

Benelux countries demonstrate significance of spectrum for Private LTE Networks

(this article has also been published at Radio Resource International)

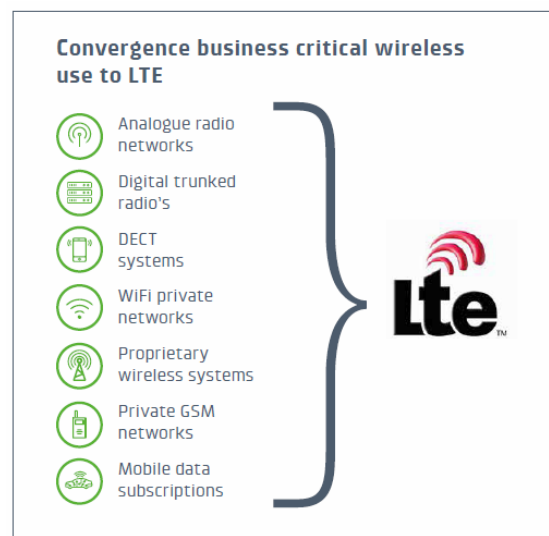
The Benelux features a lively scene for the establishment of private LTE networks and critical mobile networks. To a large extent this is due to spectrum availability for all sorts of private networks or NPN (non public networks). This article looks at the accelerating effects of spectrum availability and the innovative emergence of both networks and novel niche players in this domain and displays a couple of convincing examples of new private mobile networks from real industrial live in the Benelux.

Mobile networks for critical usage

The readers of Radio Resource International will need little convincing in order for them to understand the merits of tailored mobile networks for designated verticals and mobile broadband services with a guaranteed QoS to serve their needs and their operational processes....

Verticals such as factories, ports, airports, utilities, petrochemical plants etc all have very essential processes to operate for which communication is essential. We will call such (mobile) communication Business Critical, thereby setting the term Mission Critical aside for the nationwide mobile networks that are typically deployed by the emergency services (often designated as PPDR). Business critical mobile usage has long been served by known and proven voice-only systems, of which PMR and Tetra are well known ones, as well as by data mobile networks such as wifi or mobile subscriptions to an MNO's network. There is strong conviction that all these applications are

converging over time to one comprehensive corporate wireless network; typically private LTE for the near term and gradually phasing over to private 5G as standards evolve. 5G is completely equipped for this with its known 'triangle' of feature sets and its ability to 'slice' a set of KPI's for tailored performance and a designated usage.



KPI's for critical applications

The essence of an enterprise specific or corporate mobile network or –service is the ability to tailor and warrant KPI's that match the operational requirements of the vertical. These can either be availability – of “X 9's” – or throughput or latency – of X msec or less - for time critical applications such as vehicle control; all related to the processes the mobile service has to support. As we'll see further down, there have already been very demanding applications in for instance ports and airports, industry and utilities. They all have business criticality in common.

The fact that such private mobile networks for verticals have over time become critical to their owners is illustrated by the fact that these users have started organising themselves to develop required KPI's and compare use cases and jointly lobby for spectrum which is after all the raw material for any mobile network. As we'll see further down, this has lead to the availability of private spectrum in quite a few markets; though the situation does differ per country. More on spectrum further below.



Facilitation by standards

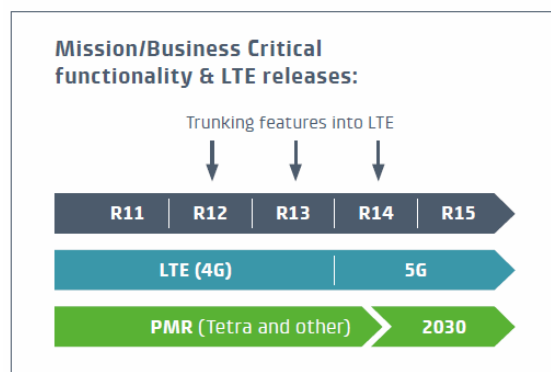
Mobile standards are being designed globally by 3GPP; from early generation GSM up to current 5G specifications. Fortunately and due to the work of for instance the CCBG working group of the TCCA¹; the standards that have

