Experiences and benefits of automation in Traffic Management Centres

EU EIP Workshop

Future Challenges for Traffic Management Centres

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Introduction

- Task 4 is part of EU EIP Activity 4.2 and it deals with automation of road operator ITS

- Main objectives of Task 4 are:
  - identify the requirements of automating the road operators´ ITS systems to facilitate automated vehicle – infrastructure integration
  - identify practices and lessons learned from implementing autonomic functions on road side and traffic centre systems
  - analyse optimal automation level of traffic control/management/information centre operations and services

- So far our activity has produced 3 deliverables and we had organized 2 workshops involving EU EIP and external stakeholders - https://eip.its-platform.eu/activities/sa-42-facilitating-automated-driving#Del

Automated and autonomic

- Our focus is on automation of TMC operations in general while also looking more specifically at the potential benefits of implementing autonomic functions

- Autonomic systems embody self-assessment and self-management abilities that enable the system to assess its own state, then adapt or heal itself in response to that assessment. The interface between system and owner is set at a very high level: the owner sets out goals, policies or service levels that the system must follow, and the system translates these into its system functions resulting in a change of behaviour*

*http://www-03.ibm.com/autonomic/pdfs/AC%20Blueprint%20White%20Paper%20V7.pdf

Autonomic functions for TMCs

- Proposed high-level autonomic functions for TMCs:
  - self-management
  - self-optimizing
  - self-healing
  - self-configuration

- Proposed supporting autonomic functions for TMCs:
  - self-learning
  - self-diagnostic

Recognised functions

- The following TMC functions should benefit the most from automation and autonomic properties:
  - Information on unplanned events (incident/obstacles information)
  - Information on planned events (roadworks information)
  - Traffic time information
  - Queue protection
  - Line control/traffic detour
  - Stationary vehicle detection
  - Variable speed limits
  - Dynamic Lane Management
  - Temporary Hard Shoulder Running
  - Ramp Management
  - Weather (actual and predictions) information
  - Design of traffic management plans
  - Calibration of traffic management equipment/systems
  - Cross-border traffic management
  - Wrong way driver information

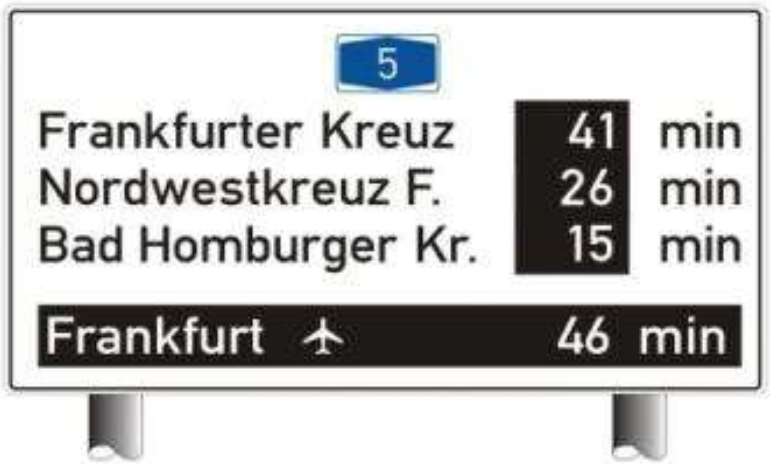
Automation scales

AUTOMATION FROM THE SYSTEM POINT OF VIEW		AUTOMATION FROM CENTRE OPERATOR POINT OF VIEW	
A4	Autonomic system	5	System is capable of and is trusted to make decisions in all situations. No operator involvement nor presence is needed
A3	Autonomic subsystem	4	System is capable of making decisions in all situations, but the operator may take over if there is a special need
A2	Autonomic software modules	3	System makes decisions, but in case it has no decision-making capability, the decision is left to the user made aware by the system of the dilemma
A1	Autonomic hardware modules	2	System makes decisions on actions, but operator always has a time window to interfere. In case of no decision-making capability, the systems notify the operator and just do not make decisions
A0	Automated module (as precursor of autonomic module)	1	Operator decides, but system provides recommendations
		0	Operator makes all decisions utilizing system output and displays

Examples of existing automation

- Traffic Control Centre Hessen

TMC Function	Levels
Traffic Time Information Services	A4; 5
Network Control Systems	A4; 5
Line Control Systems	A2; 4
Temporary Hard Shoulder Runnings	A0; 0
Roadworks/ Slot Management	A2; 4

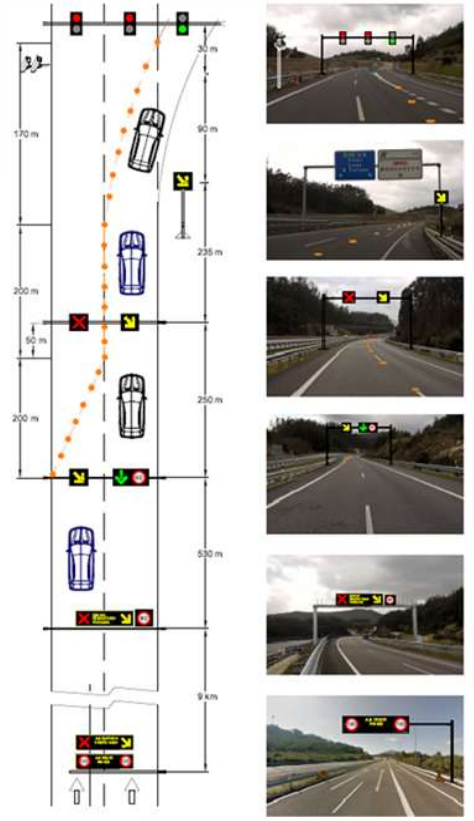


Dynamic sign with travel time information

Examples of existing automation

- Spanish Traffic Management Centres

TMC Function	Levels
Traffic Time Information	A2; 4
Weather information and pollution measures signalling	A0; 0
Queue protection	A2; 4
Dynamic Lane Management	A2; 1



