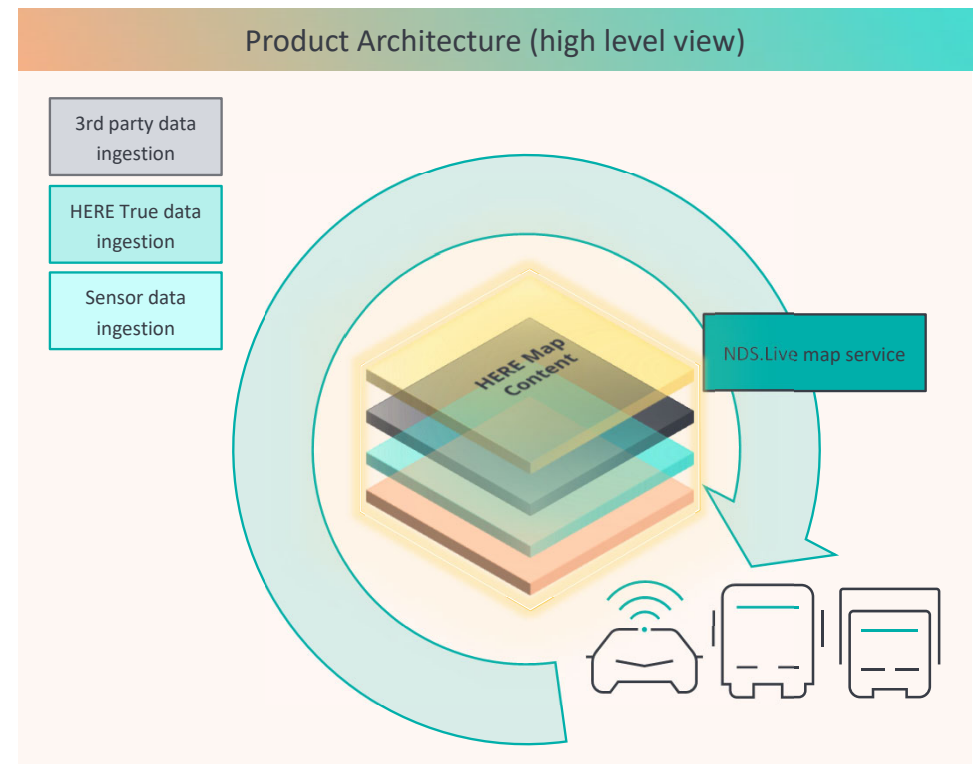
HERE HD Live Map

For driver assistance and automated driving

HERE Maps & NDS.Live

Automated Content Management & Publication

- Less lag thanks to new automated content management and publication pipelines on HERE Platform
- Blend of traditional sources with growing pool of sensor data creates increasingly fresher map data
- Consuming HERE Maps via HERE Automotive Publications means you get it direct from the source

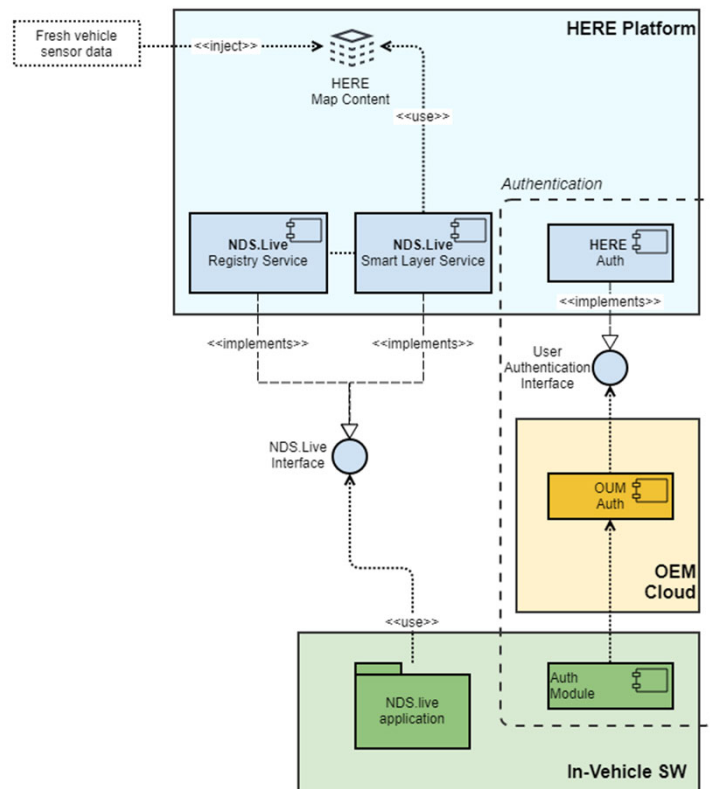


Why NDS.Live is an advantage

- **Cost Advantage**
 - No need for large data storage hardware in the vehicle
 - No need to download large datasets, e.g. don't need whole of Europe or whole/multiple countries
 - Only consume what is needed – the area the vehicle is driven
- **Great User Experience**
 - Features support the driver thanks to the latest map data
 - Simple and no touch - no need for map update prompts or manual downloads via PC, USB, or similar
 - Future-proof – consumers expect seamless experiences supported by connectivity today and more so in the years to come
- **Scalability**
 - Stack features now or even later by letting us configure the NDS.Live Smart Layers to support them
 - No need to consume data twice



HERE ISA Map via NDS.Live Map Service



- Delivers NDS.Live ISA layers via NDS.Live interface
- Authenticates end users
- Publishing cycle is from once a day (e.g., for daily speed limits) to once a month (e.g., for full ADAS attributes) - depending on layer and according to product specification
- Optionally provides large number of tiles as a download for offline use case

Thank you

Boris Gumhold, Sr. Engineering Manager

Philip Hubertus, Sr. Manager, Product Management

NDS Public Conference, June 8th, 2021

NDS.Live Joint Development Team - NavInfo

NDS Public Conference June 8, 2021

Overview

- Enhancement of NDS.Classic offering by NDS.Live streaming solutions
- NDS.Live Joint Development Team
 - Providing input for NDS.Live lane model
 - Implementing NDS.Live SmartLayerTile service for HD lanes
- Developments since last public conference
 - SD road data (ADAS, characteristics, rules)
 - OpenStreetMap
 - Static and variable speed limits for EU ISA regulation