¹ Resp. Critical Communication Broadband Group and The Critical Communication Association

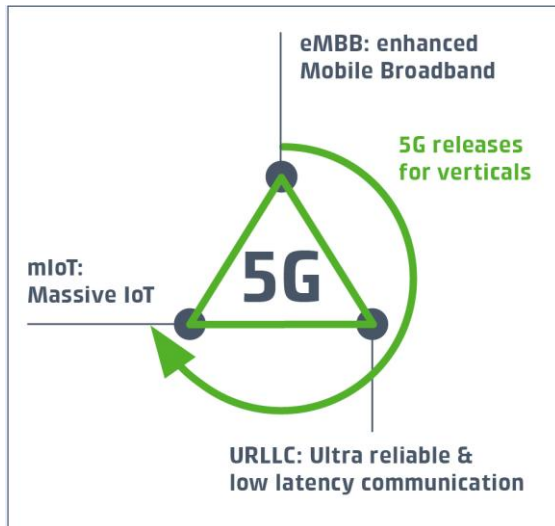
seen the light lately have embraced a couple of features that verticals find very essential for corporate networks, be it voice or data. A couple of obvious and typical features for enterprise mobile networks are

- PTT or push to talk functionality for voice and data; something users have come to appreciate in their existing PMR networks.
- Group calls, again as we're used to from PMR; but now for voice as well as for data.
- Direct mode or handset to handset communication, an essential function to 'bypass' the network in critical circumstances if needed.
- Priority and pre-emption, a function required in order to be able to guarantee availability to at least subsets of users.

The LTE and 5G standards have already embraced all these features; they appeared in the LTE standards as off release 13. Likewise the standards incorporate subsets of specs that facilitate IoT or machine type mobile communication, such as NB-IoT or LTE-M; both LTE-subsets, incorporated as off release 14 and also available under 5G. With the usage of 3GPP standards the (corporate) user can implicitly benefit from all these features that can be made available wholly or in part for a corporate mobile network.



This summer, the standard 'reached' Rel. 16. In 5G, the standardisation continues to develop specific features and KPI's related to verticals and industries, notably URLLC and massive IoT:



Fundamental choice: 'make or buy'

When drafting the requirements for a corporate mobile network or service; there is the very fundamental choice often referred to as 'make or buy'. In the context of a corporate mobile network this choice essentially differentiates between

- establishing your own corporate network and managing it, either yourself or through a qualified third party
- alternatively sourcing the entire mobile provisioning as a service (aaS).

This choice is rather fundamental as it involves different partners to work with and different skill sets within one's own organisation. Possessing and running your own network will inevitably require some LTE/5G, spectrum and networking knowledge. Sourcing aaS will require managing of the agreed KPI's and service level, but requires less intricate knowledge of mobile networks. Also, the aaS option will allow an OPEX model whereas

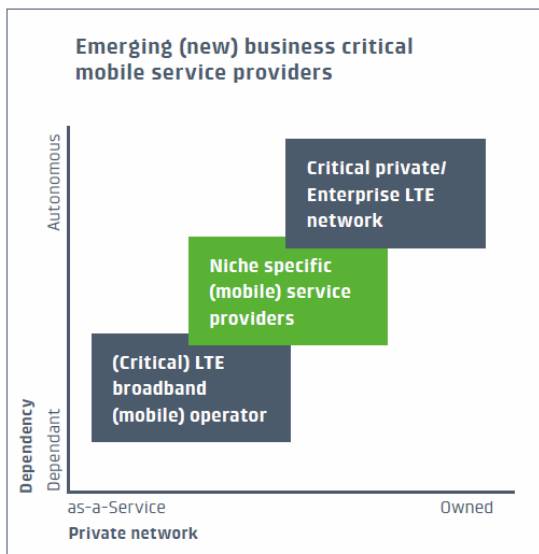
owning the network will often boil down to a Capex model hence an investment.

