

ITS Distributed Roadside Infrastructure and Standardisation needs

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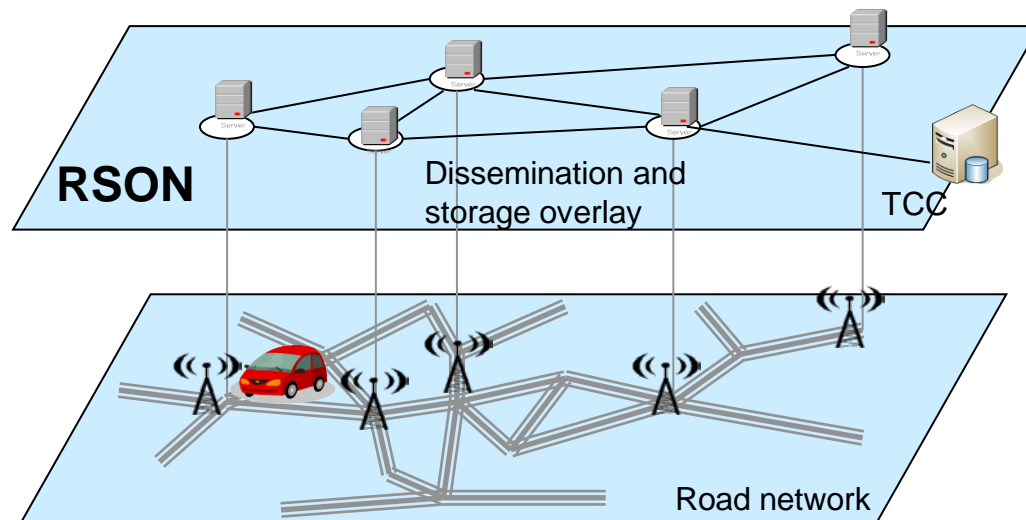
Outline

- Introduction
- Architecture
- Addressing and Routing
- Service application example
- Experiments
- Open standardisation issues
- Conclusions and further work

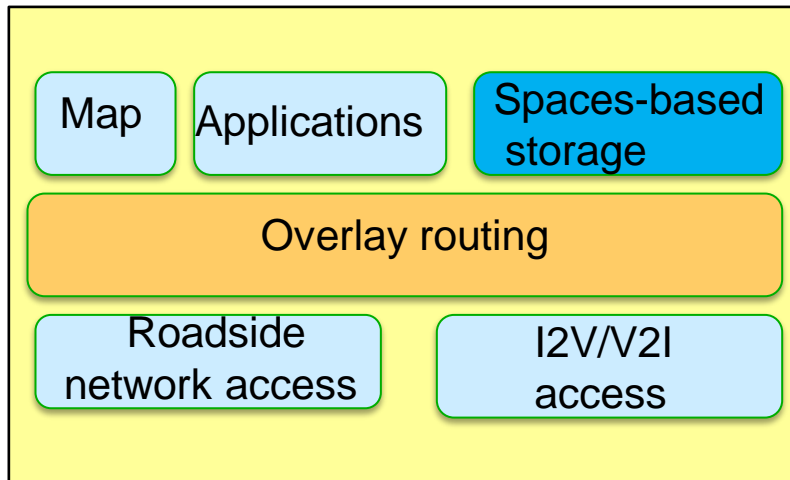
Motivation: Road Side Overlay Network (RSON)

A cooperative ITS system requires often decentralized mechanisms

- To collect and store environment and car sensor data,
- To intelligently distribute data to relevant geographical regions
- To organize itself in case of node failures



