CHARM and the largest highway ATMS ever procured

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The CHARM initiative – the Common Highways Agency Rijkswaterstaat model – was (and still is) a large-scale, strategic collaboration between Highways England (now known as National Highways) and the Dutch Rijkswaterstaat. Its aim was to deliver an open and modular, next-generation advanced traffic management system (ATMS) for their national road networks.

Purpose and scope

At its core, CHARM aims to modernise and consolidate road traffic management operations across England's strategic road network by replacing ageing, fragmented, legacy systems with a single, integrated and future-proof road traffic management system. The initiative covers over 4,000 miles of motorways and major roads in England, and is on a similar scale in the Netherlands, with direct impact on resource management, incident detection, event planning and traveler information services.

Traffic is managed through regional and national traffic management centres, enabling more effective coordination and response to incidents, congestion and maintenance needs.

As part of the CHARM programme authorities procured a single traffic management platform – DYNAC®, provided by Austrian company Kapsch TrafficCom (with main partner CGI). It was measured against industry recognized ATMS offerings following strict selection criteria established for the procurement based upon technical and functional specifications as well as specific use cases envisioned for the National Highways and Rijkswaterstaat. The Kapsch DYNAC solution was selected to be delivered and implemented given its proven track record for mission critical ATMS applications, adherence to the technical standards, configurability and future proofing capabilities, sustainability, and overall value to the Agencies corresponding with the CHARM programme objectives.

What makes CHARM unique

Open, modular ICT architecture: The new system enables seamless integration with other commercial off-the-shelf systems and supports continuous innovation, helping prevent vendor lock-in and future-proofing agency operations.

Increased reliability and resilience: The system increases network resilience by operating all control centers regionally but within a unified national platform, enabling consistent procedures and improved oversight.

Lower long-term cost of ownership: CHARM aims to achieve net savings of around £66 million over 15 years [1][1].

Innovation Support: Through a pre-commercial procurement approach, CHARM challenged the market to develop new, innovative traffic management features, resulting in new incident detection and network management prototypes that are now integrated into the national ATMS.