Mobile players and new entrants

Developing the 'own network' option will require sourcing from an LTE/5G vendor such as but not limited to Nokia and Ericsson or system integrators that work with either these 'carrier grade' players or the likes of for instance Druid, Quartus and others who develop enterprise specific LTE core networks (EPC) for LTE and 5G, running as a service out of software rather than being composed of dedicated hardware. Thus, these core networks are very scalable, also downward. The AaS model will most probably entail a service from an MNO that offers segment specific 'sliced' services or a service provider from a new league of Enterprise mobile Service Providers or mobile ESP's (or Neutral Hosts as they are often called) that have recently emerged. The Benelux already features some of those as we'll see below.

Interestingly; the CCBG of the TCCA wrote a white paper on critical mobile broadband back in 2018. I was involved in that paper as well and it was published at the CCW in Berlin in May 2018. Already then, this white paper¹ identified the anticipated emergence of a new league of players 'in between' the classical network vendor and the known MNO, offering resp networks and mobile nationwide mobile services.

This new league was envisaged to be niche specific, tailored to one or some verticals and able to provide a QoS on the service that meets the demands of the individual vertical or corporate:



Back in 2018 when the paper was first drafted we could envisage the necessity and emergence of such new players; meanwhile they have actually emerged on the market as we'll elaborate for the Benelux further down.

Spectrum for critical corporate mobile networks

THE most essential 'raw material' for any mobile network or service is spectrum! Spectrum possession is a valuable asset which is displayed time and again by the amounts operators pay in auctions for access to suitable spectrum for their mobile networks. Likewise any private mobile network operator or service provider will have to dispose of spectrum.

If an operator were to offer to verticals a tailored mobile service, he would most probably do so deploying his already available licensed spectrum with potentially additional features such as slicing to obtain required QoS. For either a vendor, a system integrator or a Enterprise Service Provider however, access to any spectrum at all would be of essence. These actors can either revert to the MNO's for shared or exclusive use of the MNO's spectrum at a fee, which is not often granted or may prove costly. Alternatively, the new player can

dispose of designated spectrum issued by their regulator for the specific purpose of enterprise or campus networks and/or geographically confined local area usage. This spectrum is not internationally harmonised yet IS available in some countries as we'll see, the Netherlands being one of those.

Aggregating demand


There are some organisations for aggregating the corporate demand for critical mobile services. They are varied and amongst those are Agurre in France, the Spectrum Policy Forum in the UK, association KMBGⁱⁱ in the Netherlands and the - originally German - 5GACIA industry alliance for process automation. These efforts are still somewhat fragmented, local and uncoordinated, but they have started and practice shows that looking for commonalities does work and collectively articulating demand leads to allocation of spectrum as is the case in a.o. France, Germany, the UK and the Netherlands.

In Europe, some countries like the Netherlands have allocated a 100 MHz of spectrum in the bands that are also foreseen for later 5G usage by MNO's: the bands 42 and 43 or 3.4–3.6 GHz and 3.6- 3.8 Ghz. Both the Netherlands and Germany have made 100 MHz of spectrum available in the band 43 for enterprise purposes. This 'reduces' the amount of spectrum to be auctioned for MNO 5G networks to 'just' 300 Mhz. The availability of this spectrum in a band that is a 3GPP band and has a LTE/5G device eco system is no small gesture and constitutes recognition of the relevance of corporate mobile networks.

Spectrum for private networks, some countries

In France and through Agurre, relevant national users can dispose of 40MHz of spectrum in 2.6GHz TDD bands for









again enterprise purposes. In the UK, the intended band for private usage is the 3.8 – 4.2 GHz band. In Germany, the 5GACIAⁱⁱⁱ alliance focuses on 4 and 5G networks for  plant automation in for instance factories, warehouses and petrochemical parks and now disposes of the 100 MHz in the 3.5 GHz band mentioned previously. 5GACIA encompasses all large German manufacturers and expands internationally.

