Connecting Production and Simulation Worlds

Practical Insights from NDS.Live – OpenDRIVE Interoperability



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Agenda

From production maps to simulation — and back again

01

TWO WORLDS, ONE ROAD NETWORK

Why production maps and simulation drift apart

02

THE BRIDGE

The NDS.Live ↔ OpenDRIVE converter AAI built for NDS

03

WHERE THE MODELS DIFFER

Geometry, topology and attributes at a glance

04

CLOSING THE LOOP WITH REPLIMAP AND REPLICAR

From production map to simulation and back

05

INSIGHTS AND YOUR MAPS

What we learned, and what RepliMap can build for you

Why Now: NDS.Live Use Cases in 2025

The map moves into the cloud, the car — and the simulator

OUR FOCUS

Autonomous mobility

ODD awareness, self-contained tiles, OTA updates — and AI integration & simulation via the NDS.Live–OpenDRIVE converter.

In-vehicle infotainment

Hybrid navigation, AR guidance, real-time traffic and hazard services.

Software-defined vehicles

SOA-compatible map services and continuous OTA optimisation.

E-mobility

Detailed EV charging POIs: connectors, compatibility, availability.

Safe mobility

Safety-related traffic information, Euro NCAP alignment, privacy & security.

Smart mobility

C-ITS and automotive IoT built on self-contained tiles.

Feb 2025

NDS use-case outlook names simulation integration as a pillar of autonomous mobility

Dec 2025

NDS releases the bidirectional NDS.Live ↔ OpenDRIVE converter

Today

Practical insights from implementing and using it

Source: NDS Association, “NDS.Live Use Cases in 2025”

Two Worlds, One Road Network

Same roads, two very different descriptions

Attribute	NDS.Live · production	ASAM OpenDRIVE · simulation
Purpose	Cloud-native map standard for navigation, ADAS and automated driving	De-facto standard for static road networks in simulation
Data model	Granular, modular data layers delivered in tiles	Road-centric XML file: roads, lane sections, junctions
Geometry	Shape-point polylines in geographic coordinates	Analytic reference line (line, arc, spiral, polynomials) with lanes in s/t
Lifecycle	Continuously updated, versioned production pipelines	Authored or edited per test scenario and campaign
Consumers	In-vehicle navigation, ADAS and AD functions	Simulators, scenario tools, virtual validation

The Gap: Why a Converter Matters

Without a bridge, map and simulation drift apart

NDS members asked for a reliable, specification-aware translation tool for their simulation workflows.

Source: NDS Association, Dec 2025

01

Manual, one-off conversions

Project-specific scripts that are hard to reproduce, review or maintain.

02

Map–sim divergence

The simulated road network no longer reflects the production map the vehicle uses.

03

No way back

Edge cases crafted in simulation rarely flow back for evaluation in map tooling.

04

Inconsistent across teams

Different tools interpret the same specification differently.

The NDS.Live ↔ OpenDRIVE Converter at a Glance

From one-way export to a bidirectional tool — still maturing

Released	**December 2025**
Published by	**NDS Association**
OpenDRIVE target	**ASAM OpenDRIVE V1.6**
Implementation	**AAI Innovations**
Access	**NDS Developer Portal**

True bidirectional conversion

Road geometry, lane topology, connectivity and ADAS attributes in both directions.

Layer-aware output

Respects NDS.Live's granular data layer model; changes stay locally limited.

Deterministic rules

Same input, same output — consistent results across teams and releases.

Built for automation

UI tool, command-line interface and service mode for batch jobs and CI/CD.

What AAI Delivered for NDS

What we built — and what it took

DELIVERED

Complete pipeline, both directions

NDS.Live → OpenDRIVE and back again

UI conversion tool

Conversions without touching the command line

Full source code

Available to NDS consortium members

KEY CHALLENGES WE OVERCAME

01

Synchronising with NDS' code

Adapting our existing and new pipeline code to align with the NDS code base.

02

Resolving complex intersections

Turning real-world junctions into consistent topology on both sides.

03

Our own smoothing algorithms

Converting discrete point clouds into continuous road geometry.

The same road, described three different ways

Where the models differ · detailed slides in the appendix

GEOMETRY

Points vs. curves

NDS.LIVE

Shape points in geographic coordinates

OPENDRIVE

Analytic reference lines in s/t coordinates

WHAT TO WATCH

Smoothing quality and elevation continuity

TOPOLOGY

Tiles vs. junctions

NDS.LIVE

Lane connectivity across self-contained tiles

OPENDRIVE

Road-local lane IDs and connecting roads

WHAT TO WATCH

Errors are silent: a road can look right and be undrivable

ATTRIBUTES

Layers vs. one file

NDS.LIVE

Granular, versioned data layers

OPENDRIVE

One XML file per road network

WHAT TO WATCH

State what converts, per layer and version

One rule across all three: normalise into a neutral model first, then translate.

Workflows in Practice

Three loops that connect the two worlds

LOOP A

Map → Sim validation

- Export NDS.Live tiles
- Convert to OpenDRIVE
- Run scenarios in the simulator

Serves: autonomous mobility — AI integration & simulation on production map content

LOOP B

Sim → Map feedback

- Craft edge cases in OpenDRIVE
- Convert back to NDS.Live
- Evaluate in MapViewer / Evaluation Service

Serves: ODD awareness — test map consumers on roads that don’t exist yet

LOOP C

Release regression

- Convert the same input with each release
- Diff outputs deterministically
- Flag unexpected changes

Serves: software-defined vehicles — continuous, OTA-driven map updates

RepliMap is where the simulation map gets built and refined

Closing the loop · the converter moves the data, RepliMap shapes it



MAP → SIM

Enrich before you simulate

Add signals, roadside objects and 3D detail to converted NDS.Live areas in RepliMap.