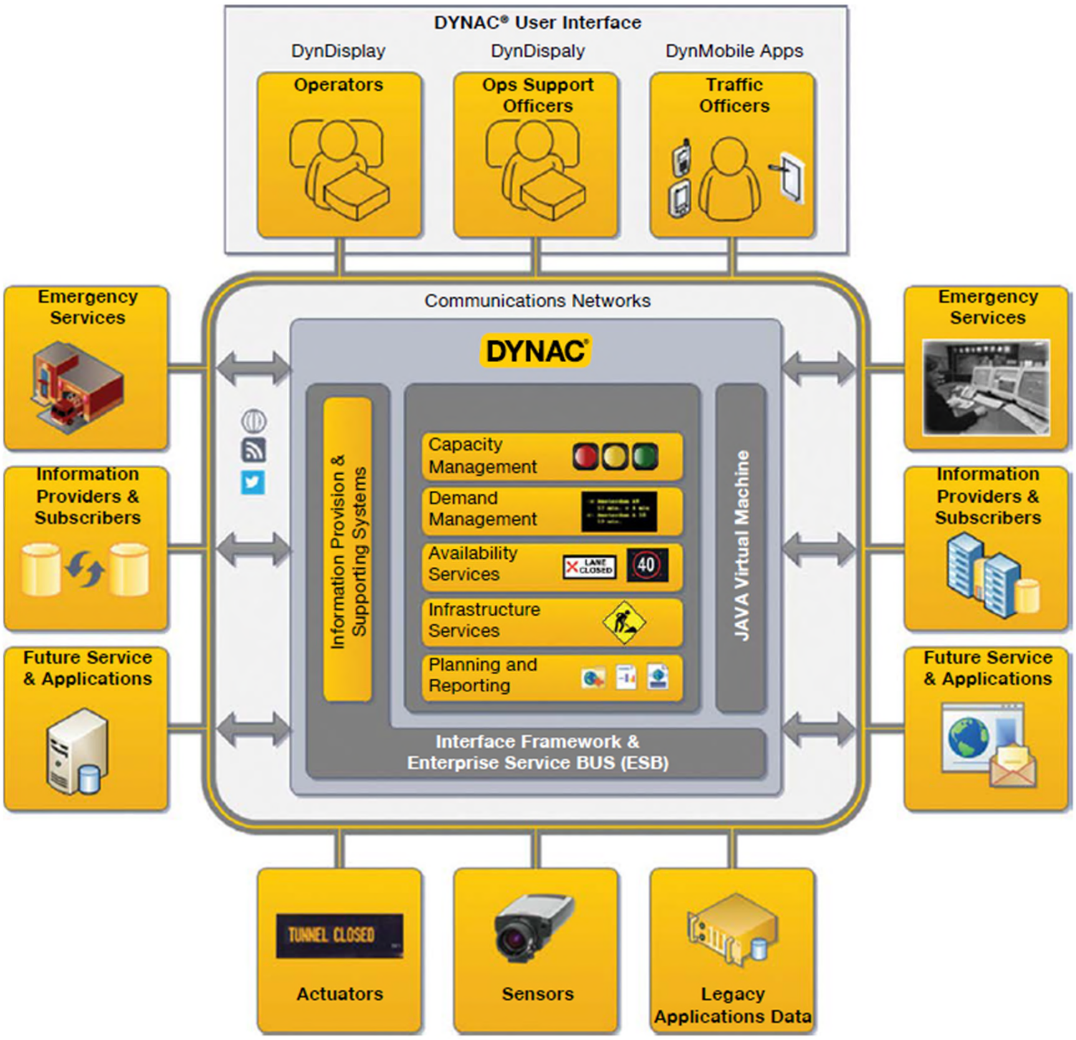

Figure 1 CHARM Integrated Systems and Services

Inside CHARM's Modular ATMS Architecture

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[1] https://s3.eu-west2.amazonaws.com/assets.highwaysengland.co.uk/digital+roads/Case+Studies_CHARM_FINAL.pdf

The CHARM Advanced Traffic Management System (ATMS) utilizes a state-of-the-art, open, and modular information and communication technology (ICT) architecture designed for scalability, interoperability, and future-proof traffic management across large national networks. The key components that define its structure are:

1. Modular integration platform

Enterprise Service Bus (ESB): This architecture utilizes a multi-layer ESB (core, edge, service) to enable flexible integration of various modules and components. The core ESB serves as a central integration point, distributing and guaranteeing message delivery. The edge ESB connects to roadside devices, supporting high-volume, low-latency communications. The service ESB connects to external services, enabling dynamic and responsive integration.

2. Data aggregation and processing

Data input layer: Collects data from multiple heterogeneous sources such as sensors (MIDAS loop detectors, CCTV monitoring, weather stations), external data sources and manual data input by the operator.

Common operational picture: Processing and combining incoming data to provide operators with a unified, real-time view of the road network, supporting monitoring and informed decision-making.

3. Control and response modules

Event and incident detection: Integrates advanced analytics to automatically detect and predict incidents, overloads, and events, enabling rapid intervention.

Dynamic response planning: Deploys rule-based algorithms and heuristics to automatically, respond to detected incidents, and proactively manage the network. Rules and policies can be configured at individual regional centers for local adaptation.

Distributed network control: Enables management across national and regional sites, providing resiliency and load balancing through virtual and clustered server deployments.

4. Flexible interface structure

Unified and standardized interfaces: The system supports more than 30 defined interface types and replaces more than 50 applications, enabling seamless integration with various asset categories (information signs, traffic lights, SVD (Smart Vehicle Detection), emergency phones, variable speed limits, connected vehicles).

Adapter layers and APIs: facilitate future module development and easy integration of new technologies and third-party systems, minimizing vendor lock-in.

5. Resource and Device Management

Comprehensive asset integration: from stationary roadside devices to mobile assets (traffic officers, NTIS (National Traffic Information Service) devices) – all managed within the same platform, supporting both legacy and next-generation technologies.

