ygomi

Dynamic Data Handling for HAD

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Overview

- Separation of dynamic and static
  - Definition of dynamic and static (including local dynamic map)
- LDM – each kind of data requires contextual knowledge, so why is this combined?
- Needs for HAD
  - Machine readable
  - No human touch (for safety systems)
  - Constantly updated

Focus on HAD

- A primary focus of map suppliers is supporting vehicle control functions leading to highly automated driving (HAD)
  - Traffic light detection
  - Speed limit compliance
  - Automatic lane changing
  - Automatic overtaking
  - Collision avoidance
  - Precise positioning

LDM Layering Overview

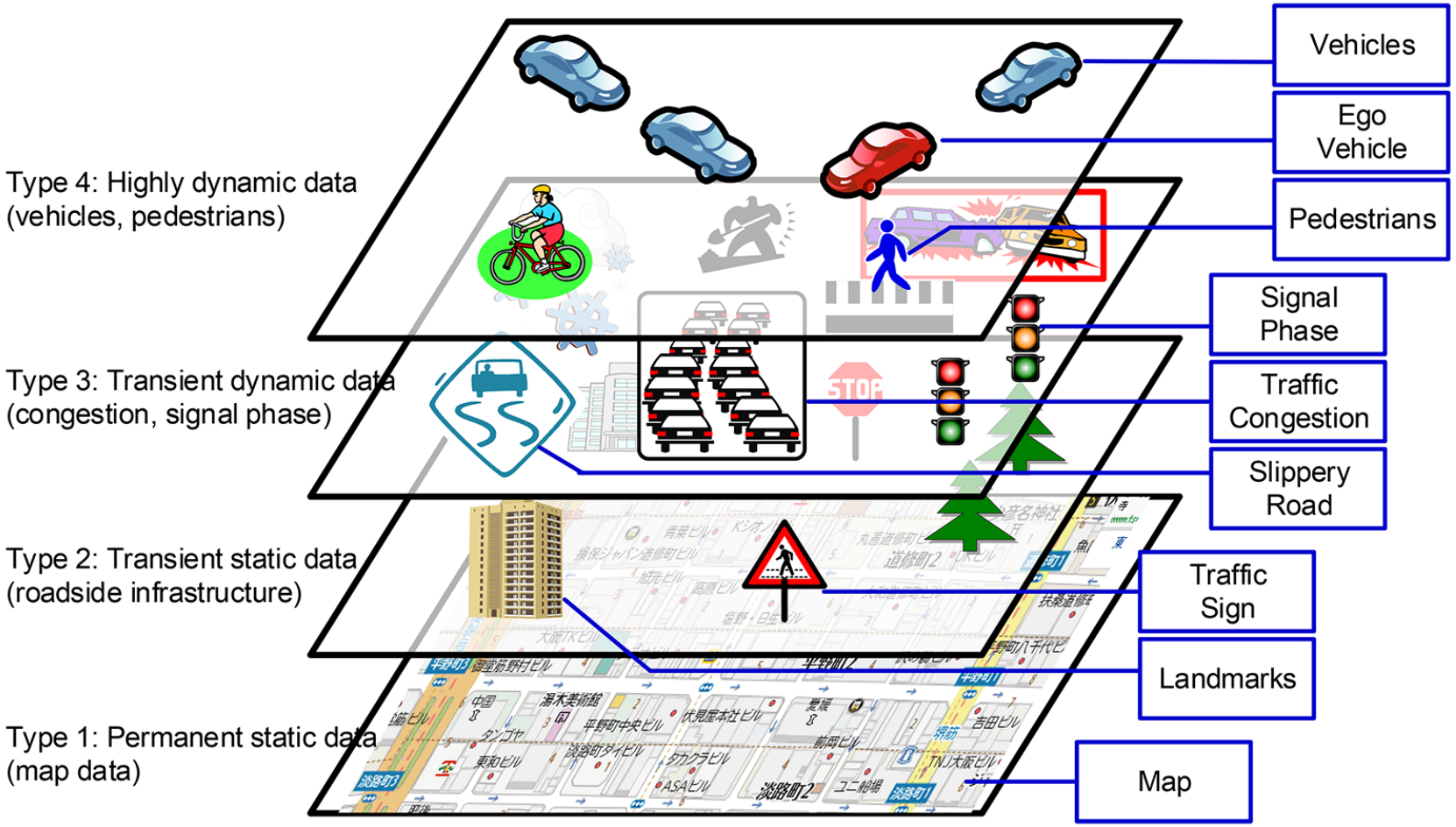


Image from H. Shimada, A. Yamaguchi, H. Takada, K. Sato. *Journal of Transportation Technologies,* 2015, 5, 102-112

Data Handling – Type 4

- Type 4, "highly dynamic data", is **too** dynamic to be handled outside of the vehicle
  - HAD systems will need to need to recognise these kinds of cases based on in-vehicle sensors
    - Early adoption
    - In case of communications failures
  - V2I communications are impractical
    - Latency is too long
    - Simultaneous processing from in-vehicle sensors and from V2I communications increases hardware requirements and increases software complexity

