INTEGRATING ARTERIAL AND MOTORWAY MANAGEMENT IN AUCKLAND NEW ZEALAND

KAREN FEHL, SENIOR CONSULTANT, RESOLVE GROUP LTD

ABSTRACT

The Auckland region of New Zealand (NZ) has had an active traffic management system (ATMS) for 14 years. Over this time the traffic management system (TMS) has been enhanced and expanded to operate 24/7 from a dedicated transport operations centre (TOC) that manages traffic on the state highway network. The network of traffic signals on the arterial network and junctions with state highways and motorways is operated from the same TOC but other aspects of traffic management systems are not integrated.

Early in 2014, what we believe to be the first New Zealand tunnel safety and traffic management system on an urban arterial road will be integrated into the state highway traffic management system. The cut and cover tunnel is being built as part of a suite of transportation construction projects called the Auckland Manukau Eastern Transport Initiative (AMETI)and is being referred to as the Panmure Covered Box or AMETI Tunnel. In addition, an enhancement to add key arterial routes and equipment to the TMS graphical information system (GIS) and management system is also underway.

Once these two projects are successfully completed, operators at the TOC will be able to manage traffic beyond the state highway network in Auckland, paving the way for progressively more expansion of the system in the future as other arterial routes are added. This will allow the benefits of active traffic management to be experienced over a greater portion of the road network in the region, and across different levels of road hierarchy.

This paper will discuss the operational, technical and management aspects of bringing urban arterial traffic management under an existing state highway management system.

KEYWORDS: Traffic Operations Centre (TOC), Incident Management, Variable Message System (VMS), Traffic Management Systems, Active Traffic Management

INTRODUCTION

Fourteen years ago, the first ATMSs were introduced in Auckland and Wellington, New Zealand (NZ). Since then, they have been expanded, upgraded and integrated for full time traffic management operated from dedicated TOCs in Auckland and Wellington. A third TOC is being established in Christchurch. *Figure 1* shows the location of these three NZ cities. In Auckland over the past two decades, a number of tools such as ramp metering on all motorway on-ramps, journey time information signs, extended dynamic lane management on the Auckland Harbour Bridge and beyond, and increased

CCTV and variable message sign (VMS) coverage have been implemented in Auckland. This has allowed continuing optimisation of the state highway network with managed motorway techniques on NZ's busiest urban motorway network. *Figure 2* illustrates the key transport networks in the Auckland region. The dark orange routes are motorways, orange shows state highways or primary arterials and the grey line indicates the rail network in the region.

Figure 1: Map of New Zealand showing the location of the three TOCs

Figure 2: Map of Auckland Region showing transport links

On the Auckland local arterials, there have also been many tools introduced for better traffic management including VMS for event management, CCTV monitoring of intersections, public transport timetable information systems and journey time information signs. Other dynamic traffic management tools such as parking availability signs in city centre parking buildings have also been introduced. The region's traffic signals are managed and operated from the Joint Transport Operations Centre (JTOC) however, while the signals operators manage the SCATS for both the local arterial network and the state highways, there has been no other integrated traffic management at the system level.

JTOC is an entity set up and funded jointly by Auckland Transport (AT) and the New Zealand Transport Agency (NZTA). AT and NZTA share a common goal of delivering their services under a "One Network" philosophy where the boundaries between organisations, jurisdictions and even modes are seamless to the user and information is accurate, useful and timely.

In addition, both AT and the NZTA are working together to optimise network performance using all of the tools available to them, thereby getting the most benefit out of the existing infrastructure, road space and intelligent traffic management tools.

In 2009, a project to upgrade the original ATMS software to better meet the needs of the NZTA commenced. The result has been the staged implementation of DYNAC® Enterprise Server (DYNAC) across the whole country, a traffic management system software package developed by Transdyn Inc. Among the reasons for upgrading the TMS software was its off-

the-shelf nature. The updated TMS provides better opportunities for expansion and enhancement of the system to control different devices, expand coverage and improve the level of influence the system has on the One Network.

Figure 3 shows an overview of the DYNAC system as it will operate once the projects described in this paper are complete.

