GIS as basis for transformation of the transportation sector
Trond Hovland, ITS Norway
Agenda

1. General and special trends in Mobility and ITS
2. Digital infrastructure – based on maps – for all modes
3. Road and road transport
4. ISO committees and organization of work
5. Cooperation
6. The End
General trends

Autonomy

Connected car

Shared mobility

ITSTur
SAE levels of automatization

- SAE J3016
- ITS Norway

Driver in control

Self-driving

0 1 2 3 4 5

Autonomous
Hype-cycle: Smarter with Gartner (1)
Hype-cycle: Smarter with Gartner (2)
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Remember Levels of autonomy 0 – 5! 

SAE levels of automatization:

0 1 2 3 4 5

Self-driving

Driver in control

Autonomous
### Levels of autonomy: 0 - 1

<table>
<thead>
<tr>
<th>Responsible entity</th>
<th>Roles Services provider/users</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual car operation</td>
<td>Fleet operators, PTA</td>
<td>Non</td>
</tr>
<tr>
<td>Traffic Management Centres</td>
<td></td>
<td>Data using NeTEx, SIRI</td>
</tr>
<tr>
<td>Road and Mapping Authority</td>
<td></td>
<td>Sensors, traffic lights, signs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traffic rules and regulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maps, topology and geometry</td>
</tr>
</tbody>
</table>

Maps (topologies) for navigation and tracking

Source: ITS Norway and Here
Levels of autonomy: 2 - 3

<table>
<thead>
<tr>
<th>Responsible entity</th>
<th>Rolle: Services provider/users</th>
<th>Data</th>
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<tbody>
<tr>
<td>Partial automated car</td>
<td>Private mobility</td>
<td>ADAS</td>
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<tr>
<td>operation</td>
<td>Public Transport</td>
<td>Data using NeTEx, SIRI, NAP</td>
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<tr>
<td>Fleet operators, PTA</td>
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<td>Traffic Management Centres</td>
<td>Dynamic traffic</td>
<td>Datex II, TPEG, TISA, TN-ITS</td>
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<td></td>
<td>Traffic Surveillance</td>
<td>Sensors, traffic lights, signs</td>
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<tr>
<td>Road and Mapping Authority</td>
<td>Digital driving instructions</td>
<td>Traffic rules and regulation</td>
</tr>
<tr>
<td></td>
<td>Navigating/navigation</td>
<td></td>
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<tr>
<td></td>
<td>Digital descriptive</td>
<td>Maps, topology and geometry</td>
</tr>
<tr>
<td></td>
<td>Basic Map</td>
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<tr>
<td></td>
<td>Navigable network</td>
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</table>

Maps for dynamic information & regulations

Source: ITS Norway and TC204
## Levels of autonomy: 4 - 5

<table>
<thead>
<tr>
<th>Responsible entity</th>
<th>Rolle: Services provider/users</th>
<th>Data</th>
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<tbody>
<tr>
<td>Partial automated car operation, Fleet operators, PTA</td>
<td>Private (e.g., autonomous vehicles)</td>
<td>Non</td>
</tr>
<tr>
<td>Traffic Management Centres, OEM, Fleet management/back office</td>
<td>Dynamic (e.g., traffic surveillance)</td>
<td>NeTEx, SIRI, NAP ++</td>
</tr>
<tr>
<td>Road and Mapping Authority, OEM, Map Providers</td>
<td>Routing (e.g., navigation)</td>
<td>C-ITS/CCAM</td>
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<tr>
<td></td>
<td>Digital (e.g., topology and geometry)</td>
<td>Sensors /ITS Stations</td>
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**Physical Road infrastructure**

HD maps & detailed manoeuvring

Source: ITS Norway and the Internet
Connections between Traffic Management in all modes

Vessel Traffic Centre
- Coastal Network
- Fair/seaways
- Coastal Administration

TMC
- Road Network
- Road topology
- Road Administration

Rail TMC
- Rail Network
- Rail topology
- Rail Administration

ATM
- Air Network
- Airways
- Aviation Administration

Private TMC
- Internal networks
- Harbour, airport
- Private Administration
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BIM, Laser, maps, car/lidar

Source: Internet, Kartverket, Tomtom
Belt-elements to create a electronic-twin road-segment ...

Source: Doihara and Kakumoto, TC204 WG3
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Geographic standards

ISO/TC 204
Intelligent transport systems

ISO/TC 211
Geographic information/Geomatics

ISO/TC 59/SC 13
Building Information Modelling (BIM)

GDF
ISO/TC 204/WG 03 “ITS database technology”
ISO/TC 204/WG 09 “Transport and traffic control”
ISO/TC 204/WG 07 “General fleet management and commercial/traffic”
ISO/TC 204/WG 08 “Public transport/transportation”
ISO/TC 204/WG 04 “Integrated transport information, management and control”
ISO/TC 204/WG 10 “Traveler information systems”
ISO/TC 204/WG 16 “Communications”
ISO/TC 204/WG 17 “Nomadic Devices in ITS Systems”
ISO/TC 204/WG 18 “Cooperative systems”
ISO/TC 204/WG 19 “Mobility integration”

