Tools for the TOC
- An overview

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1. Background

The operation and maintenance of operational technology is an important part of Highways England's management of the Strategic Road Network comprising nearly 100,000 devices with an estimated replacement cost of approximately £4.8bn.

In order to realise the benefits of future strategic programmes of work, such as the Smart Motorway and Expressway programmes, Highways England need to ensure that the operational technology it deploys is available and performs to a high standard.

The Operational Technology Strategy (ref. [1]) describes how these challenges will be addressed through the development of central resources including a dedicated technology management function housed in a Technology Operations Centre (TOC). The Tools for Technology Operations Centre (T-TOC) project[1] is intended to deliver a set of technical solutions to support the technology management function. The project will look to re-use resources and systems from other projects where appropriate.

2. Proposal

The Operational Technology Strategy represents a shift away from the current operational model, where regional maintenance contractors act independently to meet individual network level KPIs. It describes a new model where operational decision-making is centralised and Highways England staff take overall control of the delivery and operation of technology, directing service organisations to perform the tasks required. This more holistic approach also aligns with the new Asset Delivery[2] approach being adopted across Highways England which has already being implemented in Area 7.

Whilst a major driver of the T-TOC project is the need to replace life expired systems used for operational technology, there is also a requirement to ensure that the systems we procure are flexible enough to support the service management requirements of our business IT .

In order to deliver this operational model, a Technology Operations Centre (TOC) will be created and will be operational 24/7. It will adopt best practise from other industry sectors which manage significant numbers of technology assets across extensive geographic areas, such as telecommunications and utilities operators, and builds on the approach taken by the National Roads Telecommunications Services (NRTS) contractor. The T-TOC project will support the TOC by providing tools and building ITIL aligned processes.

Within the TOC, a single service desk will cover all operational technology and co-located staff, with access to a consistent set of information, will enable remedial work to be prioritised and co-ordinated, building intelligence at the centre of HE operations. The T-TOC project will deliver the systems required to support the work carried out in the TOC, and more widely in supporting and maintaining the operational technology.

[1] The project was previously referred to as the SDS Futures project.

[2] Previously referred to as the Asset Led Delivery Model (ALDM)

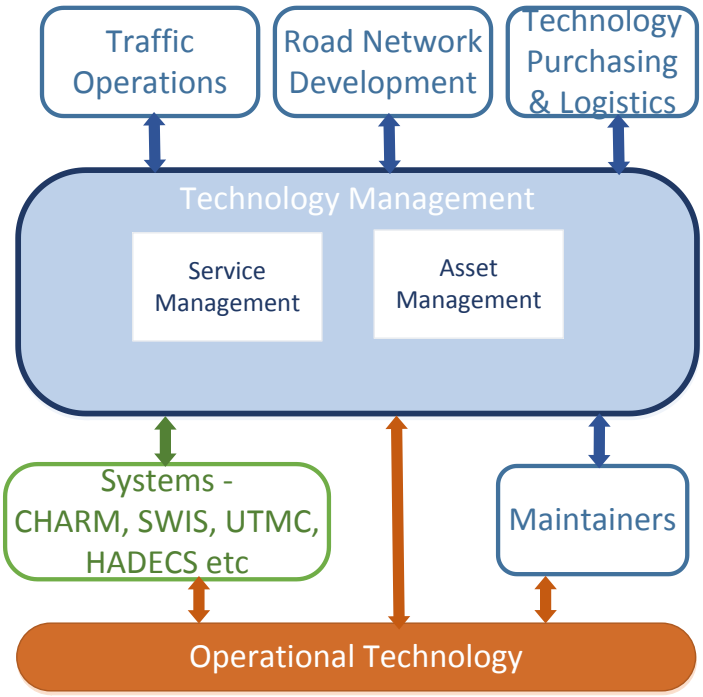

Figure 1 - TOC Context

T-TOC will utilise CHARM, as it is rolled-out across regions, to monitor operational technology. This will in turn enable the existing TPMS[3] and associated HALOGEN[4] systems to be gradually retired. T-TOC will communicate with other systems to bring all of the technology deployed to manage the road network under the maintenance and management regime. These other systems include the weather system SWIS[5], with its own network of roadside monitors, and Ramp Metering installations.

Going forward industry standard approaches, in particular SNMP[6], will be used to monitor operational technology directly.