Automated detour scheme on Motorway A-8, Alto del Fiouco

Examples of existing automation

- Traffic Management Centres in Finland

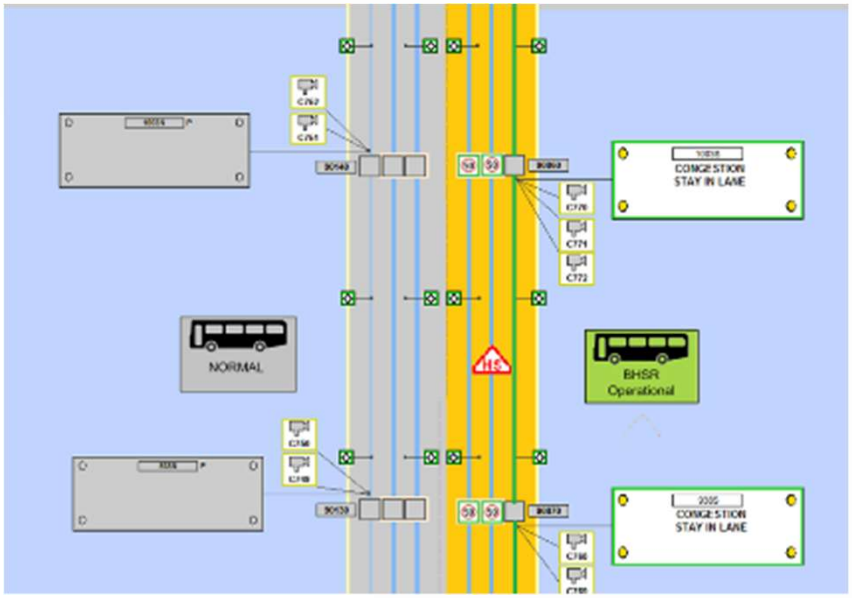
TMC Function	Levels
Variable speed limits	A0; 1
Information on unplanned events	A3; 5
Weather information	A2; 5
Calibration and diagnostic of traffic management equipment/systems	A2; 5
Wrong way driver information	A2; 1
Queue protection	A2; 5
Travel/traffic time information	A2; 5

Weather controlled Variable Speed limits

Examples of existing automation

- Traffic Scotland Systems

TMC Function	Levels
Queue Protection and Management	A2; 4
Bus Lane and Bus Hard Shoulder Running	A2; 1
Refuge Monitoring	A2; 2
Traffic Scotland Information Services	A4; 4
National Traffic Data System	A4; 5



Bus Hard Shoulder Running

Examples of existing automation

- Netherlands traffic management centres

TMC Function	Levels
Queue Protection	A4; 4
Variable speed limits	A4; 4
(Truck) Height Warning	A4; 4
Ramp Management (Ramp metering)	A4; 4
Traffic time information	A4; 4
Traffic flow information	A4; 4
Temporary Hard shoulder running	A3; 3

Traffic time information

How to assess the benefits of automation?

Deployment KPIs

- number of hardware components with automated alarms
- % of hardware modules capable of self-diagnostic and self-healing at least in 95% of cases without human intervention
- number of performed automated actions/unit of time
- % of traffic information messages updated automatically out of the total messages updated per day
- % of traffic information provided automatically per type of information
- % of automated operations with self-learning capability
- % of ratio of automated/manual road work/other maintenance operations planning per type of road

Operational KPIs

- % share of correct automated actions versus all proposed automated actions
- % reduction per year of operator man-hours for traffic management centre operations with reference to the introduction of the automation
- delays/decision times by automated system (could be compared by the ones of human operators)
- automatically detected incidents (compared with the ones by human operators)
- average latency (time needed) from incident detection to traffic information (compared to a human operator)
- average latency (time needed) from incident detection to traffic management operation (compared to a human operator)

Benefits for society

The safety related benefits are the following:

- The increasing of general level of safety on the road where the autonomic functions or systems are implemented;
- The avoidance of human errors in terms of taking the decision and solving the complex problems generated by incidents and failures;
- The increasing operator's speed of reaction in the aftermath of an incident and the reduction of time between the beginning of an incident and the intervention of the road operator;
- The increasing reliability of the system and increasing lifespan for all systems which are self-healing oriented;
- The integration and interoperability between autonomic systems will be better solved in terms of increasing the safety on road.

The service quality related benefits are the following:

- The decision of the system will be taken better and in shorter time;
- The general quality level of ITS services will be improved;
- The real time data as well as safety-related and sensitive data will be available at the right time and the decisions based on these data will be more accurate and responsive than the average human operator would take.
- The better monitoring of the system as well as the quality control will be done by the system itself and the reporting procedure will be cost and time efficient.

Conclusions

- There are already experiences with automation in TMCs showing benefits such as operator workload reduction, increased efficiency in operations, increase of road network capacity and safety, and reduction of traffic delays.
- All systems presented have automated operations for one or more of the selected functions.
- Although there is a large variation of the values among the different systems, functions with an overall low level of automation and, on the other hand, ones with and overall high level, can be identified. For example, traffic time information scored at least 4 on the scale of automation from the operator point of view in all implementations. In contrast, hard shoulder running scored at most 3 on the same scale, even as low as 0 in one implementation.
- The automation is needed and brings benefits for TMCs, but the operators should always be capable to and have the means to intervene whenever the system requires input, or when it becomes obvious that the system decision leads to a safety risk.
- There is potential for further advances of TMC automation in close cooperation with vehicle manufacturers.

THANK YOU FOR YOUR ATTENTION !

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