GIS
ISO/TC 211/AG 01 “Outreach advisory group”
ISO/TC 211/AG 02 “Advisory group on strategy”
ISO/TC 211/AG 03 “Program maintenance group (PMG)”
ISO/TC 211/AG 04 “Joint advisory group (JAG) ISO/TC 211 – OGC”
ISO/TC 211/AG 05 “Harmonized model maintenance group (HMMG)”
ISO/TC 211/AG 06 “Ontology maintenance group (OGM)”
ISO/TC 211/AG 07 “Terminology maintenance group (TMG)”
ISO/TC 211/AG 10 “XML maintenance group (XMLG)”
ISO/TC 211/AG 11 “Advisory group to support UN-GGIM and other related UN activities”
ISO/TC 211/AG 12 “Control body for the ISO geospatial register”
ISO/TC 211/AGH 13 “Improving engagement”
ISO/TC 211/AGH 14 “TC211-TC204 task force”
ISO/TC 211/WG 04 “Geospatial services”
ISO/TC 211/WG 06 “Imagery”
ISO/TC 211/WG 07 “Information Communities”
ISO/TC 211/WG 09 “Information management”
ISO/TC 211/WG 10 “Ubiquitous public access”

BIM
ISO/TC 59/SC 13/TF 1 Terminology
ISO/TC 59/SC 13/TF 2 Business Planning and Strategy
ISO/TC 59/SC 13/TF 6 Framework for object-oriented information exchange
ISO/TC 59/SC 13/WG 8 Building information models - Information delivery manuals
ISO/TC 59/SC 13/WG 11 Product data for building services systems model
ISO/TC 59/SC 13/WG 13 Implementation of collaborative working over the asset lifecycle

Source: ISO
Geographic standards – need interactions

Figure 1: Roles and relations in the digital geospatial environment.

Source: Dr Knut Jetlund, Doctoral thesis
### Geographic standards – some of the actors

Table 3. Studied specifications and technologies.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Stakeholder</th>
<th>Standards or specifications</th>
<th>Technologies</th>
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<tbody>
<tr>
<td>GIS</td>
<td>OGC</td>
<td>CityGML, LandInfra/InfraGML</td>
<td>Information modelling: ISO/TC 211 UML and MDA, Implementation: GML, JSON</td>
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<tr>
<td>GIS</td>
<td>INSPIRE</td>
<td>Inspire Transport Networks</td>
<td>Information modelling: ISO/TC 211 UML and MDA, Implementation: GML, OWL</td>
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<tr>
<td>ITS</td>
<td>ISO/TC 204</td>
<td>GDF</td>
<td>Information modelling: UML and XML, Implementation: XML, MRS</td>
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<td>ITS</td>
<td>ISO/TC 204</td>
<td>TPEG 2</td>
<td>Information modelling: TPEG 2 UML and MDA, Implementation: XML, Binary</td>
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<td>ITS</td>
<td>CEN/TC 278</td>
<td>DATEX II</td>
<td>Information modelling: DATEX II UML and MDA, Implementation: XML</td>
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<td>ITS</td>
<td>Triona et al.</td>
<td>OpenTNF</td>
<td>Information modelling: UML, Implementation: GeoPackage</td>
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<td>ITS</td>
<td>VIERES</td>
<td>OpenDRIVE</td>
<td>Information modelling: XML, Implementation: XML</td>
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</table>
Geographic standards - Cooperation

ISO/TC 204
Intelligent transport systems

TC204 /WG3
ITS GEOGRAPHIC DATA

ISO 20524-2:2020
Intelligent transport systems -- Geographic Data Files (GDF)

GDF5.1
Navigation and mobility

ISO/TC 211
Geographic information/Geomatics

19148 Linear Referencing
19147 Transfer Nodes
19132, 19133 and 19134 LBS
...

TC211
19115 Metadata
19110 Feature Catalogue
19109 Conceptual schema
19108 Temporal Schema
19107 Spatial Schema

Map and car makers
Road geometry
Regulations
Road furniture
Dynamic data

Road and mapping authorities
Road databases
Road geometry
Regulations
Road furniture
Dynamic data

Source: ITS Norway
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Gap-analysis and harmonisation of standards

ISO TC59/SG13 BIM  →  JWG 14 BIM-GIS  ←  ISO TC211 GIS  →  JWG 11 GIS-ITS  →  ISO TC204 ITS

Source: ITS Norway

Intelligent Transport Systems
WI 1: Gap-analysis GDF and TC211 based model – TR
- Redefine the GDF-model based on TC211-standards
- Enable handling of very detailed and accurate geometries
- Enable map-data exchange between all actors
- Align with data models based on ISO 19100 like TISA, TN-ITS, Datex II, etc.

- Name: ISO TR 19169
- Initiated: By TC 211 (May 2019), confirmed by TC 204
- Objective: To foster mutual understanding of harmonization issues between overlapping domains of both TCs
- Enable a GIS-based transition from GDF 5.1 to 6.0

- Administered by TC 211
  - Trond Harald Hovland appointed as convenor by TC 211
  - Takeshi Doihara appointed as co-convenor by TC 204
Status TR 19169 and PWI 5774

ISO/PRF TR 19169 (Stage 50.00 as of April 8\textsuperscript{th} Approved)

- Geographic information – Gap analysis for Geographic Data Files (GDF) and ISO/TC211 conceptual models to improve harmonization
- Recommendations: To develop GDF 6.0 (and the belt concept)

ISO/PWI 5974 (Stage 00.00 since 2020-10-05)

- Evolution and revision formation for Geographic Data Files (GDF)

Initial topics:
- The belt concept and linear referencing
- Time domain
- Indoor navigation

ISO/TC211/JWG 11 meetings:

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New Work Items?

• Digital infrastructure and hubs – Gap-analyses
• Maritime ITS – mapping of harbors and aligning land-sea standards
• 3D-referencing – i.e., for drones - understanding status and concepts
The End

Thank you for listening!

Any questions?