The best known and widely published case of private spectrum is the CBRS^{iv} regime in the USA, where through a distribution and application mechanism verticals can dispose of shared spectrum in the 3.5 GHz band ('band 48') originally 'owned' by the ministry of defence for certain radar applications.

CBRS is the most developed application of (shared) private spectrum and tends to receive a lot of attention in the media.

To summarise visually:

Private spectrum in surrounding countries		
Country	Spectrum	Availability
Netherlands 	1800 MHz 'guard band': 5 Mhz 3.5 GHz : 100 Mhz	Over a decade Several years already
Germany 	3.7 – 3.8 GHz	Regional licences Per H2 2019
UK 	3.8 – 4.2 Ghz	E 2019
France 	40 Mhz in 2.6 GHz TDD	Available via/for Agurre members
Sweden 	3.7 – 3.8 GHz	Planned, awaiting 5G auction nov '20
USA 	CBRS, 3550-3700 MHz	H2 2019

Spectrum availability DOES accelerate private networks

This intriguing statement is supported by evidence from practice in the Netherlands. Not only does the Dutch regulator provide the mentioned 100MHz of private spectrum for campus and enterprise networks; due to which there have already been 179 applications already.



More so, the Netherlands has also made available a band of 5 MHz in the 1800 MHz domain, the so called extended DECT GSM guard band.

That slice of spectrum has been available to verticals and niche application for quite some time, around a decade already. This band has been extensively deployed by integrators and ESP's for the provisioning of on premises tailored private GSM services for years, often replacing DECT or trunking systems. In the Netherlands, the uptake has been very strong in health and care institutions, but also in warehousing, production and other verticals.

A study commissioned by the Dutch regulator itself revealed that this shared spectrum for local and vertical networks has already been used by verticals in 500-700 cases! In a country the size of the Netherlands that is a convincing number; demonstrating that there is a vivid market for enterprise mobile networks provided the spectrum is available. This same spectrum is still available today and now used for private LTE systems. Thus, In the Netherlands one can dispose of TWO band for private purposes: the 5 MHz in the 1800 MHz guard band and the 100 MHz in the 3.5Ghz band 43.

Examples of private networks in the Benelux

As was previously mentioned, the existence of private spectrum in the guard band alone has led to 100's of private networks in the Netherlands alone over the last decade. The additional availability of the mentioned 3.5 GHz private spectrum option has again led to 100's of applications and usages in industry and in neighbourhood- or campus mobility. An often quoted and very convincing example of a private network running a very business critical application is the private LTE network in the port of Rotterdam. That port – once the worlds largest but now surpassed by Chinese ports – has a very large container terminal called ECT, European Container Terminal. At ECT, there are 100's of autonomous vehicles, autonomous and remotely controlled cranes and AGV's and remote controlled straddle carriers to unload, move and distribute containers over the terrain and onto trains and trucks.

Apart from the quayside cranes, *all* autonomous vehicles and cranes are controlled over a private LTE network! This application is truly business critical, without the network vehicles stand still, containers do not get delivered and goods do not arrive in the warehouses thus supplies in Holland and the

European *hinterland* would dry up. This network is a good example of what spectrum availability may yield. It deploys a Druid core (EPC) and some 20 Airspan radio's (E-nodeB's) in band 43 all over the site of the terminal and 100's of vehicle mounted routers for the vehicle control software that runs over the network.



Other applications are of course abundant, we'll mention some.

- Provider Greenet deploys the 3.5 GHz private spectrum for neighbourhood mobility and Fixed Wireless Access in multiple locations.
- The airport of Amsterdam holds a spectrum licence in 3.5 GHz for potential deployment of a private LTE system for all airport processes for which a market consultation has already been held.
- System integrator Avics has upgraded an existing private GSM system in a care institute to private LTE, replacing wifi and meeting local 'NEN2575' criteria for requirements for life saving critical alarms.