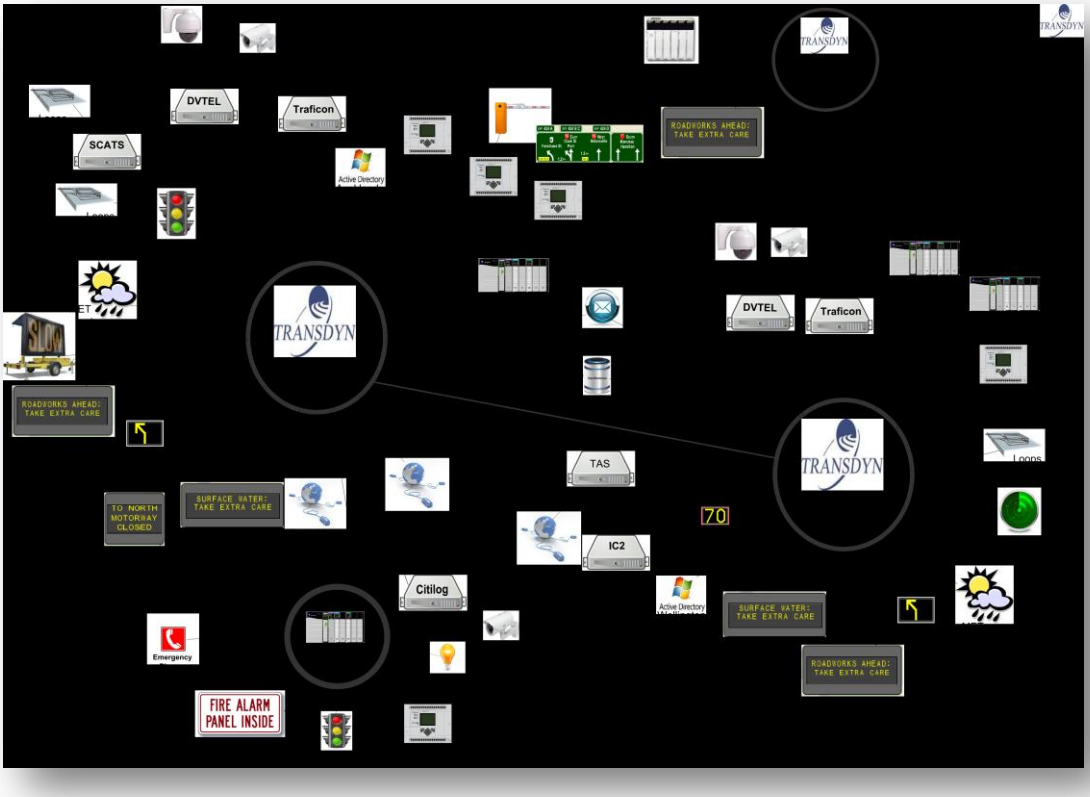

Figure 3: DYNAC System overview diagram (Source: based on a diagram developed by Ian Callan, Transdyn)

BACKGROUND

The NZTA is responsible for the management and maintenance of 11,000km of state highways throughout the country. The Agency works closely with other territorial local authorities (TLAs) that are responsible for everything from roads and footpaths to cycling, parking and public transport within their local jurisdiction. In Auckland, the TLA is Auckland Council, whose transport functions are undertaken by Auckland Transport (AT), a Council controlled organisation.

Like many countries, NZ has continued to experience urban drift and increased immigration in the past 30 years. This has been accompanied by increasing car ownership rates and urban intensification. While local planning laws have encouraged this, growth has not generally been accompanied by commensurate levels of investment in the transportation network. NZ also sits in the top four countries in the world in terms of private vehicle ownership per head of population.

These factors have contributed to steadily increasing traffic volumes and congestion across the Auckland region. The NZTA's records show the average annual daily traffic (AADT) on the Auckland Harbour Bridge (AHB) in 1990 was 120,000, rising to nearly 158,000 in 2012 with no increase in available lanes. On the city's Southern Motorway, as it approaches the city centre across the Newmarket Viaduct, the 1990 AADT was recorded as 118,500, rising to over 160,000 in 2012. As well as the increase in traffic volumes, the peak periods have continued to spread over longer periods of the day. On the northern approaches to the AHB for example, the city bound peak periods each extend for more than three hours, during which time average speeds drop to below 30km/hr in places. Traffic volumes on the arterial network also reflect these increases.