Proposed RSU node architecture

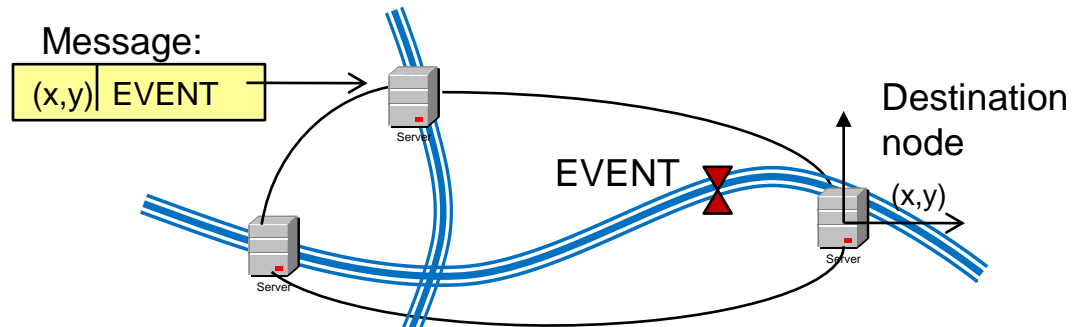


Benefits from the design

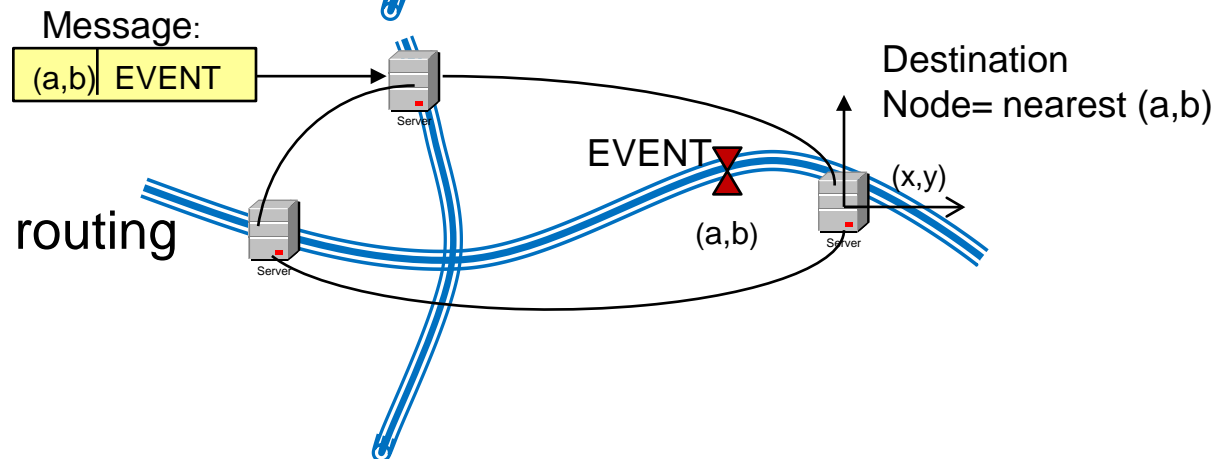
- Global addressing and content storage in the network – like a large distributed database
- Data centric routing mechanism

Content based Routing

a) Standard Geo-routing



b) RSON content based routing



In case b) the message doesn't need to know the destination node
– the overlay takes care of it !

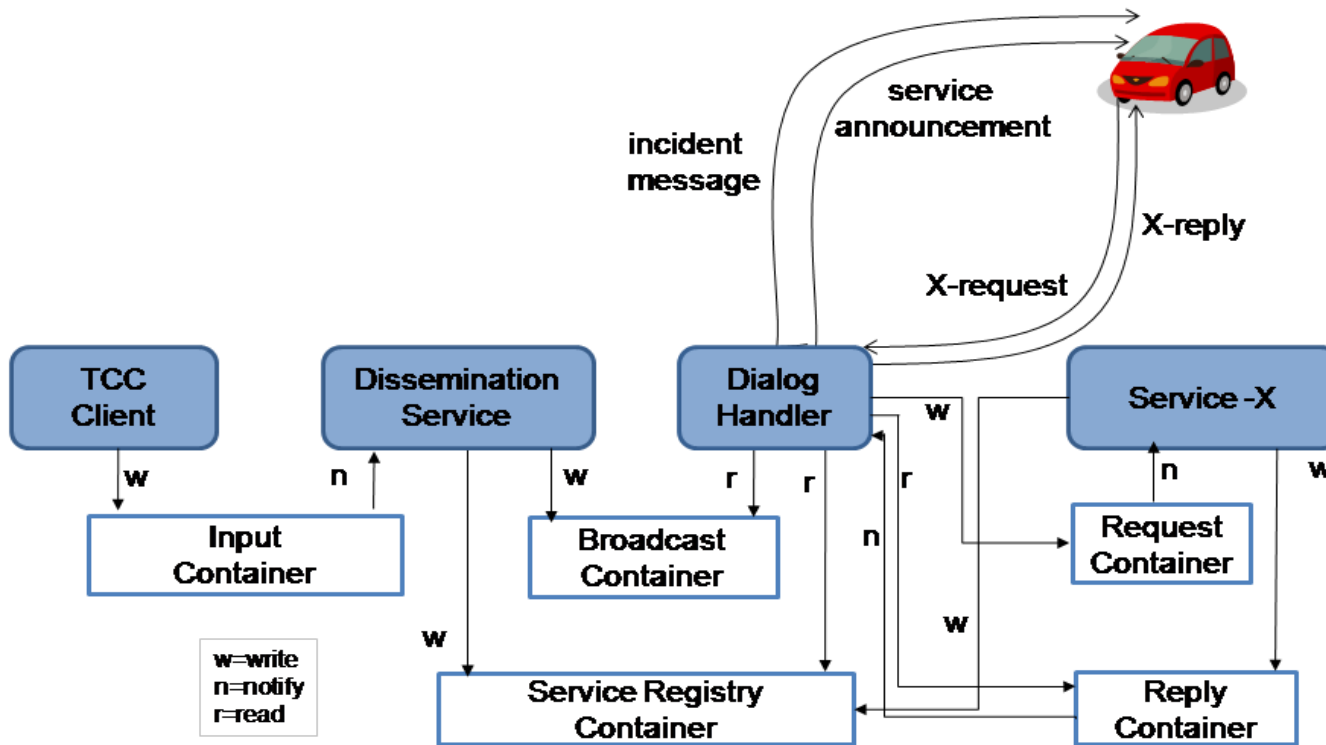
Space based computing (XVSM)