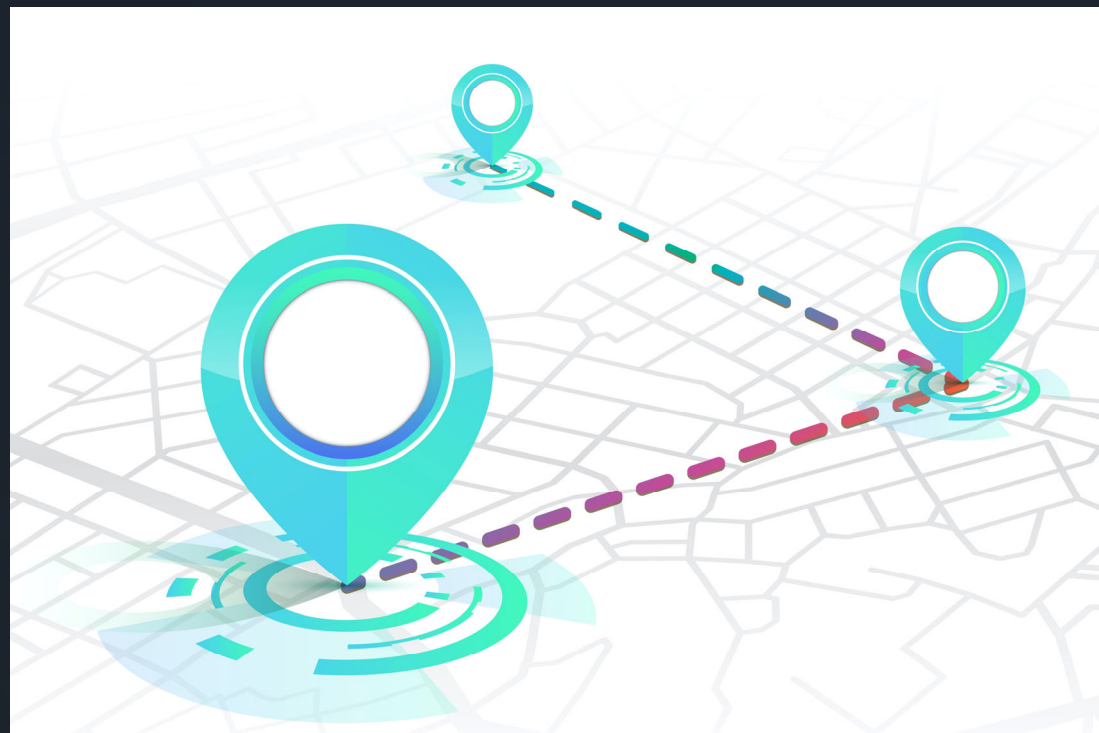


NDS.Live SmartLayerTile service

- Road network to describe the connectivity and geometry of roads
- Characteristics and rules for basic attributes
- ADAS layer to provide highly accurate attributes that are needed for ADAS applications
- Framework completed to provide various SD and HD NDS.Live streaming services
 - With flexible configurations
 - Based on raw data from various providers
 - Through a standardized interface
 - With a unified and interoperable global filling

OpenStreetMap

- Dedicated NDS.Live SmartLayerTile service based on OpenStreetMap
- Features
 - SD roads
 - Characteristics and rules
 - ADAS layer
 - Static speed limit layer
- Usage
 - PoC for usage of OpenStreetMap data for ISA
 - Coverage and quality analysis



Speed limits for ISA

- Separate NDS.Live layer containing speed limit information
- Support for different referencing mechanisms (direct and indirect references)
- Support for static and variable speed limits



Speed limits (references)

- Direct references
 - Use NDS IDs to directly reference features in another NDS layer
 - Enable seamless and integrated maps
- Indirect references
 - Map agnostic referencing using coordinates and different attributes
 - Enable usage of NDS.Live layer with multiple maps
 - Flexibility and optimization by using as little attributes as possible but as much as needed



Speed limits (variable speed limits)

- Steps
 - Identify and match gantries / signs to the road network
 - Identify affected road segments
 - Country-specific rules and heuristics
 - Request current speed limit values from online service
 - Create and publish NDS.Live layer



NDS.Live Offering

- NDS.Live SmartLayer TileService
 - Road / Lanes
 - Characteristics, Rules, ADAS
- Use cases
 - ADAS streaming
 - ISA streaming
 - HD streaming
- Flexible configurations
- Various sources => one unified filling



THANK YOU

NDS.Live joint proof of concept developments



Christian Schneider-Wieland
Hans-Ulrich Otto

NDS Public Conference June 8, 2021



TomTom 

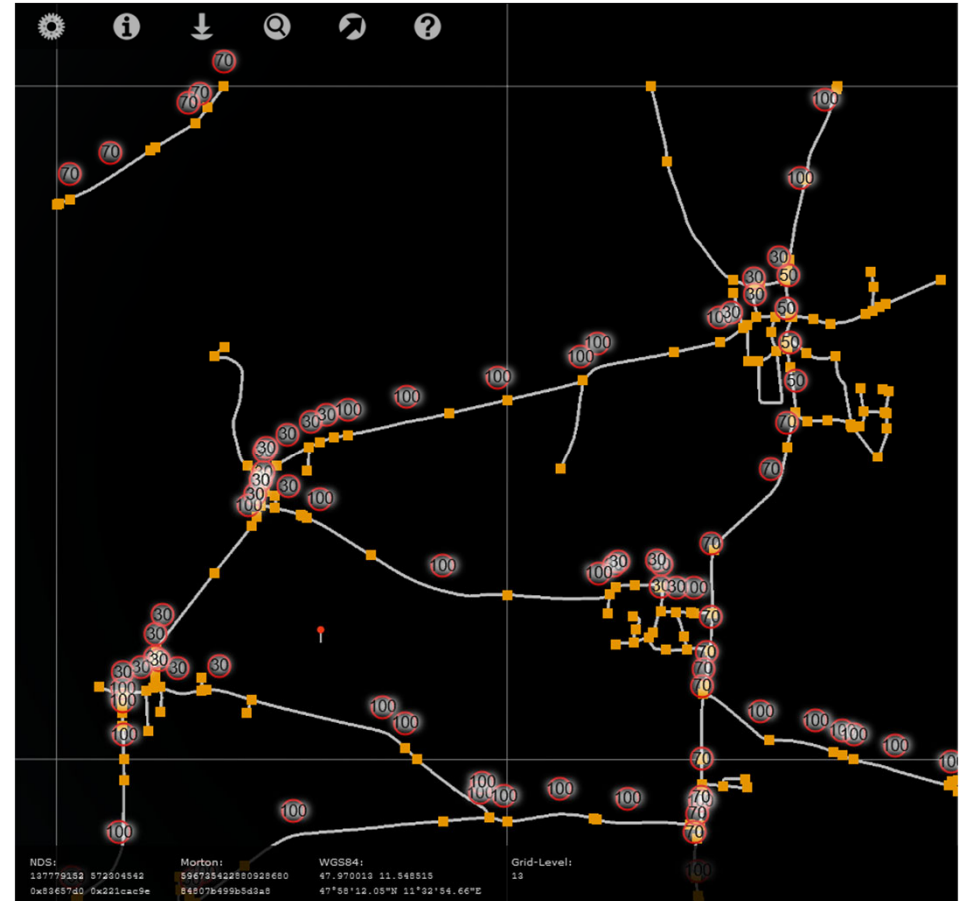
NDS.Live

Interests in POC phase

- Learn on:
 - Technical feasibility / complexity
 - Market potentials
- Demonstrate Interoperability
 - Clients accessing the TomTom Service
- Java Reference implementation
 - Validation by multiple parties

Scope of TomTom basic NDS.Live service

- NDS.Live smart layer tile service with several layers
- NDS.Live Registry



NDS.Live

Evaluation

- POC ramped up within 2 months by several man-months of effort
- Use of NDS.Classic map and access layer gave an easy head start
- TomTom knowledge on Cloud Navigation contributed
- LiveLab is a valuable test and debugging framework