New entrants for private networks emerging

Netherlands

Largely thanks to the mentioned availability of multiple spectrum options, the Netherlands have seen an emergence of new novel players in the private network or Non Public Network (NPN) area. First of all, the available spectrum allowed known integrators such as Koning en Hartman and Spie to become full service providers of managed private networks; providing a system and the management of it. In addition, new players are offering full service network aaS options, even all the way up to funding of a network and making it available in an OPEX model. These new players are for instance Spanish Cellnex^v who operates enterprise networks in countries such as Spain and Italy and is also present in the Netherlands. There is Finnish service provider Ukkoverkot - recently rebranded as Edzcom and taken over by Cellnex - who already runs private port and airport networks as well as industrial mobile networks in Scandinavia. Edzcom claims to have 26 of those enterprise specific mobile networks already and expands towards the UK and France as well.

In addition there is a new venture Priocom^{vi} in the Netherlands who offers mobile networks services with certain KPI's as an MVNO for verticals, making use of an arrangement they have with an MNO on whose network they deliver the service. In addition to the ones mentioned, other new entrants have emerged in the Netherlands, displaying the pending demand for private mobile services from verticals and the stimulating effect the availability of private spectrum has for the emergence of new providers and offering for industry niches.



Belgium

In Belgium, yet another situation emerges. The Belgian regulator so far hasn't allocated a band for private usage yet – as have done their Dutch and German neighbours – hence for a private mobile network one would have to either revert to the MNO's for a spectrum arrangement or apply for an MNO based service. However; there is a player called "Citymesh"^{vii} that acquired 3.5 Ghz spectrum some years back, originally intended for backhaul of urban wifi networks. The regulator – BiPT- did offer the spectrum to MNO's back in 2015 but there was no interest then... That very spectrum is now also deployed by Citymesh herself for campus networks and enterprise mobility in addition to the backhaul for wifi networks they have been offering and operating for quite some time already. With the emergence of private mobile network demand, Citymesh on occasions also has granted access to its spectrum for individual use cases and 3rd party private networks. Examples are the seaport of Zeebrugge – a contender of nearby Rotterdam – where again a private LTE network is deployed for vehicle control. Also Brussels airport 'Zaventem' has started deploying a private LTE system for its apron processes based on a network with Nokia equipment. Here too, Citymesh makes use of its existing licence in 3.5 Ghz and deploys it for this private network purpose.

Thus, Citymesh has positioned itself as both an operator of wifi and LTE networks for campuses

but also as a 'wholesale' provider of spectrum for new ESP's.

Concluding take-away from the Benelux

The case of the Benelux has demonstrated, notably in the Netherlands, what the availability of private spectrum can signify for the enterprise critical mobile network market, for the emergence of new players and for the establishment of novel service formats for verticals such as network as a service as offered by Cellnex. Also the alternative deployment of existing licences can create novel mobile offering as is demonstrated in Belgium. The demand for enterprise mobility is evident from the 100's of systems that have been realised over the years in the Netherlands alone.

New full service and fully funded formats are available for those verticals or enterprises that do need critical mobile broadband or IoT yet would rather source it as a service and preserve their Capex for investments closer to their core business.

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ⁱ The white paper 'critical communications and (new roles for) Mobile Operators', available on <https://tcca.info/about-tcca/tcca-resources/whitepapers/>

ⁱⁱ KMBG or *Kritisch Mobiel Breedband Gebruikers* is the user alliance of Dutch Critical Mobile Broadband Users.

ⁱⁱⁱ 5GACIA: 5G Alliance for Connected Industry and Automation; www.5GACIA.org

^{iv} CBRS: Citizen Band Radio Service

^v Cellnex is Europe's leading operator of wireless telecommunications and broadcasting

infrastructures, present in 8 countries. Based on its expertise in security & emergency networks, the Company is diversifying into private networks such as Indoor systems and Private LTE/5G networks

^{vi} Priocom is a JV between national MNO T-Mobile and enterprise PMR provider Flash.

^{vii} Citymesh was established in 2006 with the primary aim of providing campus and urban mobility over wifi networks. They later expanded into private LTE networks. More on www.citymesh.be.