Auckland Transport, as part of their strategic planning, has identified a number of congestion hotspots and areas for likely future growth around the region for targeted improvements. The Panmure area, to the east of the city centre, is one such area. In Auckland, improving the motorway flow and providing accurate and timely travel information is of limited use to road users if access to the motorways is heavily congested and the local network cannot provide efficient alternatives when incidents occur. The inclusion of the arterial network in the TMS is a step towards addressing this issue.

INTEGRATING ARTERIALS INTO THE TRAFFIC MANAGEMENT SYSTEM

Future expansion of DYNAC will include adding new and existing equipment located on the local arterial network to the TMS managed by JTOC. This will allow progressively more ability for the operators to record and monitor incident information from the arterial network and distribute information to users (and network managers) of both the arterial and state highway networks.

The motivation for the gradual expansion of the network controlled by the TMS is reflected in the JTOC charter, which aims to provide an integrated approach to moving people, goods and services safely and effectively throughout the Auckland region. A further objective is to allow customers to make smarter, more informed choices about the way they travel.

As a partnership between AT and the NZTA, JTOC's aims reflect the two parent organisations' focus on providing one single network with seamless boundaries across Auckland. As previously mentioned, this is known as One Network, and is a recognised operating philosophy for the organisations. JTOC also reflects the partner organisations' focus on getting the most out of the current network and systems.

There are currently two separate projects that are contributing to the expansion of the TMS to the arterial network. Both are planned for commissioning in the first half of 2014, and both will provide the opportunity for traffic and incident management in a more integrated way. The two projects are the Panmure Covered Box, an instrumented covered road being built as part of the Auckland Manukau Eastern Transport Initiative (AMETI) and the Auckland Arterials Enhancement project.

AUCKLAND MANUKAU EASTERN TRANSPORT INITIATIVE (AMETI)

AMETI is a group of transport projects for the eastern suburbs of the Auckland metropolitan area that aims to give residents greater transport choices and to unlock the economic potential of the area. This is being achieved by improving strategic transport links in the region and by encouraging more people onto public transport so that roads are freed up for freight and business traffic. Roading improvements will focus on unlocking areas of key congestion.

At present, all existing routes are heavily congested with local and through traffic competing for road space. This also has a negative impact on public transport, walking and cycling. In future it is anticipated that specific routes will focus on local journeys and public transport while other routes will become the primary route for through traffic to central Auckland and for freight and business traffic[i].