Next steps

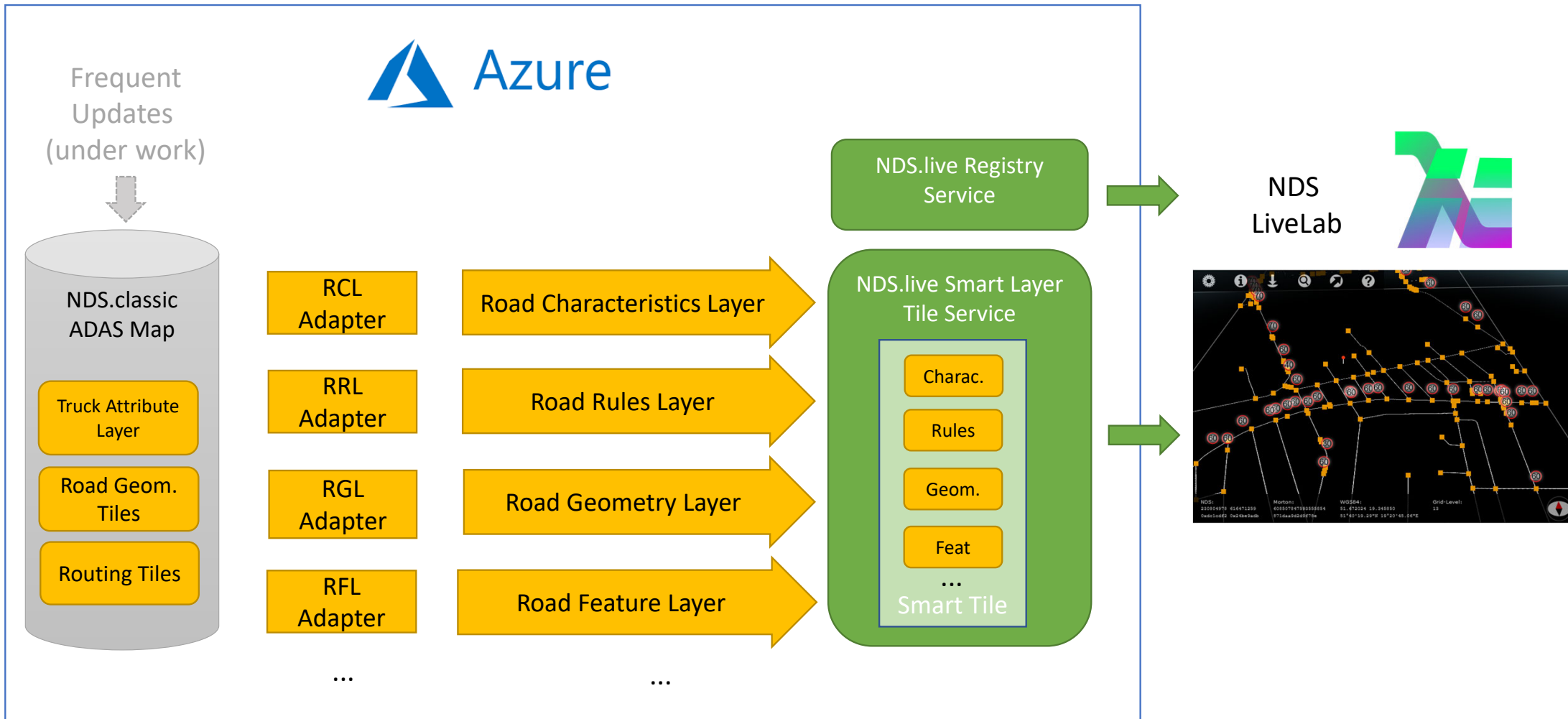
Complete the Road Rules and Road Characteristics Layers

Working on high freshness of base data

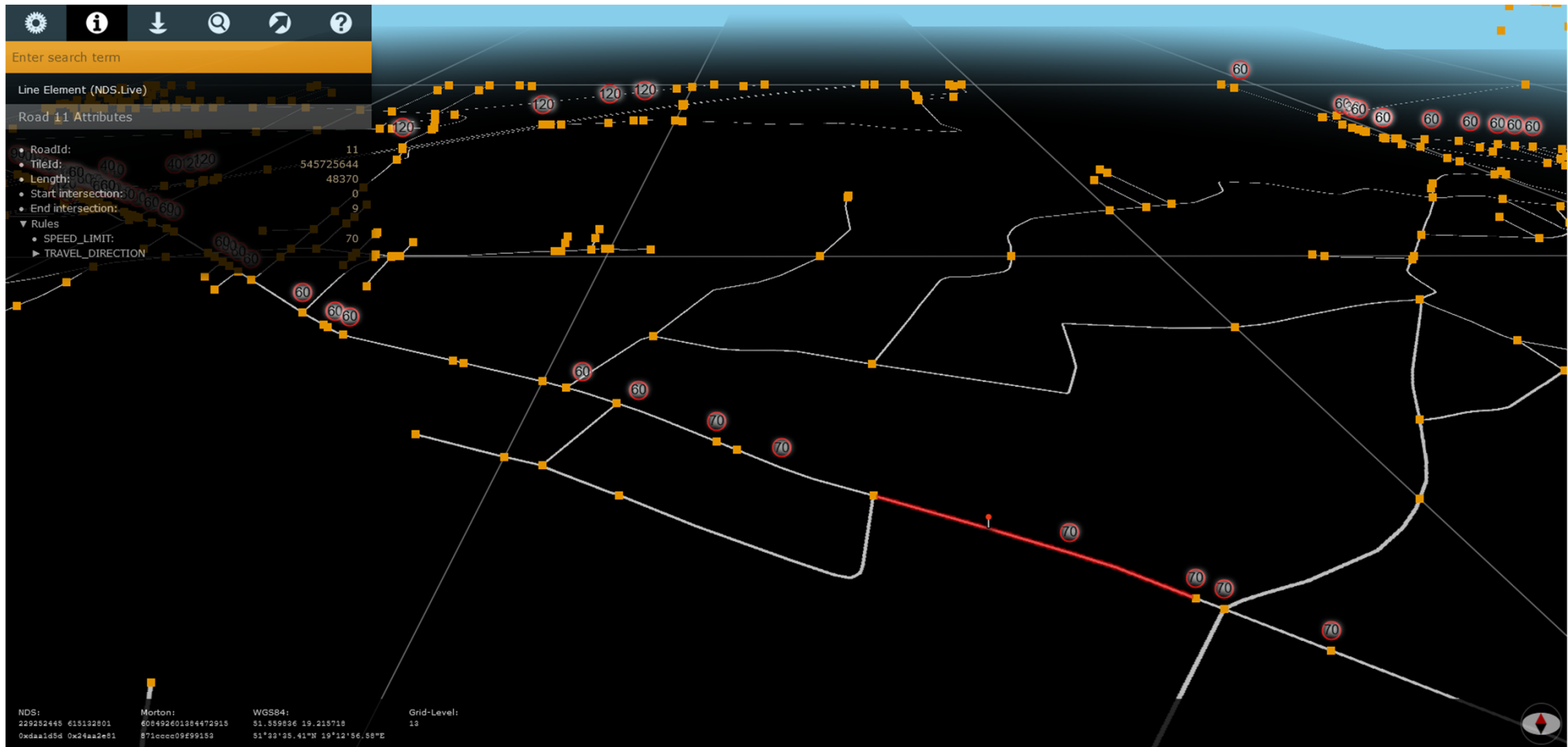
- Weekly to daily frequency of updates for all smart layers
- Validation of versioning mechanism
- Support of client-side update strategies