- Containers
 - addressed via URLs
 - arbitrary entry types
 - String, Integer, Tuple, Java-Object, XML, ...
 - access: read, take, write...
- Several coordination models
 - implicit order,
 - direct access,
 - content matching.

Distributed hash tables DHTs

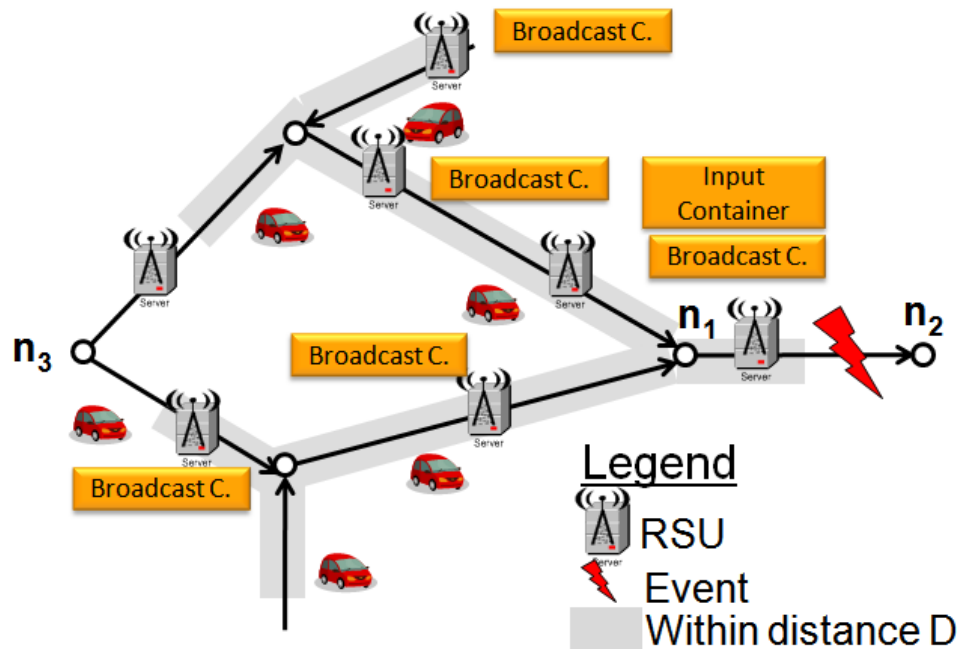
- implement some self-organizing concepts
 - add/remove node, failure handling (replication)
- content-centric addressing
- scalable, known route length

