The Pilot Results of Hybrid Commercial Network Usage in Public Safety Mobile Broadband

The current discussion concerning broadband access to public safety mobile units has been active and ongoing for years. The primary reason for discussion regarding this issue is the fact that current dedicated digital authority networks cannot provide the data capacity required for modern applications. However, capacity limitation seems to be the last point that discussion participants can agree on. The question of how to bring the broadband to these vehicles has multiple opposing viewpoints and conflicts of opinion.

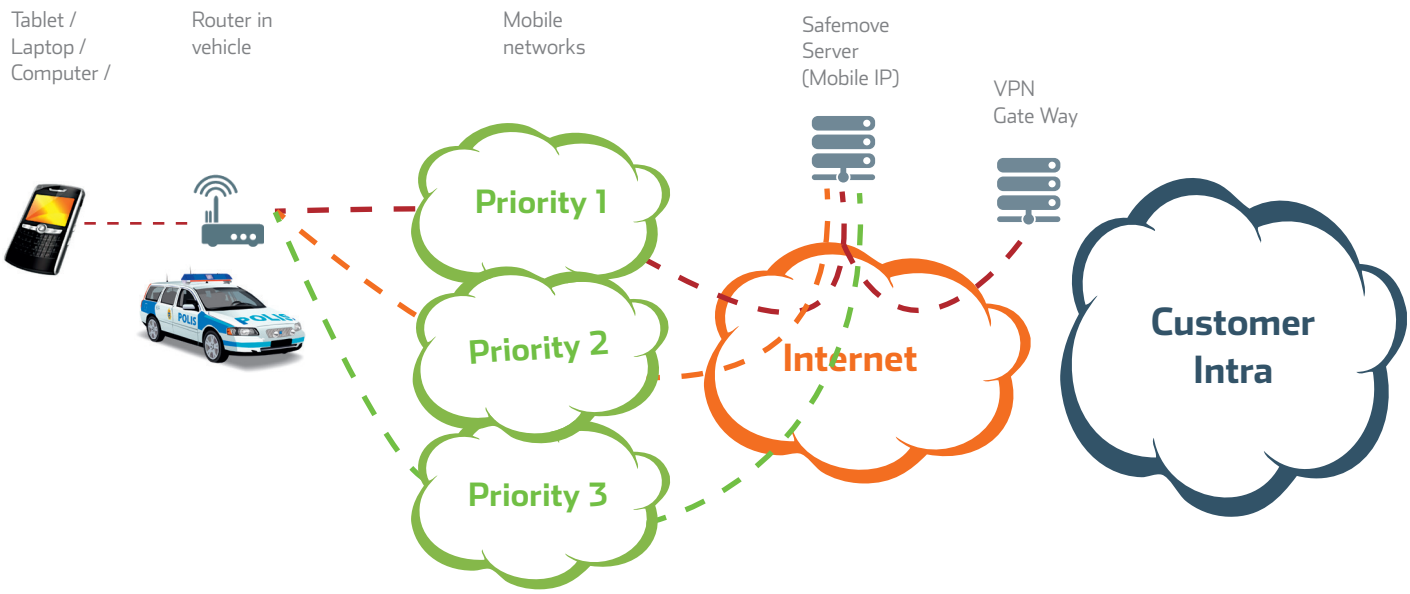
The first and the most obvious answer to bringing broadband into public safety vehicles is to build dedicated networks for authorities. The main problem with this solution is the huge cost involved, along with limited available frequencies. The second solution is to use a commercial provider with special deals to offer the data capacity required. Here the main concern is the availability of the data and resilience of the network. The third option includes several hybrid solutions, either combining dedicated and commercial networks or using multiple commercial ones. The key problems with this latest solution are perceived to be resilience and availability.

Participants in this discussion are however too often lead astray by either their own personal experiences on how networks function, by operator promises regarding availabilities, or dedicated network equipment providers' denigration of commercial networks. The only way to know with certainty the availability of any single network or selected networks together, is to test them in real life environments with the same applications used by the authorities.

This document shows the results of several selected pilots or tests conducted in Europe and the USA. The number was limited for presentation purposes, but very similar or even identical results have been seen from tens of tests around the world.