TomTom NDS.Live Demo Setup



TomTom NDS.Live Demo Example



Thank you



TOMTOM 

NDS.Live Interoperability

Multiple Backends – Still Different Results



Elektrobit

Dirk Spiesswinkel
NDS Public Conference
2021-06-08



About map data

Back in the day

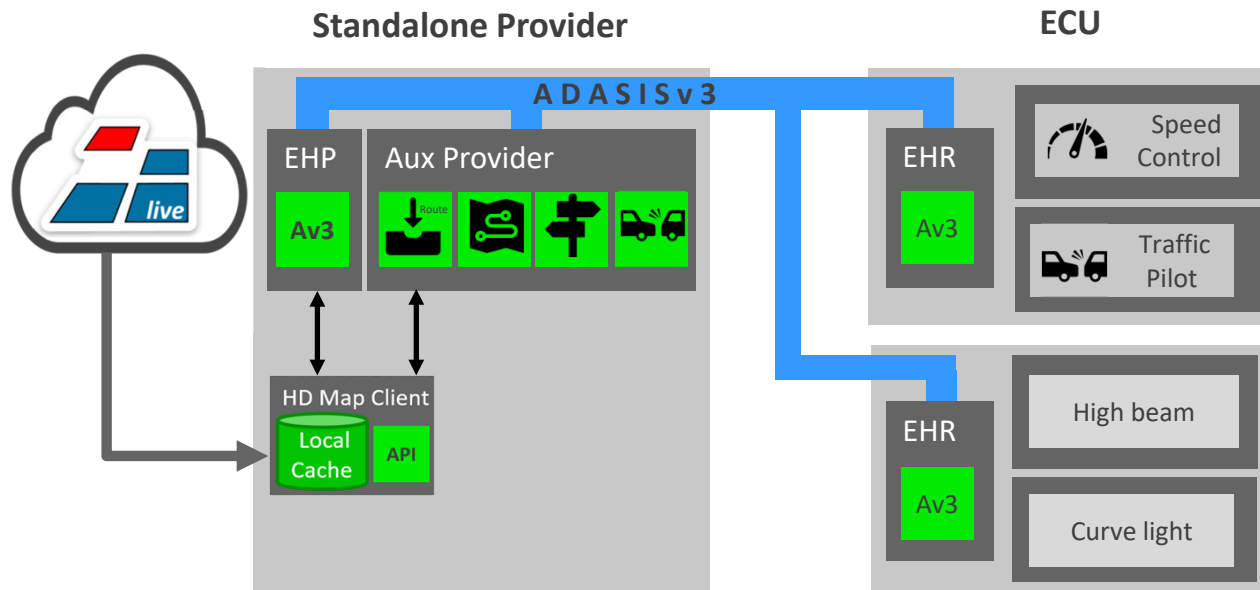
- ... a static local map in the vehicle was state of the art
- ... which was updated first once a year, then two times, then four times per year

Today

- ... dynamic and up-to-date map data is needed to serve ADAS/AD
- ... systems with an HD map have the need of a streamable map
- ... even systems which use an SD map ask for streamable solutions



Setup with NDS.Live



Protocol compatibility

- ADASIS compatibility is still given due to clear map abstraction concepts

MAP

- Architecture changes from supporting multiple APIs to NDS.Live
- Only one NDS.Live Map Client implementation needed
- Caching strategies are available and can be reused
- Abstract backed architecture to be technology and map provider independent

Dynamic data

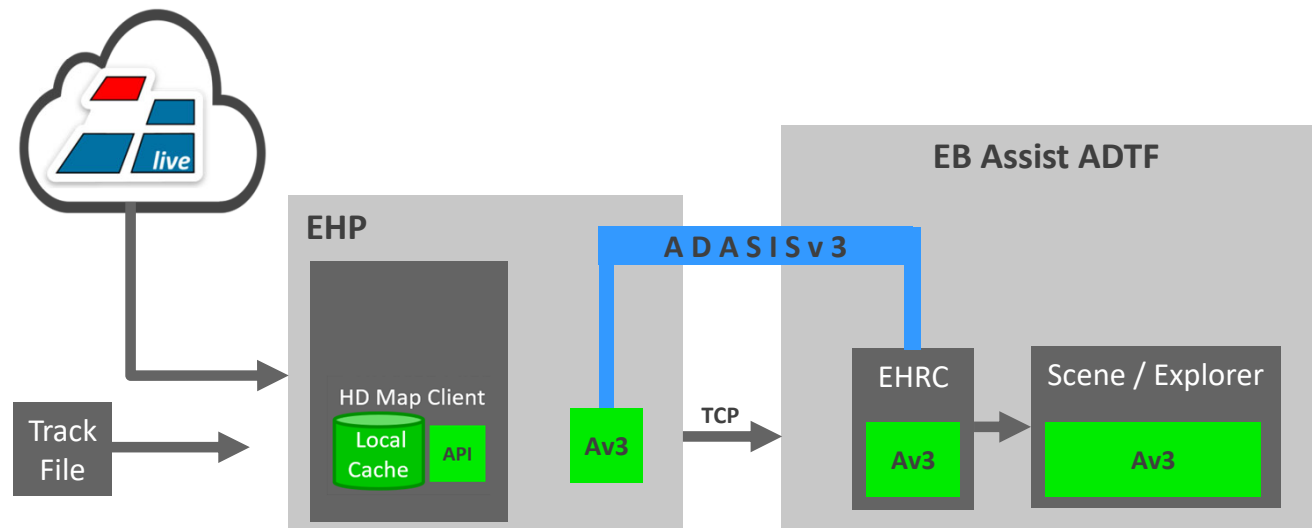
- Auxiliary data can now also be handled through the same interfaces
- Auxiliary provider can facilitate the availability of data layers in NDS.Live

Demo Setup

- SmartLayer Tiles along Car Position (3 x 3)
- Multiple Backends



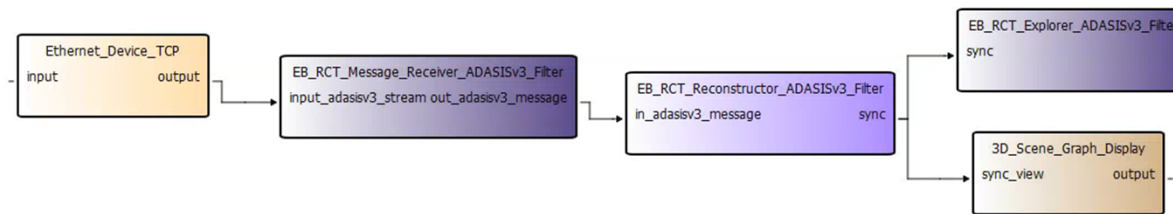
- Map Matching
- Most Probable Path
- ADASISv3 eHorizon Provider
- ADASISv3 eHorizon Reconstructor
- Visualization