6. Operator and user interfaces

Customizable graphical interfaces: aggregate all relevant information for real-time network monitoring, validation, and operator control. They enable easy scenario management, report generation, and log analysis.

7. Resilience, Scalability, and Virtualization

Data centers and virtualization: Uses redundant data centers, load-balanced virtual server clusters, and 24/7 availability to ensure operational continuity and system resiliency.

Scalability: The system can be expanded and updated with new modules and services as operational needs evolve, ensuring future-proof capabilities for national road traffic management.

In summary, the CHARM ATMS system is based on the principles of modularity, openness, and interoperability, implemented through the use of an enterprise service bus, standard interfaces, configurable rule engines, advanced analytics, integrated resource management, and a resilient, scalable ICT infrastructure. This architecture enables innovation, reduces long-term costs, and provides the flexibility to adapt to new technologies and future needs

Assets and interfaces:

- 7 regional TMCs / 1 national TMC
- 7000 km motorway / 4M vehicles per day / 20k incidents per month
- 100 ramp metering devices
- 3,000 CCTV
- 3,500 message signs
- 100 meteorology devices
- 6,000 MIDAS sites (loop detectors)
- 10,000 signals (LUS, BOS, VSLS)
- 7,000 emergency telephones
- 3,000 NTIS devices (Incl. ANPR)
- 900 traffic officers
- 100 on-road supervisors
- 34 ATMS interfaces

Figure 2 Assets and Interfaces

How was the implementation carried out

The first Regional Operational Centre ROC) switched to DYNAC in 2020, with the rollout taking place in stages across all seven ROCs in England. The initial implementation involved the installation of the new system in control centres in England and the Netherlands, followed by further expansion and the signing of long-term support contracts.

Timeline of Events:

- 2015 – Contract Award: Kapsch TrafficCom was selected by National Highways to deliver the DYNAC Advanced Traffic Management Software.
- 2016–2018 – Development and Integration: This phase focused on designing and customizing the system, including CGI's development of the Enterprise Service Bus (ESB).
- 2019–2023 – Regional Rollout: DYNAC was gradually deployed across seven ROCs in England, with five going live by early 2023.
- 2024 – Final Steps: The last two ROCs undergo final testing and validation, with continued support and change management.
- June 2025 – Full Rollout: Complete rollout across all seven ROCs and upgraded to the same version of DYNAC.

Challenges faced during implementation:

- Integrating different systems: One major challenge was bringing together various legacy systems, custom technologies, and proprietary protocols into a single platform including large scale infrastructure owned and managed by others.
- Managing a large network: Coordinating the rollout across seven ROCs and over 4,000 miles of roads required detailed planning and execution.
- Adapting over time: Managing a long-term project meant handling evolving requirements and processing more than 50 change requests each year.
- Keeping services running: The team ensured uninterrupted service during the rollout using ITIL-based service management practices.
- Covid-19 pandemic: It had a notable impact on the implementation especially to on-site installation and testing all activities required for system integration, testing and support needed to shift towards remote collaboration,
- Diverging expectation of the solution from two different clients: CHARM started as a joint venture, but from project management point of view, over time the two agencies needs changed and Kapsch had to split CHARM into two project CHARM HE and CHARM RWS

What we learned

- Working together across borders: The CHARM initiative showed how successful international collaboration can be. By teaming up, the UK's National Highways and the Netherlands' Rijkswaterstaat created a shared, modular traffic management procurement process.