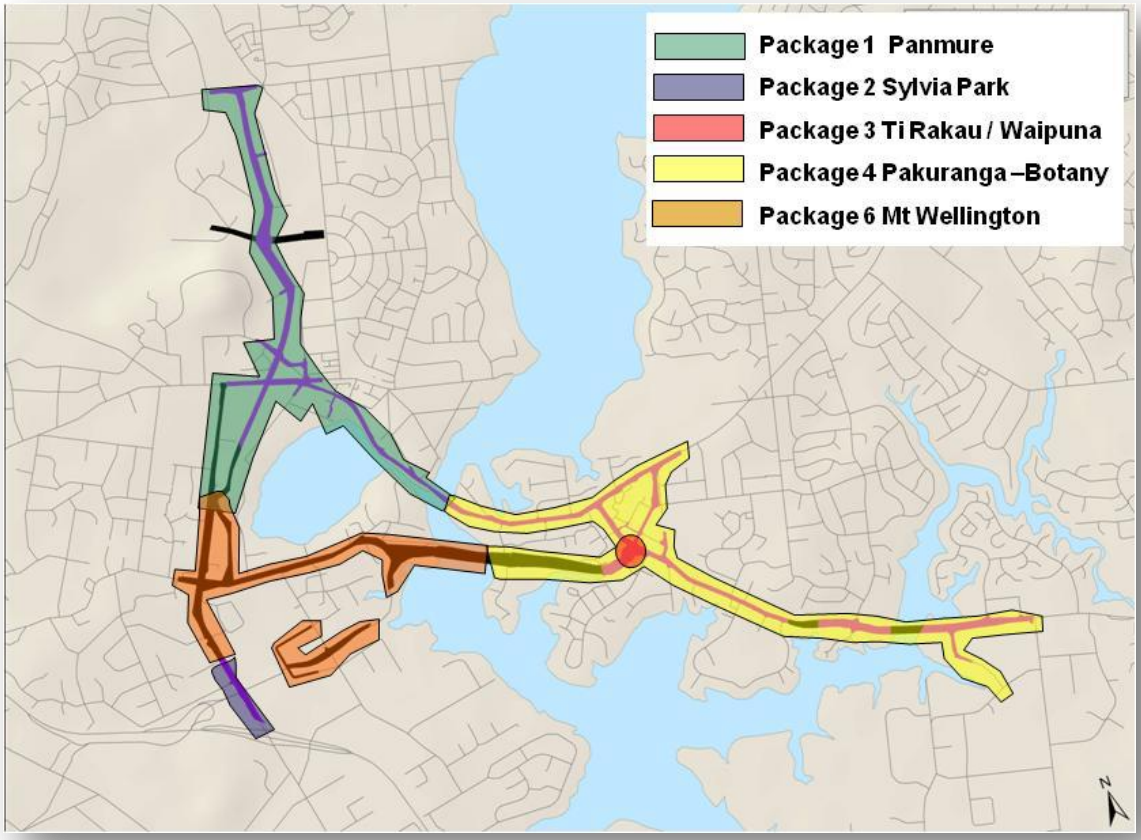

Figure 4: Diagram showing AMETI Packages (Source: Auckland Transport)

The AMETI improvements are being delivered in a number of stages and packages as illustrated in *Figure 4*. The first package (shown in green in *Figure 4*) is currently under construction and consists of a new bus/rail interchange and a new link road to connect congested Mt Wellington Highway with the area to the north of Panmure. This new road and the adjacent railway line will pass under an existing arterial road, a new local road from where passengers board buses and a new pedestrian plaza. Covering the road and rail corridors in this manner will help to avoid severing movement between the station, the Town

Centre to the east and proposed developments to the west by providing low-traffic and pedestrian friendly areas above it. This covered section of the new road is known as the Panmure Covered Box or AMETI Tunnel[ii], and its cross section in *Figure 5* shows how it relates to the rail and bus facilities. The site of the Panmure Covered Box is located approximately 3km from the motorway network.

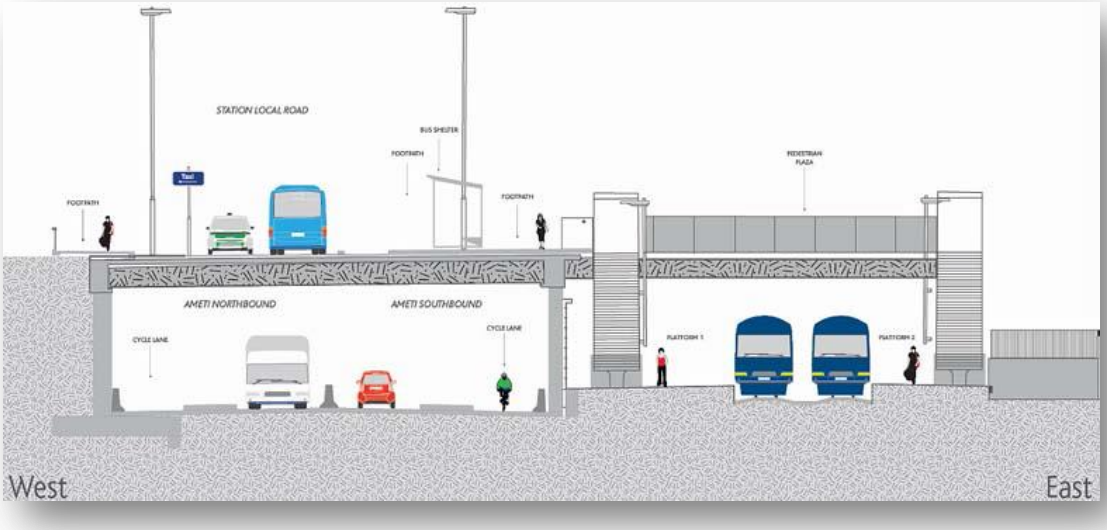

Figure 5: Cross section showing AMETI Phase 1 road and rail tunnel arrangement (Source: Auckland Transport)

PANMURE COVERED BOX

The Panmure Covered Box is 220m long and in many respects will act like a short urban road tunnel. It is to be fitted with fire safety and incident management equipment so that it can be automatically monitored and remotely managed. The NZTA already manages tunnels on the state highway network in Auckland, Wellington and Christchurch using the TMS, DYNAC. Operational procedures are in place, and the tunnel systems are key to the safe and efficient operation of strategically important routes.