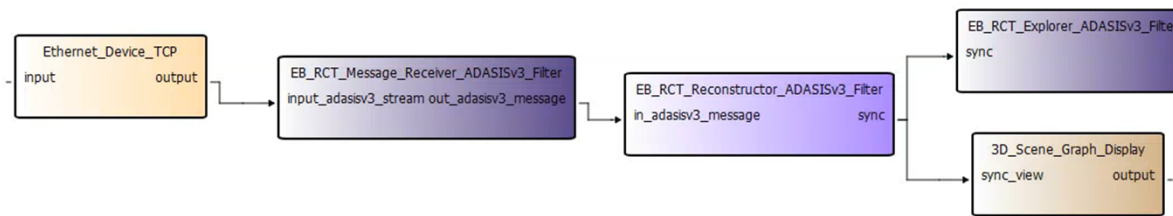
Configuration Editor - C:\Program Files\ADTF\2.13.2\bin\adasis_provider\config\system.xml

< > Live Playback Recording



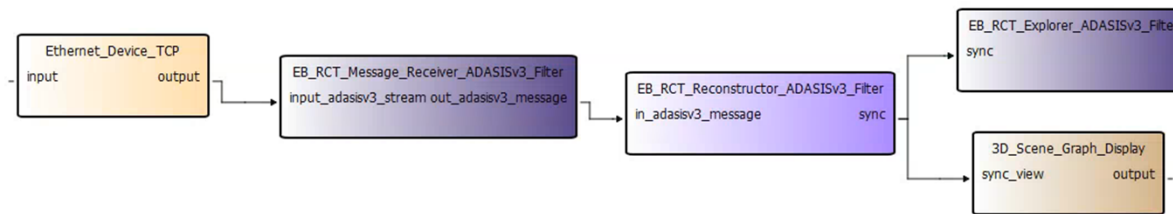
Configuration Editor - C:\Program Files\ADTF\2.13.2\bin\adasis_provider\config\system.xml

< > Live Playback Recording



Configuration Editor - C:\Program Files\ADTF\2.13.2\bin\adasis_provider\config\system.xml

< > Live Playback Recording



What's next?

Adding support for

- ... map streaming by path and object
- ... both road- and lane-based map materials
- ... additional attribute coverage (e.g. truck attributes)



Get in touch!

www.elektrobit.com

Dirk.Spiesswinkel@elektrobit.com



Elektrobit




External



Route Visualization with NDS.Live

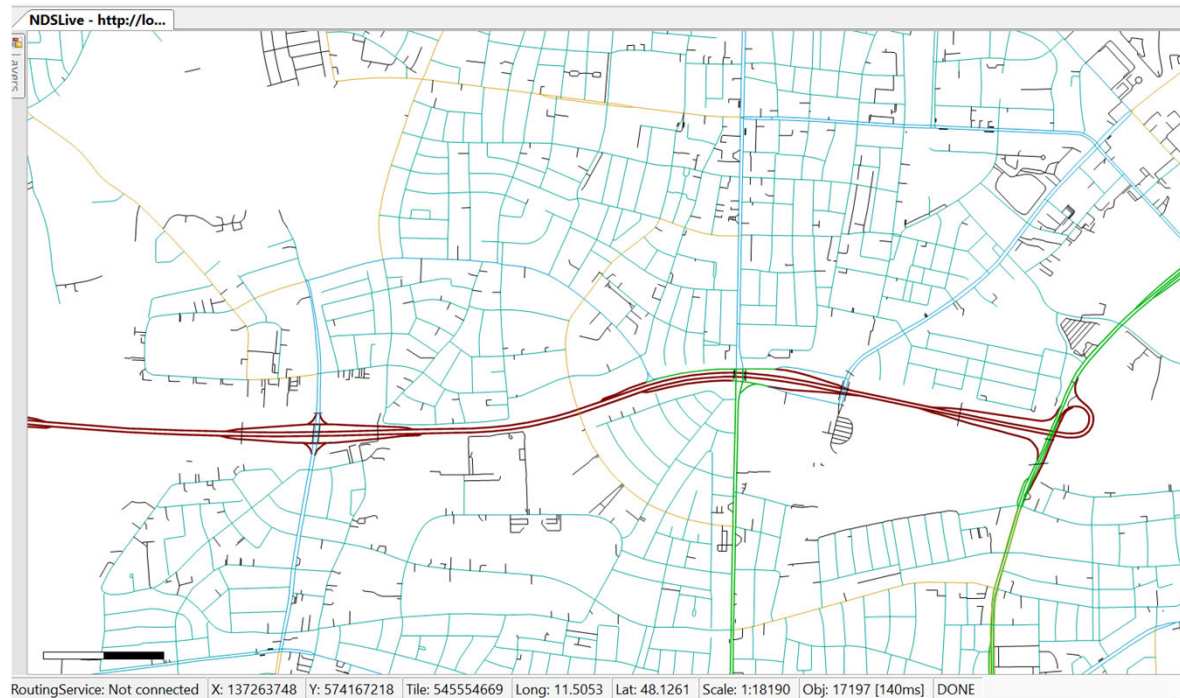
Frank Aurich, JOYNEXT



- 
- 1 Recap & Goals
 - 2 Implementation
 - 3 Live Demo

Recap

- Implemented visualization support for NSD.Live SmartLayers
 - ROAD, LANE (Geometry), Rules, Characteristics



└ Goals

- ④ Develop route calculation service for NDS.Live
 - Use existing route calculation engine for NDS.Classic
- ④ Develop route calculation client for route visualization
 - Support both NDS.Classic and NDS.Live map data on client side
- ④ Bonus: Support third-party route calculation service
 - Provided by NNG

└ NDS.Live RoutingService

- Map-independent interface definition for calculating routes
- Input: Start + destination coordinates
 - Optional: stopovers, route options
- Output: Description of the route using indirect feature references (geometry, bearings etc.)
- Client has to map-match references to underlying map

Service RoutingService

```
service RoutingService
{
    /** Module definition of the routing service. */
    ModuleDefinition getServiceModuleDefinition(Empty);
    /** System token of the routing service. */
    NdsSystemToken getServiceNodeSystemReference(Empty);
    /** Metadata on implemented methods of the routing service.
    */
    RouteServiceCapabilities getServiceCapabilities(Empty);
    /** Calculate a route with options. */
    RoutingServiceResponse getRoute(RoutingServiceRequest);
};
```

Implementation

• Server application

- Wrapper around existing route calculation engine for NDS.Classic data
- Uses HTTP/REST
- Written in C++

• Client application

- Plugin extension for NDSViewer (NDS Visualization Tool)
- Written in .NET
- Currently only evaluates route points (coordinates)