SIM → MAP

Author the edge case once

Build rare scenarios in RepliMap, then convert them back to NDS.Live for evaluation.

BEYOND NDS.LIVE

Start from raw data

Build networks from LiDAR, imagery, GeoJSON or HERE data where no map exists yet.

One road network, kept consistent from production map to simulation and back.

RepliMap turns raw road data into simulation-ready maps

RepliMap · AAI's road network engineering platform

WHAT GOES IN

Any road data

- LiDAR point clouds and mobile mapping
- Reference imagery and sensor data
- GeoJSON, Mapbox and HERE data
- NDS.Live, via the converter

WHAT REPLIMAP BUILDS

Road networks as machines see them

- Lanes, junctions and traffic rules
- Signals and roadside objects, placed in bulk
- Centimeter-level geometry and elevation
- Validation as you edit

WHAT COMES OUT

Simulation-ready maps

- ASAM OpenDRIVE networks
- Assets reused across vehicle programs
- Round trip to NDS.Live via the converter
- Cloud, on-prem or hybrid

ReplicaR tests automated driving on the maps RepliMap builds

ReplicaR · AAI's simulation platform for ADS verification and validation

AAI REPLICAR

Where the map gets tested

Simulation platform for verification and validation of automated driving systems, running on ASAM OpenDRIVE maps from RepliMap.

TÜV SÜD certified

Simulation software for ADS testing, version 5.3.2 (2025)

Scenario generation

Explore known and unknown scenarios, not only replays

Software in the loop

Object-list and sensor simulator for SIL testing

Closed and open loop

Let the system react live, or replay recorded drives

Intelligent traffic

Traffic library with realistic road users

ODD definition

Describe operational design domains in AAI's own scenario language

Open standards

Built on ASAM OpenX, with a CARLA co-simulation client

Practical Insights

Six lessons for connecting map and simulation

01

Normalise first, translate second

A neutral internal model keeps rules maintainable as both standards evolve.

02

Make tolerances explicit

Agree on acceptable geometric deviation up front, per use case.

03

Junctions are first-class

Connecting roads and lane links need explicit rules — that is where conversions break.

04

Automate the round trip early

A → B → A within tolerance is the most honest check — we haven't automated it yet, and we would start with it next time.

05

Scope by layer, out loud

State which layers and versions are covered; silent gaps erode trust fastest.

06

Keep a human in the loop

Visual review in MapViewer catches what metrics and schemas cannot.

From our implementation: complex intersections and point-to-curve smoothing were the hardest parts — elevation between connecting roads is still open.

Where the Potential Lies

Known open issues and opportunities for further development

OPEN ISSUES (RELEASE NOTES)

Elevation breaks between connecting roads

Listed in every release so far

Boundary & geometry alignment

Open in the latest release

CONVERSION QUALITY

Continuity between segments

Heading, curvature and elevation without seams

Reliable conversion of complex maps

Tested on six test maps so far — more real-world maps would harden it

QUALITY TOOLING

Schema verification

Check every import and export automatically

Automated NDS ↔ ODR round trip

Turn known issues into regression tests

Further opportunities: edit NDS.Live test areas in RepliMap and write them back via the converter · simulation-ready twins of NDS.Live test regions

Need a map for simulation? Tell us what you need

From request to simulation-ready road network in three steps

JUST ASK

RepliMap can create your maps.

Tell us the road, the use case and the data you have. We build the network.



A test track, a city district, a highway corridor or one rare junction

01

Tell us what you need

Area, use case, target simulator and any data you already have.

02

We build it in RepliMap

Lanes, junctions, signals and roadside objects, validated against ASAM OpenDRIVE.

03

You get a simulation-ready map

OpenDRIVE out of the box, and NDS.Live through the converter.

AI assistants can now call our map and scenario tools directly

Two MCP servers in development: the tool computes the answer, the assistant explains it

ODR MAP VALIDATOR · MCP

Validate OpenDRIVE maps on request

Schema check
The .xodr file against the ASAM OpenDRIVE schema

Geometry and lane topology
Reference line continuity, lane predecessors and successors

Junction connectivity
Connecting roads defined consistently

Validation report
Status, issues and where they sit in the map

ASK *“Which validation issues affect junction 12?”*

AUTOSCENARIO · MCP

Generate test scenarios from a description

Scenario from text
Describe a traffic situation, get a concrete scenario

Parameter variation
Sweep speeds, gaps and actors for test coverage

Map-aware placement
Actors placed on lanes of the OpenDRIVE network

Standard export
ASAM OpenSCENARIO with the matching OpenDRIVE map

ASK *“Create a cut-in at 80 km/h on this highway, ten variations.”*

The tool decides what is valid. MCP gives the assistant access, in chat or in CI.

Try the MCP servers
aai-innovations.com/mcp-services

BACK TO THE STORY

Production map data for autonomous mobility is only as valuable as the simulations it can feed — and the feedback it can take back.

GET THE CONVERTER

NDS Developer Portal

developer.nds.live

COMPANION TOOLS

MapViewer · Evaluation Service

Inspect and evaluate converted data

READ MORE

nds-association.org

aai-innovations.com/replimap

Thank you — questions?

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