The Panmure Covered Box does not have the same level of strategic regional importance as the state highway tunnels, but there are significant advantages for integrated incident management across all regional road tunnels and the decision has been taken for the Panmure Covered Box systems to be fully integrated into DYNAC. The intention is for the system to be operated in the same manner as the other tunnels under JTOC control.

The key business needs for the Panmure Covered Box are defined as including[iii]:

- Visual monitoring of traffic flow approaching and within the tunnel
- Quick identification of incidents and emergencies within the tunnel
- Provision of early and accurate warning / advisory messaging to drivers and cyclists during incidents or emergency situations

The equipment being provided to achieve this is:

- VMS at key junctions on the approach to the Panmure Covered Box
- CCTV coverage at key junctions, co-located with the VMS
- Automatic video incident detection
- Loop-based detection for performance evaluation
- Lane control signs to indicate when the tunnel is closed
- Barriers at either end of the tunnel
- A public address system and emergency sounder and strobes
- Linear heat detection system linked to an automatic fire alarm raised with the New Zealand Fire Service
- Fire hydrants and booster system
- Emergency exit and way finding lights
- Emergency telephone system
- Communications and power redundancy systems

The equipment and associated control systems listed above is being procured and installed as part of the construction contract for the Panmure Covered Box, while the software integration work is being undertaken by the TMS vendor as a DYNAC system enhancement.

CHALLENGES AND OPPORTUNITIES

Although JTOC is a joint organisation funded by AT and the NZTA, to date the procurement and enhancements to the DYNAC TMS have been funded solely by the NZTA. For this project, AT is funding the procurement, implementation and testing of the equipment and the software integration work. In addition, AMETI is part of a capital expenditure project run by AT's capital projects team. This is has meant that an AT capital projects team has had to manage the design, implementation, integration and testing of a system that will ultimately be handed over to JTOC to operate.

As a result of the different funding arrangements for this project, a balance has needed to be found between providing a look, feel, and operating interface that is consistent with other tunnels operated by JTOC, and the expectation the project funder has for a cost effective project that is fit for the purpose. As the AMETI link road that runs through the Panmure Covered Box is an arterial road with a planned speed limit of 50 km/hr (possibly rising to 70 km/hr at some stage in the future), it will have a different role in the regional road hierarchy from the motorway system.

This differing approach between the organisations was particularly apparent because the Panmure Covered Box is the first new piece of AT road being instrumented for eventual management by JTOC. The different strategic importance of the Panmure Covered Box will be reflected in the way it is operated, however many of the details of this have not yet been determined. In future, the issues associated with this will be easier to manage because there will be a precedent for JTOC management of arterial roads to either follow or modify.

Historically the design of the Panmure Covered Box and the wider AMETI project was completed earlier than the development of the concept of

operations for the tunnel. The addition of the TMS equipment and system has followed the design of the rest of the project.

This has been a challenge for the design team, who have had to revisit many aspects, in particular the fire system, the need for barrier arms and the system architecture once the operational requirements were defined and agreed. The construction team and the system integration teams have had a number of elements change at a late stage resulting in variations to the original contract to achieve a consistent approach to TMS between the Panmure Covered Box system and the rest of the TMS.

Commissioning and testing has not yet been completed for the project. During testing, some elements that have not been used in the TMS to date will be tested. Of particular note is the automatic video incident detection system, which is an off the shelf product but has not been used integrated with DYNAC in New Zealand before.

AUCKLAND ARTERIALS UPGRADE

The second project to expand the coverage of JTOC beyond the state highway network is the Auckland Arterials project. This has brought 21 existing VMS under JTOC management. JTOC can display free format (ad-hoc) messages on the signs. These VMS are located at strategic points on the local arterial network. They are typically used to provide driver information associated with special events such as at the Eden Park sports venue or journey time information on key routes.

The key arterials have already been added to the GIS maps viewed by operators of the system. Once the software including this enhancement has been released early in 2014, operators will be able to click on a piece of road and easily record a range of information about the incident in a structured way. This will allow a broader understanding of the impacts of incidents and facilitate better up-to-date travel information for road users.