Live Demo

WE CONNECT FUTURE

ISA/ADAS use cases with NDS.Live Horizon Assist and SmartLayer Path services

3rd NDS Public Conference
2021-06-08

Ottó Nyíró

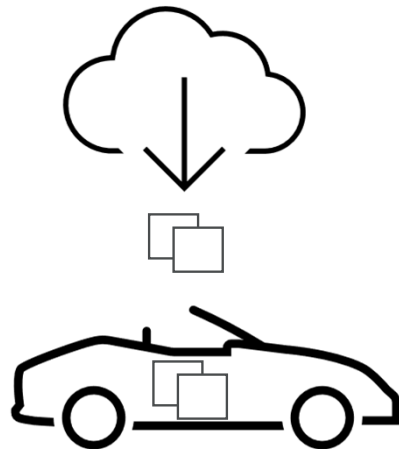
Otto.NYIRO@nng.com



NNG's focus in the NDS.Live Joint DevTeam

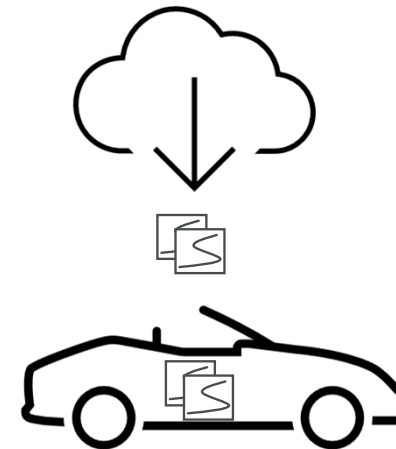
Provision ISA/ADAS applications with map in a smart way

SmartLayer **Tile** service



NDS.Live Client,
onboard eHorizon

Horizon Assist,
SmartLayer **Path** service



NDS.Live Client

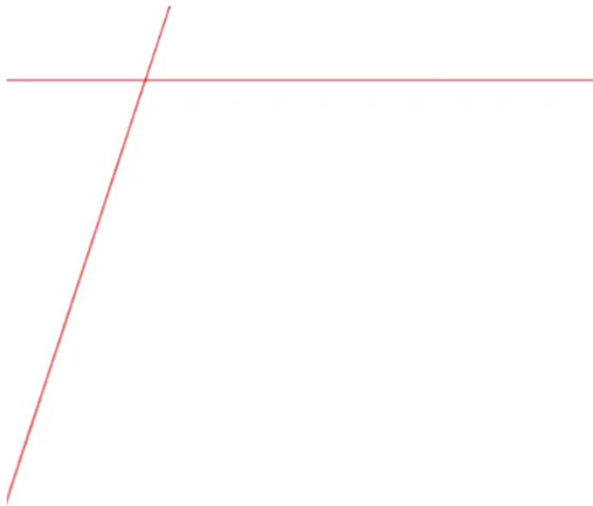
NDS.Live SmartLayerTile service for onboard eHorizon

- Requesting a **SmartLayer Tile** around the car position
- Map matching on the cached SmartLayerTile
- Fetching the speed limit info
- Calculating the Most Probable Path
- Streaming the next tiles based on MPP

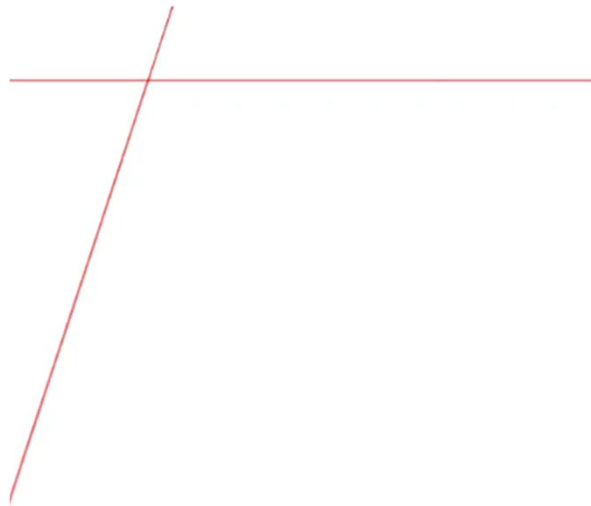


Ok

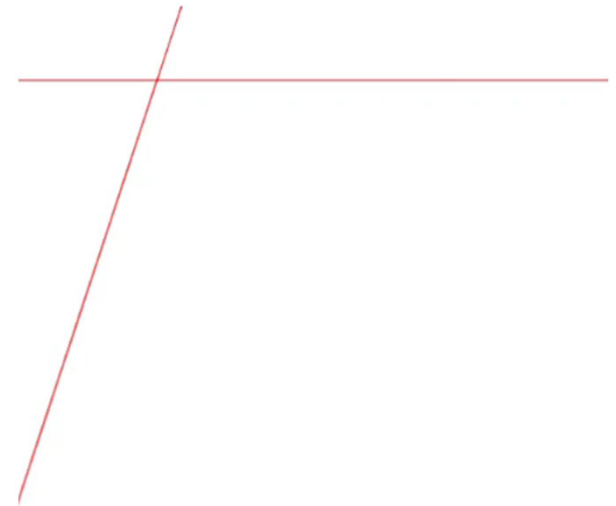
Interoperability with SmartLayer services