Typical testing environment

The selected testing environment included in all conducted tests contains the following set-up:



Each vehicle was equipped with a Multi-Channel Router (MCR) with selected available main operators in each case. A laptop or a tablet was attached to the router. The router created a Mobile IP tunnel to a server in the cloud and from there the connection to authorities' back-end systems was created.

We wanted to test against the clarified customer claims. The first claim was that out in remote regions there is no network coverage at all. The second was that one operator is enough in the cities.

Remote locations

For remote location testing we selected a third network to ensure we get the maximum coverage. Only in Iceland did we use two networks due to fewer available operators without network sharing. We always try to select networks that have as little coverage overlap as possible. The locations tested include are some of the most remote in Europe, including Ireland, Norway and Iceland. The results were surprising.

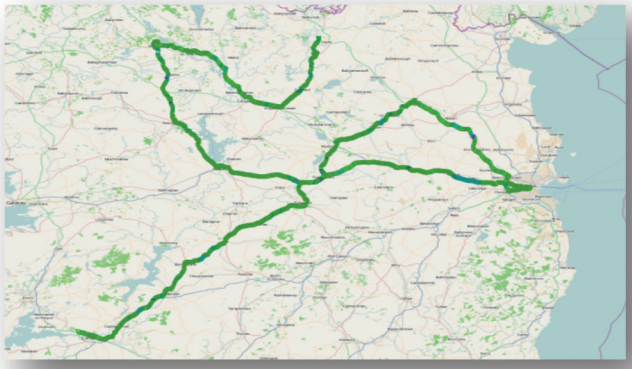
It is understandable that single network availabilities are significantly lower than in the cities. But surprisingly they still are very seldom as low as 80%. The number of service interruptions increases with lower availability and it was noted that some of the breaks extended from tens of second to minutes and even tens of minutes when driving. Despite much lower individual network availability in these areas, the bundled uptime results were excellent. Over 99% is an excellent figure considering the places where these test routes were driven. Places so sparsely populated that there are often no inhabitants within a radius of tens of kilometers.

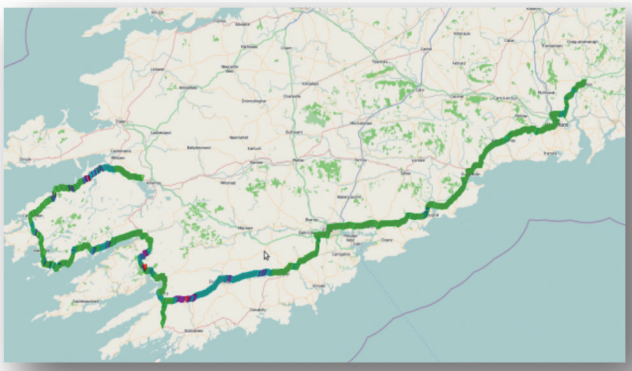
Even in these remote locations, the bundled solution offered uninterrupted connectivity as any longer breaks in data were reduced to zero. The user did not experience any interruptions to the service, even when some short breaks in the data stream occurred.

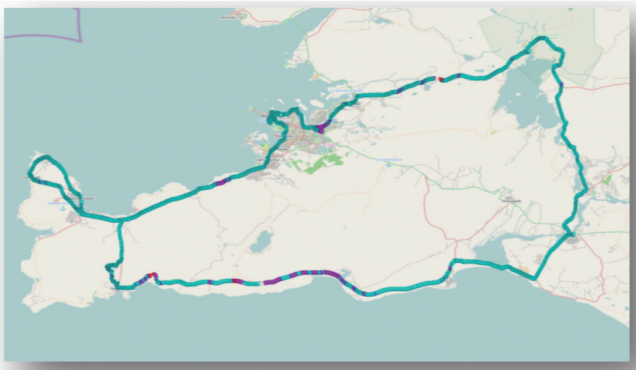
Availability heat maps show clearly how multiple networks combine to provide the high availability encountered.