At a later date, the information collected with the help of the expanded GIS will be used to assist in the development of VMS messages.

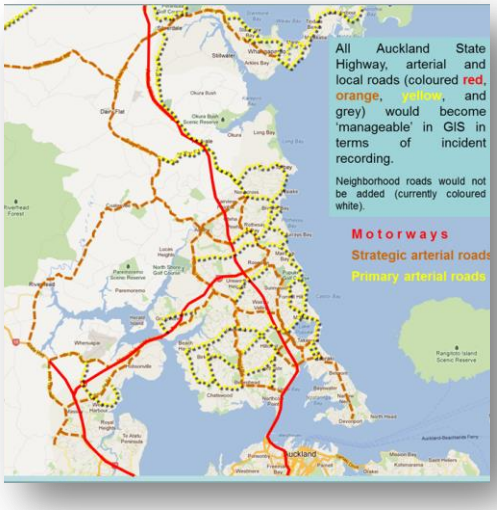

Figure 6: Map showing motorways, strategic arterial roads and primary arterial roads in northern Auckland region (Source: Peter Bathgate, JTOC)

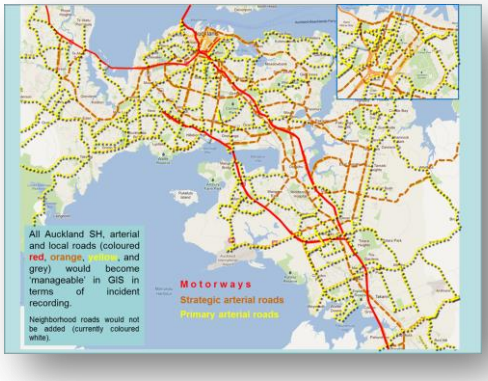

Figure 7: Map showing motorways, strategic arterial roads and primary arterial roads in central and southern Auckland region (Source: Peter Bathgate, JTOC).

Once business rules have been developed, the setting of dynamic messages to assist with incident management will be expanded to these newly added signs on the network. Agreement at JTOC, and with AT will be necessary before this stage is reached but once it is in place, it will provide the ability to collect incident data from the expanded network and use it to set messages. As can be seen in *Figures 6 and 7*, the difference in coverage between the motorway network and the arterials network is significant.

Technically this project is not difficult. Politically, it will require the development of agreed operational procedures for VMS on arterials by JTOC and the sections of AT that have been developing the expanded VMS capabilities. Questions such as which agency will be responsible for setting the messages during planned special events have not yet been resolved. These signs are currently managed by a special operations section of AT.

The expansion of the system to include VMS owned by a local TLA will be a first, and has already raised the issue of cost sharing for ongoing maintenance and support of the TMS. As previously mentioned, to date the procurement, development and ongoing support and maintenance costs of DYNAC have been met by the NZTA. AT have funded all of the traffic signals system and equipment, while the operations costs have been split between the JTOC partners.

Once completed, the two projects described in this paper will enable a more network wide approach to incident management in Auckland. The One Network approach identifies a number of objectives and JTOC will be in an improved position to help fulfil them.

WHAT HAVE WE LEARNED?

A number of lessons have been learned through these first two projects to include key Auckland arterial routes in the TMS. In future, projects should expect to instrument key arterial roads as part of capital projects. In order to facilitate this as smoothly as possible, it is desirable to agree operational expectations by the different parties early in the process. Early high-level agreement will lead to clarity of scope and specifications and can avoid the possibility of using valuable design and construction time reconfirming the end user requirements.

It is important to accept that communication between the relevant parties will need to be ongoing and that key decision-making people need to be identified early in the project so that the process is as efficient as possible.

There is a challenge when ITS systems are part of two programmes – a construction programme on one hand and a software development and release process on the other. It is important to make sure that one process doesn't get ahead of the other. In the cases discussed there were some software development stages that were carried out before final choices of devices were made for variations. With hindsight, it is clear that a more efficient process was possible.

ACKNOWLEDGEMENTS

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[i] Auckland Transport website: www.aucklandtransport.govt.nz/improving-transport/ameti

[ii] Auckland Transport, Business Case for Construction AMETI Phase1, February 2013

[iii] Auckland Transport, AMETI Panmure Covered Box Concept of Operations, December 2012