Ok



Ok

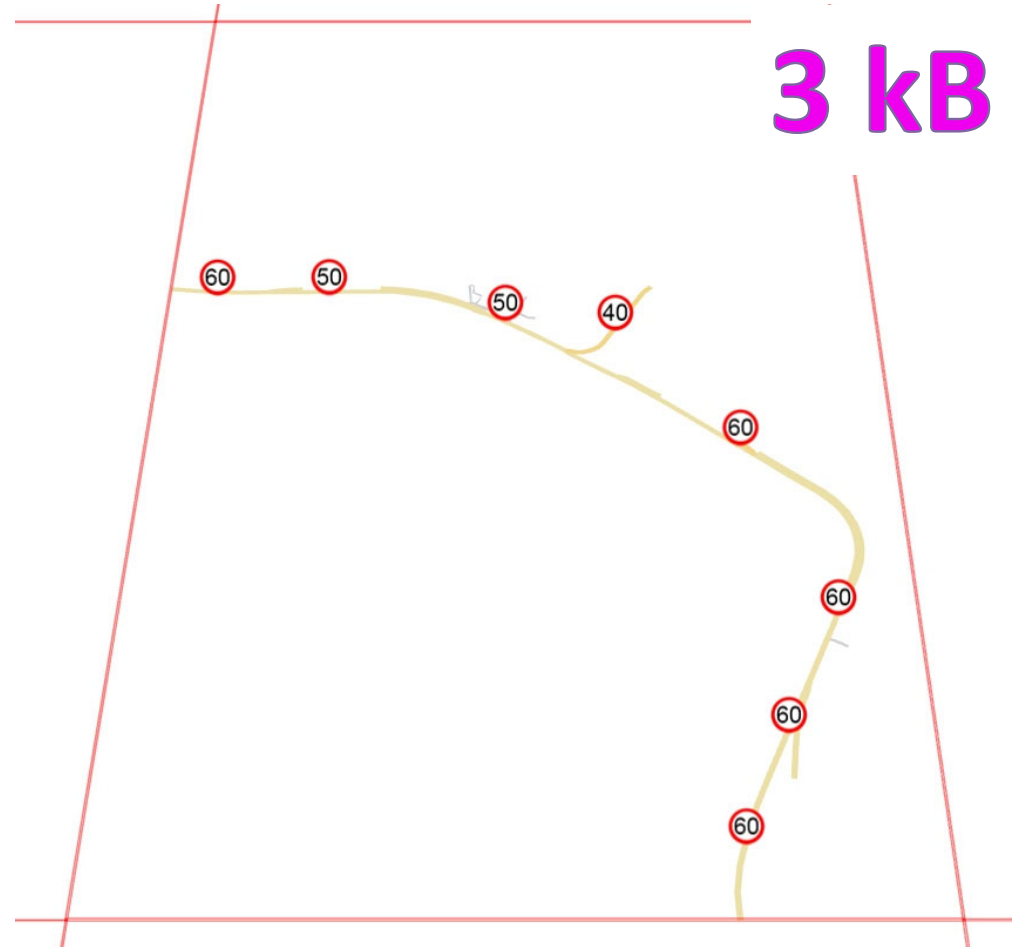
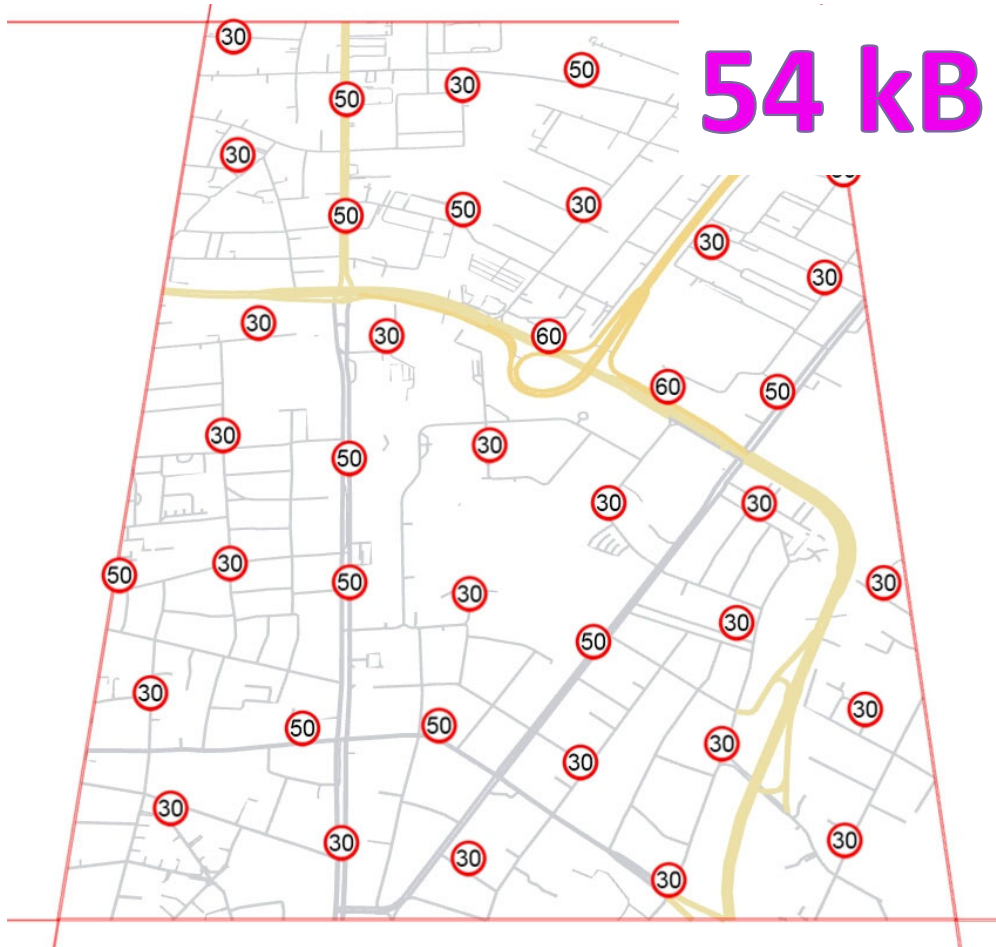


Ok

SmartLayer Tile

vs.

SmartLayer Path



Online Horizon Assist, SmartLayer Path service

- Utilizing online **Horizon Assist** for map matching and horizon calculation in the cloud
- Fetching NDS.Live **SmartLayer Path** from the server
- Adding **Stubs** based on topological selection
- **Caching** Path persistently for later re-use
- Speed Limits can be **distributed to ISA ECUs** directly, or encoded in ADASIS



Ok

Significant data consumption reduction with Path



Ok



Ok

Fetching Adjacent Roads for the Path

Without Stub

50 m Stub

150 m Stub



Ok



Ok



Ok

Caching Strategy for SmartLayer Path

Both onboard and in the cloud

- SmartLayer Path is **cached tile-based**
- **Multiple independent paths** can persist in any tile
- Supporting **pre-caching** mechanism to bridge connectivity white zones
- Can be **combined with Home Area** concept to pre-cache the full tiles of the frequently used area (for daily routes).