- A flexible, future-ready system: Thanks to its open and modular design, the DYNAC system easily integrates with older systems, adapts to new technologies, and simplifies upgrades and maintenance.
- Rolling out in phases reduces risk: By introducing the system gradually across the seven Regional Operations Centres , teams could catch and fix issues early, keep services running smoothly, and train staff step by step.
- Challenges of updating existing infrastructure: Reusing current infrastructure meant building custom interfaces, using robust middleware like Enterprise Service Bus, and conducting thorough testing.
- Pandemic: The pandemic accelerated digital transformation and cloud-based infrastructure adoption, which aligned well with CHARM's modular and scalable architecture. It also encouraged flexible service management practices, which were integrated into the AIMS support framework to maintain continuity
- Ongoing support is key: With over 50 change requests each year, the system needs agile development, strong collaboration with vendors, and a focus on continuous improvement.
- Training and knowledge sharing matter: To ensure all ROCs could use the new system effectively, comprehensive training, documentation, and support tools were essential.
- Customer relation: Developing a strong working relationship between the vendor and the client allows for challenges to be overcome and not multiplied.

Development of innovative traffic management prototypes within the CHARM PCP project

The CHARM PCP (Pre-Commercial Procurement) project was a collaboration between National Highways, the Dutch Rijkswaterstaat, and other partners. The project's primary goal was to stimulate the market for the development of innovative road traffic management modules that go beyond existing solutions, with a particular focus on modernizing and improving the efficiency of the national road network.

The CHARM PCP project used a structured, competitive process consisting of three phases:

Phase 1 – Concept and Feasibility Study

Several companies were selected to propose concepts for new road traffic management functions.

Phase 2 – Prototype Development

The most promising solutions were selected for further development and the creation of working prototypes.

Phase 3 – Testing and Validation

Selected prototypes were subjected to more rigorous integration testing and evaluation before being considered for adoption as final products. At each stage, the number of participating companies was gradually reduced to ensure quality and technical feasibility in each round.

The PCP program focused on three main innovation challenges:

1. Advanced Network Management: Developing modules to optimize traffic flows and enable dynamic intervention across the entire network.
2. Detection and Prediction of Incidents: Creating new approaches to early recognition and prediction of accidents or traffic jams.
3. In-car Systems: enabling communication between vehicles and infrastructure, offering in-car information and guidance.

Some examples of prototypes:

Advanced Network Management: One prototype used algorithms and rule engines to provide drivers with optimal route guidance via on-board systems, aiming to reduce travel times, emissions and the risk of accidents.

Detection and Prediction of Incidents: Modules designed to detect and predict road incidents using sensor data and advanced analytics.

In-car Systems: technology that enables direct communication between traffic management centers and drivers, providing real-time guidance and hazard warnings, regardless of the type of road infrastructure or vehicle make.

This process encouraged both established industry leaders and new entrants to compete, fostering the cross-fertilization of ideas. The prototypes had to be compatible with the new DYNAC based ATMS platform.

The solutions were demonstrated and evaluated through reports and live tests, ensuring a robust and practical innovation before scaling it.

Six operational prototypes for incident detection, network management and collaboration within ITS functions were delivered and integrated with CHARM's ATMS system[2]. The PCP approach promoted competition in the market and provided solutions tailored to real operational needs. The project documented the process and results with a view to potential replication in other regions of Europe.

The CHARM PCP project successfully improved road traffic management by using a rigorous, phased competition to develop, test, and implement innovative prototypes. This approach not only delivered state-of-the-art solutions for National Highways and Rijkswaterstaat, but

[2] https://www.interregeurope.eu/good-practices/common-highways-agency-rijkswaterstaat-model-pre-commercial-procurement-charm-pcp

also established a replicable model for cross-border procurement of innovations in transport systems.

Final thoughts

CHARM is seen as a project of strategic importance to National Highways, underpinning its work to:

- Ensure reliable travel by enabling faster, more informed decision-making.
- Increase operational efficiency by digitizing workflows and standardizing processes.
- Be prepared for integration with new vehicle technologies and future digital services.

In summary, CHARM introduces a state-of-the-art, modular road traffic management platform that enhances the efficiency, safety and resilience of England's (and the Netherlands') strategic road network, with a focus on adaptability and sustainable cost-effectiveness.

It is important to further invest in analytics which can help improve traffic modeling and proactive maintenance planning with continuing evolution of the DYNAC platform with regular software updates and integration of new technologies like, connected vehicles and AI for incident detection