Data Handling – Type 3

- Type 3, "transient dynamic data", may be aided by V2I communications
- Does it need to be integrated into a "Local Dynamic Map"?
  - Variable message signs, variable speed limits, and signal phase and timing come from road authorities and I2V communications without a map
  - Data such as congestion and slippery road is approximate and only needs GPS position within 25 metres

Data Handling – Type 3

- Type 3 data that is useful to the vehicle: Things that aren't readily visible to the sensors in the car
  - The signal phasing ("30 seconds green, 8 seconds yellow, 40 seconds red"), is more useful to the vehicle than the current signal mode ("red")
- This type of information tends to be more useful for eco-driving applications

Blurring Lines – Faster Update of Type 1 and Type 2 Data (1/2)

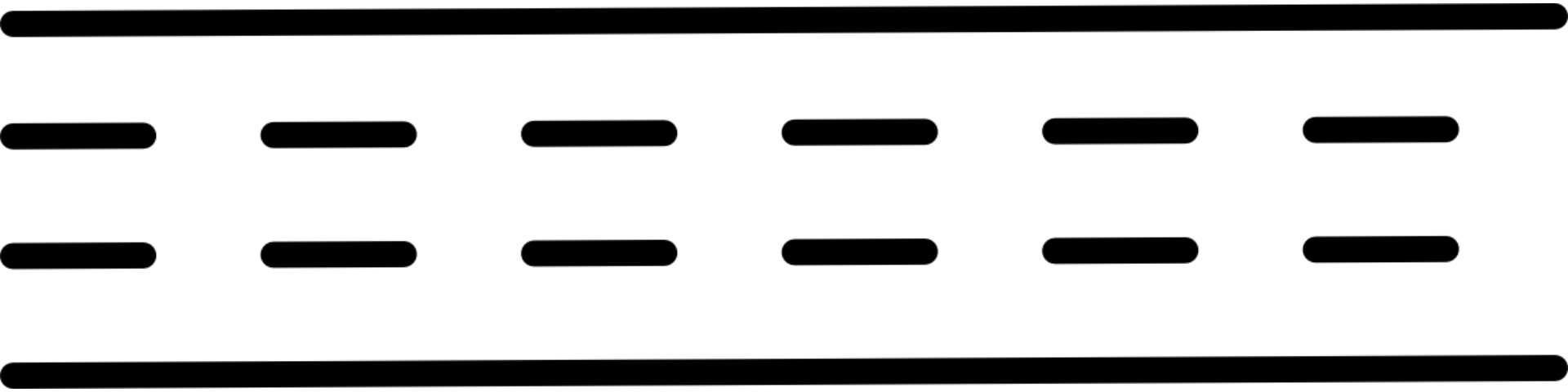
- The rest of the map updates are to base map data
- The update for this data has traditionally been defined by the data providers' ability to
  - Detect a change
  - Send out a specialised collection vehicle to record the ground truth
  - Go through the data providers' manual introduction of changes to the "master" data store
  - Distribution of the changes back to the vehicles' local copy of the road data