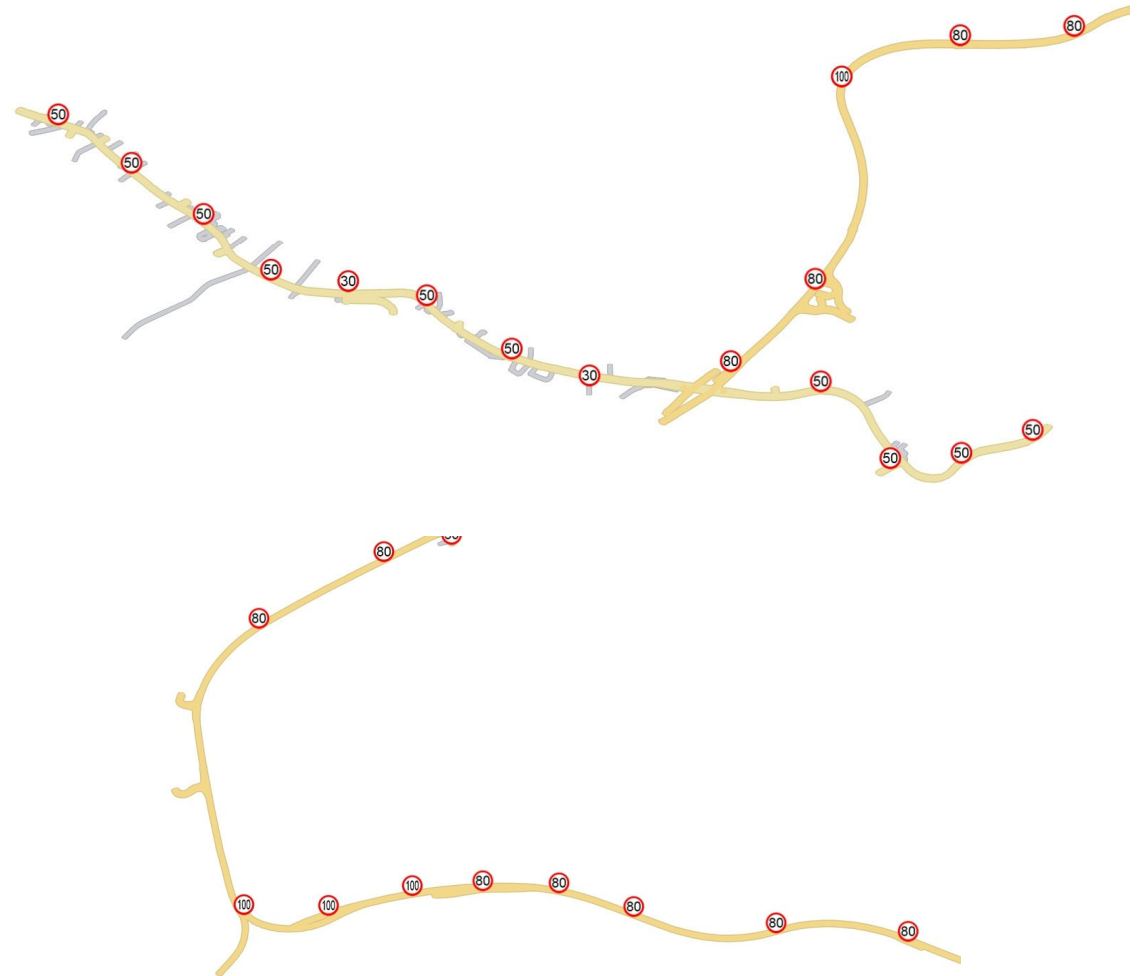
Data Plan

Smart Path size examples:

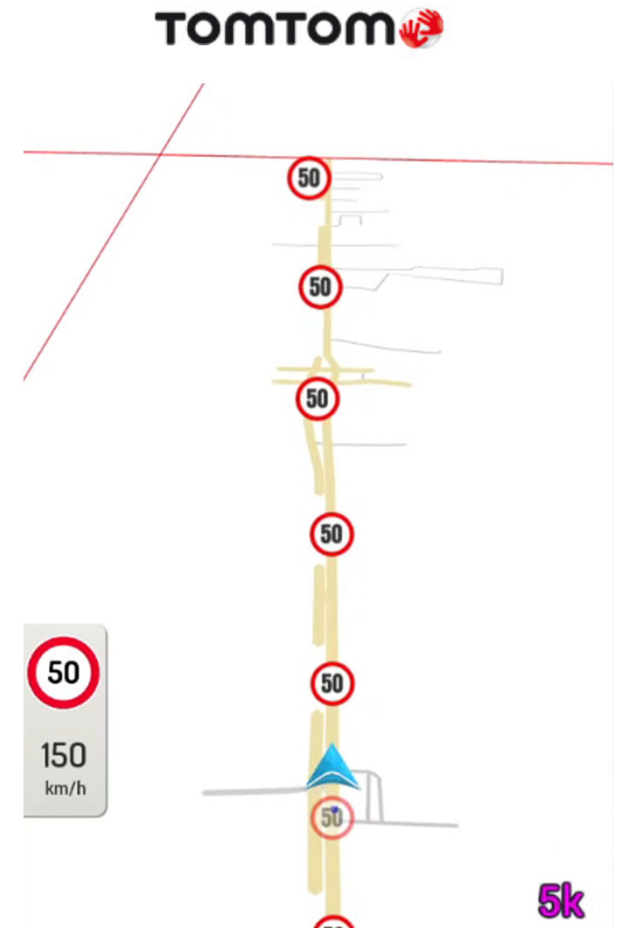
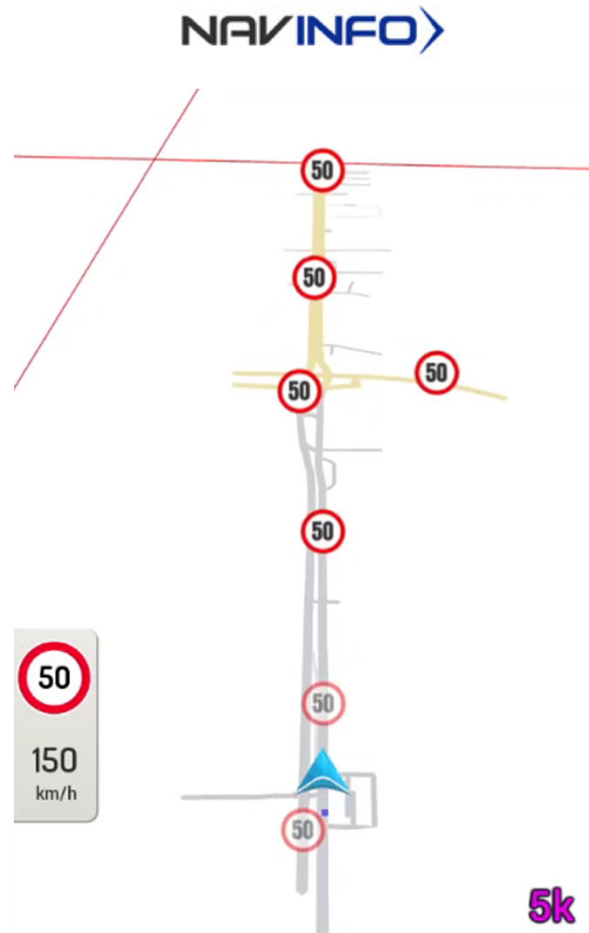
- **30 km** commuting routes in suburban-urban area in both directions: **110 kB** data usage
- **200 km** business route on highway in both directions: **130 kB** data usage

Once a path is cached, it can be re-used for later use.

Monthly data usage: 1,5 – 5 MB
(depending on the map update frequency – quarterly or monthly)



Interoperability with SmartLayer services



SmartLayer Path for Long Horizon

- Flexibility to **lengthen the path** and the adjacent roads
- Use case for **rural road network** with poor connectivity
- Can **bridge connectivity white zones** by pre-caching longer path



Ok

Fetching SmartLayer Path for Short Horizon

- Flexibility to **shorten the length** of the path
- **Configurable** path length (250 m long horizon in this simulation)
- Independent from the tiles
- Use case **for dense road network** with good connectivity
- Can further minimize the data consumption



Ok

Streaming SmartLayer Path for Short Horizon



Ok



Ok

Field Test – Deviating from the Path



Field Test – Short Path (only 100 m horizon ahead)





**THANK YOU FOR YOUR
ATTENTION!**

Ottó NYÍRŐ

Otto.NYIRO@nng.com



Q & A



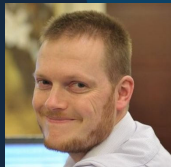
Dirk Spiesswinkel

Product Manager
Elektrobit



Boris Gumhold

Senior Manager, Engineering
HERE Technologies
Technical Chairman of the NDS Association



Nico Glorius

Product Manager
NavInfo (Europe) B.V.
Vice Chairman of the NDS Association



Christian Schneider-Wieland

Product Manager
TomTom



Michael Westphal

Principal Architect
Harman



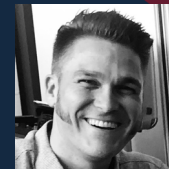
Frank Aurich

Software Engineer
JOYNEXT



Ottó Nyíró

Product Manager
NNG



Fabian Klebert

Technical Coordinator
NDS Association

Contact the NDS Association

www.nds-association.org