Automated analysis of monitored technology will identify incidents on the road network and subsequently generate the workflows required to manage these through to resolution. Since T-TOC will now be providing the workflows necessary to support all of the tasking activities for the TOC, it will replace other existing tools such as the Planned Engineering Works (PEW) system. Similarly, T-TOC will replace the manual fault reporting capability provided by the National Fault DataBase (NFDB), so this too will not be required.

These processes will all be underpinned by a definitive inventory of operational assets, and related content, which is aligned with descriptions of spares procured and held by the Technology Purchasing & Logistics team, and supports a common view of assets, their status and location. Effective data sharing will ensure that all relevant parties across the organisation will have access to this same consistent set of information.

[3] TPMS – Technology Performance Management System – current fault and asset management system used for operational technology

[4] HALOGEN – HA LOgging ENvironment – current System used to monitor the status of roadside technology

[5] SWIS – Severe Weather Information System

[6] SNMP – Simple Network Management Protocol

This approach will improve the performance and availability of operational technology, build capability in a standardised and well governed manner, and allow Highways England to meet the requirements of the Roads Investment Strategy (RIS).

3. System Architecture

Figure 2 below illustrates the key proposed T-TOC logical applications and the Highways England systems it will collaborate with. The T-TOC project intends to build the architecture, its applications and interfaces in an incremental way using an agile development approach. Where beneficial facilities, resources and software already owned by Highways England will be re-used. The scope of the T-TOC applications is shown by the red dashed line.

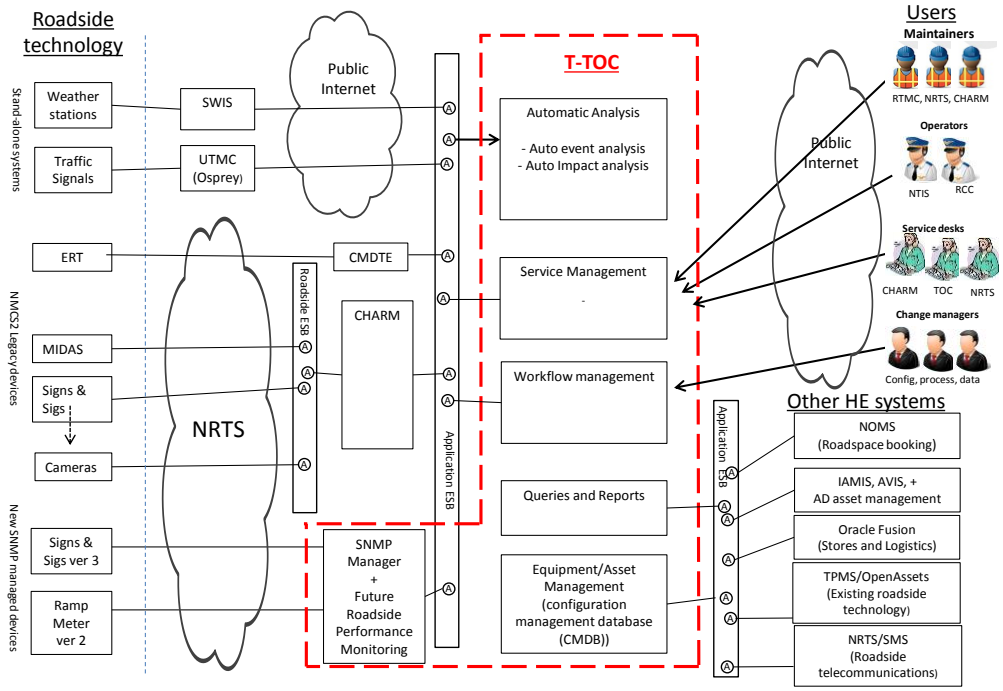

Figure 2 - Service/Asset management Solutions to deliver Future Technology Operating Model

4. T-TOC Applications

The T-TOC system will be delivered through a set of integrated COTS[7] applications that will be selected, configured and deployed during the development. These applications can be considered as falling into one of the logical groupings described below.

4.1. Automatic Analysis

Roadside technology will be monitored either through the owning systems, such as SWIS or CHARM, or more directly using a standard network management platform, the SNMP Manager. The status of each device, and any alerts raised, will be analysed. If the technology is not operating correctly, an incident will be raised for the Service Management grouping.
The sophistication of the analysis is expected to develop over time as more information becomes available and the business' understanding of the technology matures. There is a wide

[7] COTS – Commercial Off The Shelf

range of software on the market that provide this sort of automatic analysis of equipment status across distributed networks.