Blurring Lines – Faster Update of Type 1 and 2 Data (2/2)

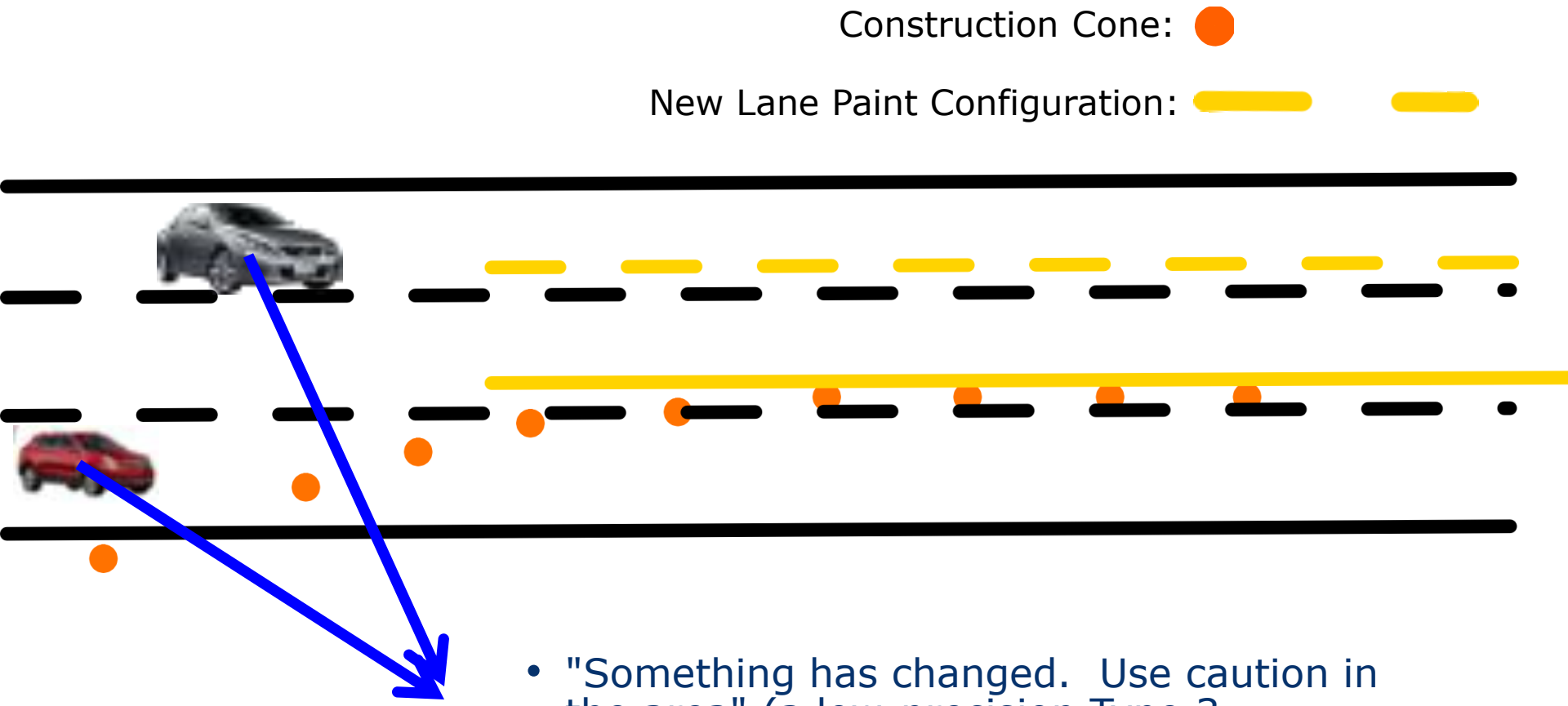
- As base data suppliers begin to rely on vast numbers of probes and automated processing, some data types that are thought of as more "dynamic" today will in the future be represented as changes to the base data