SUMMARY OF REMOTE LOCATION TESTS				
WAN 1	**Ireland**	**Ireland**	**Norway**	**Iceland**
Number of link fails	172	108	136	39
Uptime percentage	91,62%	96,87%	94,19%	96,47%
WAN 2				
Number of link fails	245	132	118	36
Uptime percentage	80,29%	94,96%	95,71%	87,25%
WAN 3				
Number of link fails	200	147	114	N.A.
Uptime percentage	93,06%	98,37%	86,97%	N.A.
Bundled				
Bundled uptime	99,22%	99,91%	99,50%	99,37%

Green	Three links OK
Turquoise	Two links OK
Pink	One link OK
Red	Both links down







Cities

Here we present the results from using the hybrid network approach within selected cities. The cities included here are Brussels, Antwerp and Los Angeles. The test duration for each of these tests is several hours - long enough to give a clear picture of real life operation of the networks within the given cities.

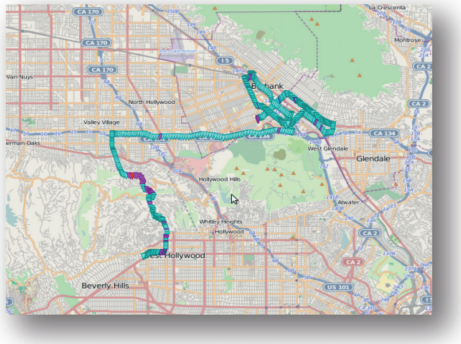
As is clear from the example, the network availabilities of individual network operators are far from the 100% claimed. Over just a few hours there may be more than 50 data interruptions. It is similarly clear that multiple networks overlap favourably. The joint coverage with just two operators is always close to 99.5% and often close to 99.9%.

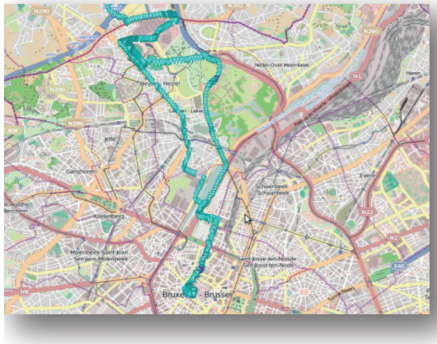
What is also important is that the bundled solution practically removed all longer breaks that would have caused the user to feel an interruption to the service.

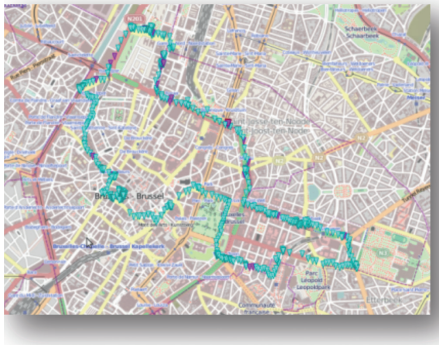
Looking at the GPS data in heat maps gives a clear visual representation of the fact that the networks are full of holes when it comes to delivering broadband to moving vehicles, even in densely populated cities.

SUMMARY OF CITY TESTS				
WAN 1	**Brussels**	**Brussels**	**Los Angeles**	**Antwerp**
Number of link fails	21	19	68	13
Uptime percentage	97,52%	98,00%	96,45%	95,84%
WAN 2				
Number of link fails	22	18	17	13
Uptime percentage	96,29%	97,65%	98,61%	96,42
Bundled				
Bundled uptime	99,56%	99,44%	99,71%	99,93%

Turquoise	Both links OK
Pink	One link OK
Red	Both links down







Summary

Anecdotal evidence and personal opinions are especially misleading in this area without accurate data regarding mobile broadband data coverage. Typically individual opinions have been influenced by personal experiences and are further confused by operators marketing messages. The discussion around the need for dedicated broadband networks is manufactured to some degree by the equipment providers themselves. Opinions that are not backed up by real data and test based findings should not form the basis of decisions made in this area.

Tests conducted in various locations across the US and Europe prove two crucial points. The first is that no city can provide sufficient broadband availability for public safety vehicles over a single network. The second is that even the most remote areas can provide availability that is acceptable for public safety mobile broadband.

It is worth noting that similar tests are always needed in a new region in order to form valid conclusions. Of the tens of tests conducted so far, all have yielded very similar results regardless of location.