4.2. Service Management

Incidents raised by Automatic Analysis, other systems and users will be managed under ITIL aligned processes using a COTS service management product. Highways England are currently trialling ServiceNow Express for the purposes of CHARM service management.

4.3. Workflow Management

There are numerous business processes within Highways England and the wider community of maintainers and suppliers that will support the Operational Technology Strategy. These will include: incident management, configuration control, asset management planning and equipment deployment. Supporting those processes with workflows will improve the efficiency of the processes, the quality of data collected and provide tracking of the maintenance activities.

4.4. Queries and Reports

The T-TOC project will store at least 3 years Logging and recording of data generated by T-TOC. Standard query and reporting tools will be used to build “real-time” dashboards, management reports and ad hoc visualisations. Highways England are looking to put in place common storage capabilities across many projects Ideally other business teams within Highways England, such as CHARM, will utilise the same common storage and share access to data.

4.5. Equipment/Asset Management

Highways England is committed to improving asset management within the business, including alignment with the ISO 55000 standard. T-TOC will deploy asset management tools, including a searchable document repository, to manage both the deployed assets (message signs, traffic counting sites, camera locations etc.) as well as the individual items of equipment used to build those assets.

4.6. SNMP Manager

For new equipment Highways England is committed to using SNMP, a de facto standard for managing networked devices. This protocol enable families of road side equipment to be managed by standard equipment, called SNMP Managers. The use of these devices will represent a step change in Highways England’s monitoring of roadside technology which legacy systems cannot provide. T-TOC support for SNMP is a key deliverable.
SNMP Managers will require a physical connection to the NRTS network which will limit the options for their hosting. The current assumption is that they would be hosted within the CHARM data centres.

5. Network Architecture

T-TOC is dependent on a number of physical and logical networks to acquire and publish information. The sections below describe how those networks are used.

5.1. Enterprise Service Bus

Highways England’s enterprise architecture calls for an Enterprise Service Bus (ESB) to provide a managed approach to the publication of web services.

The CHARM project is leading in this area and will be deploying web services into Red Hat™ Fuse™ instances within a Red Hat™ Openshift™ environment. It is envisaged that the T-TOC project will deploy services into a similar linked instance. The aim is to enable the exchange of data and invocation of web services across the business.
In the diagram (Figure 2) it refers to the Roadside ESB and Application ESB. This refers to a distinction within the CHARM infrastructure where some services require higher performance

and throughput than others. This distinction is important within CHARM but will be invisible to T-TOC, which will call services by name.
T-TOC will use the ESB wherever possible to communicate with all other Highways England systems, especially CHARM.

5.2. National Roads Telecommunications Services (NRTS)

The NRTS contract manages the roadside networks. For security reasons access is only through a limited number of physical nodes. T-TOC will have to be connected to NRTS in order to access SNMP devices through SNMP Managers. NRTS will also provide the connection for managing the Emergency Roadside Telephones. This physical connection is likely to be shared with CHARM in its dedicated data centres.

5.3. Public Internet

T-TOC will use the Internet to communicate with its community of users using desktop and mobile apps. It will also connect to standalone systems, such as SWIS and UTMC[8] systems, in order to monitor their devices.

6. Monitoring Roadside Technology

6.1. Standalone Systems

Highways England has a number of systems that are hosted away from Highways England. Examples include SWIS and UTMC systems, which manage traffic lights. These systems already have web services for publishing the status of the technology they manage, accessible through the public internet. T-TOC will build adaptors to enable those services to be accessed by the Automatic Analysis grouping within T-TOC.

6.2. NMCS2 Legacy Devices

The NMCS2[9] devices are currently polled by HATMS[10]. T-TOC will not attempt to interface to HATMS or directly to the NMCS2 devices. Instead CHARM[11] will poll the devices and then pass on status information to T-TOC through an agreed web service, published on the ESB. As CHARM deploys into regions it, and T-TOC, will manage an increasing number of NMCS2 devices. A corollary of this that existing systems will manage a decreasing pool of NMCS2 devices until CHARM is fully deployed.