Road Construction Example

"This road will be under construction starting 1 June"

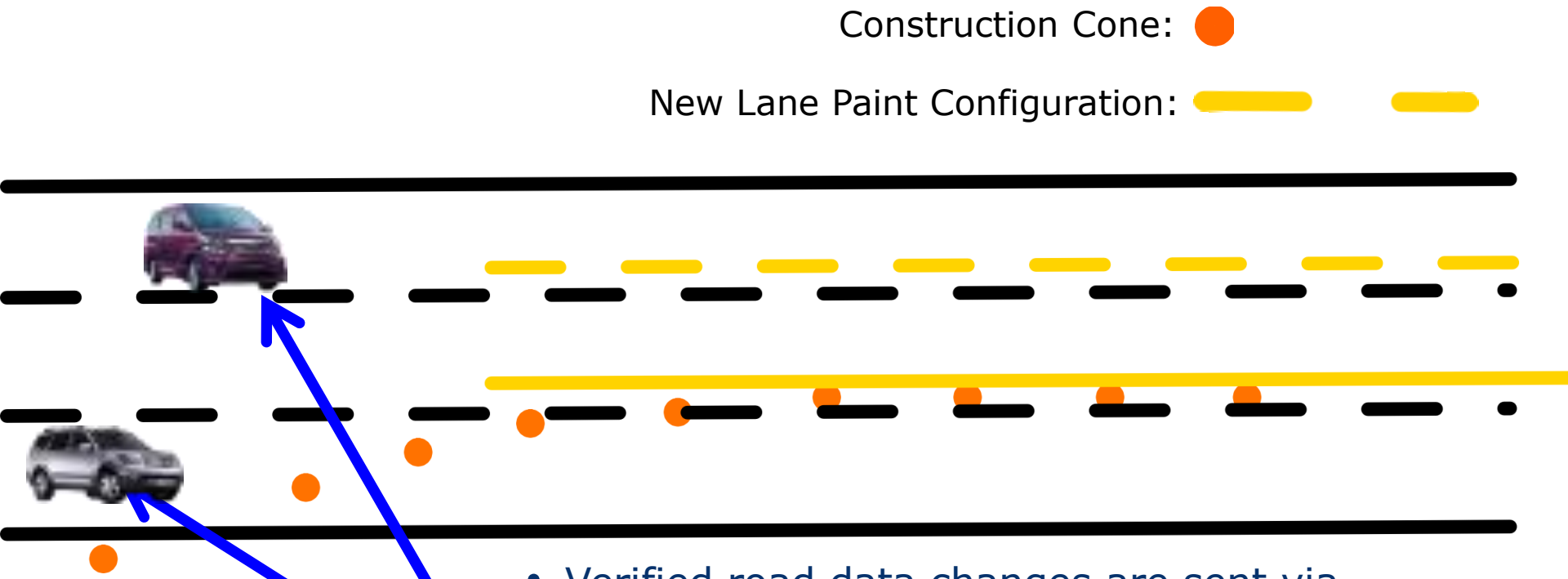


Immediately after a Lane Reconfiguration



- "Something has changed. Use caution in the area" (a low-precision Type 3 message)
- Road data differences are sent via private channels to the data provider

Once the Data Has Been Processed by the Provider



- Verified road data changes are sent via private channels to the vehicles to update their local data copies
- The new information reflect the actual, temporary lane configurations
- When the construction is taken down, the process reverses itself

Conclusion

- Minimise dynamic communications. This is because the systems must be engineered to work independently of any external communications anyway, and because using both messaging and sensors adds complexity and expense to the system
- Messages that are related to things invisible to the vehicle, such as signal timing, are far more useful than messages that duplicate information that can be sensed in other ways by the vehicle
- As base road data gets updated more quickly, some type of transient data may be incorporated directly into the road database

Thank You