Service Architecture Based on Space Containers



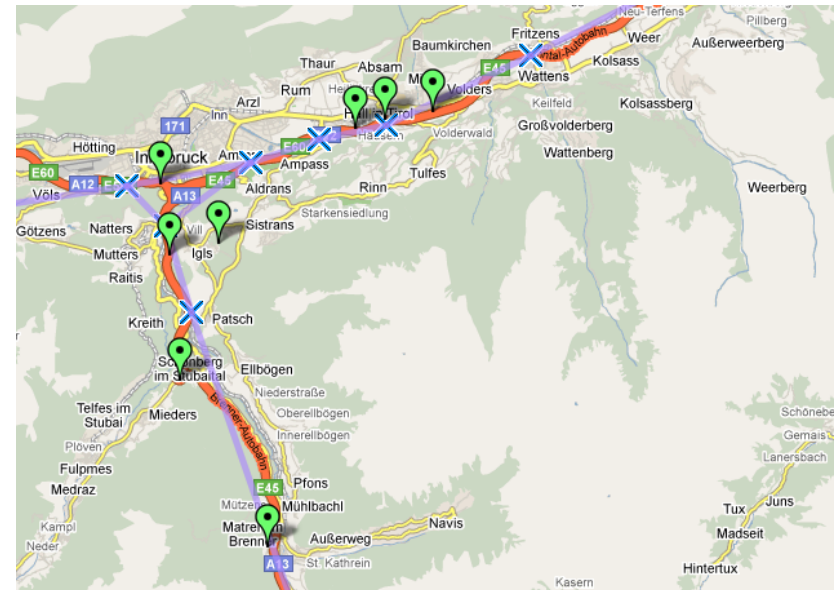
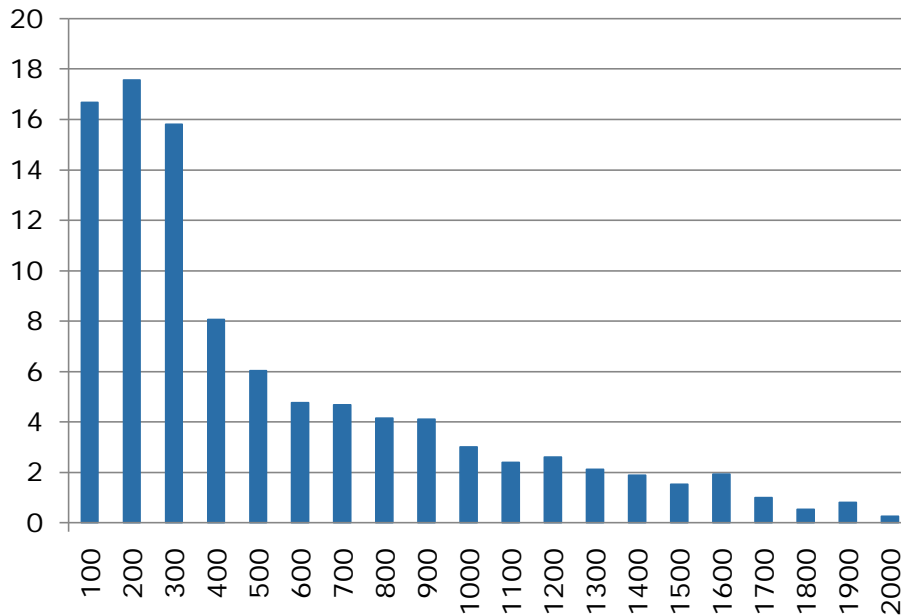
Service example: Dissemination of TPEG messages

Goal: distribute an event that occurs on arc (n_1, n_2) , D km to RSUs upstream for broadcast.



Experiments

Dissemination of 1000 replayed messages injected into an emulated network *



Histogram of delay [ms] distribution in percent

* S. Bessler, A.Fischer, E.Kühn, R. Mordinyi, S.Tomic, Using Tuple-Spaces to manage the Storage and Dissemination of Spatial-temporal Content, to appear in JCSS 2010

RSO Relation to ITS architecture under Standardisation in ETSI

- Fully supports the roadside infrastructure for cooperative service applications (as proposed by COOPERS project)
- V2I basic set of applications* can be realized in RSO:
 - Road Hazard Warning
 - Cooperative speed management
 - Cooperative navigation
 - Cooperative LBS
 - Communities Services
- Space based computing paradigm:
 - lightweight service environment in which a part of the facility layer functionality is available:
 - communication support (addressing, routing, session)
 - information support (navigational map)

COOPERS Service List

- S1. Accident/incident warning
- S2. Weather condition warning
- S3. Roadworks information
- S4. Lane utilization information
- S5. In-vehicle variable speed limit information
- S6. Traffic congestion warning
- S7. ISA with links to infrastructure
- S8. International service handover
- S9. Road charging to influence demand
- S10. Route navigation – estimated journey time
- S11. Route navigation – recommended next link
- S12. Route navigation – automatic road map update

*ETSI DTS 102 637-1 Basic set of applications

Open Standardisation issues in V2I Cooperative Systems

- Client models
 - thin client architecture (browser)
 - fat clients → application download and execution environment
- Standardisation of interactions between vehicle and infrastructure service platform
 - Service announcement
 - TPEG type message (one way, broadcast)
 - FCD message (one way)
 - Car initiated queries (sessions, dialogues)
- Map those interactions to defined message structures such as:
 - Decentralized Environment Notification Message (DENM)
 - Cooperative awareness message (CAM)
- Information exchange between infrastructure operators

Conclusions and further work

- Presented Roadside Overlay Network has many benefits:
 - Leverages the roadside infrastructure architecture
 - Reduces the load of traffic control center
 - Self-organization and self-healing features
 - saves configuration costs and enables node by node deployment
 - Provides virtualization of content storage in the network
 - Data centric routing mechanism → allows to store and process a message at the geographically closest node
- Standardisation:
 - better characterisation of service offering provided by infrastructure operator and an appropriate description of interactions are needed.

THANK YOU FOR YOUR ATTENTION !

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