6.3. Emergency Roadside Telephones (ERT)

ERTs are currently managed through a standalone system known as the CMDTE[12]. T-TOC will provide an enhanced management approach that will aim to re-use the unique telephony capability of CMDTE[13] while integrating ERTs into the wider management of operational technology.

6.4. New SNMP Managed Devices

Highways England is mandating that all new roadside equipment supports SNMP. This equipment will be connected over the NRTS network to an SNMP Manager within T-TOC. In the longer term as SNMP capable devices replace legacy equipment this will become the normal route for monitoring and management.

[8] UTMC - Urban Traffic Management Control - used to control traffic signals

[9] NMCS2 – National Motorway Communications System Mk2 – a bespoke protocol used for communicating with roadside devices which dates back to the early 90's

[10] HATMS – HA Traffic Management System – legacy systems used to control motorway signs and signals

[11] CHARM – A new Advanced Traffic Management System which will replace HATMS

[12] CMDTE -Centralised Maintenance Depot Terminal – a bespoke system which records faults on ERTs.

7. Other Highways England Systems

7.1. CHARM

The CHARM system will provide T-TOC with status information for all the NMCS2 devices that it polls. In turn T-TOC will provide CHARM with information about the status of all the operational technology on the road network.

7.2. Network Occupancy Management System (NOMS)

The NOMS manages the traffic management possessions on the road network. T-TOC will develop an interface to NOMS that will enable traffic management planning to be an integral part of incident resolution.

7.3. Integrated Asset Management Information System (IAMIS)

The IAMIS contains, in association with other systems, information about physical assets on the road network, such as bridges, gantries and cabinet bases. T-TOC intends to link the location of operational technology assets to physical items described in IAMIS. For example a message sign might be linked to the gantry it is installed on. This will enable important information about access to sites and power usage currently held separately to be shared.

7.4. Oracle™ Fusion™

The Technology Purchasing & Logistics team has the accountability for maintaining a stock of equipment, with appropriate spares, for dispatch to maintainers as required. They are currently in the process of adopting the Oracle™ Fusion™ product to support their work. It is important that T-TOC and the stores systems share a common understanding of the inventory of equipment components and software that is required for each operational asset. Ideally components will be tracked through stores systems and T-TOC using the same identifier.

7.5. TPMS/OpenAssets

Although the existing maintenance system (TPMS) will be retired by T-TOC they will co-exist at least until CHARM is fully deployed. The two systems will exchange information, using data extracts, to maintain a consistent view of the equipment and the operational assets.

7.6. NRTS Service Management System (SMS)

The new NRTS2 service provider will be providing a Service Management System which will be required to publish the status of all the roadside telecommunications services. T-TOC project will use this data to link the unavailability of roadside technology with the loss of NRTS services.

8. Users and Other Stakeholders

8.1. Maintainers

Maintainers carry out the repair and maintenance activities, often at the roadside. They will be assigned incidents to resolve. The ambition is for T-TOC to identify any required spares, describe the work required, schedule planned maintenance and measure the performance of the maintainers in new ways.

T-TOC will provide detailed information about issues with equipment, hold specifications/instructions (such as safe access methods) and support pre-emptive maintenance.

The T-TOC workflow will also support other activities, such as equipment installation and testing, co-ordinated with configuration changes to both T-TOC and CHARM.

8.2. Technology Operation Centre (TOC) Operators

TOC operators represent a new, more active, role for Highways England in managing the operational technology. T-TOC will provide an improved (deeper and broader) view of the

issues with operational technology together with the tools and data for analysis of underlying issues. The RCC operators who manage road traffic incidents and operate the technology (eg setting signs), will be able to access the some of the tools provided by T-TOC to report and track progress on fixing technology faults.

8.3. Service Desks

By aligning with ITIL and, possibly, sharing the service management platform T-TOC will support common working across the service desks within Highways England. In particular it will enable information about incidents to be exchanged to provide a common view.

8.4. Change Managers

T-TOC will support a common configuration and change strategy across road scheme design and delivery, operational technology, fixed asset management and control systems (such as CHARM). This will enable those change processes to be better managed, more responsive and better co-ordinated.
It is proposed that CHARM and T-TOC share a change management team to facilitate co-ordination.

References

[1]	Operational Technology Strategy v1.0 dated 18 Jan 2016	Agreed strategy for managing roadside and associated technology