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# 5G MAGAZINE

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## Foreword

5G industry and research developments this month show important emerging use cases, devices, and applications.

The new 5G use cases all have drones as common theme, and demonstrate ways to digest, analyze, and manage the reams of images, 3D-Video, location tracking and other data coming from the drones. First Ericsson and China Mobile report using them in conjunction with traditional cellular basestations to deliver mission-critical use cases; a combination of cloud capabilities and distributing computing at the cellular edge is used in their trial to meet computing resources, storage capacity and connectivity requirements. Additionally, we see this trial as a landmark example of enterprise 5G service enablement where governments, enterprises or other organizations have access to 5G capabilities that can be tailored to their applications and services for enhanced user experience such as the one covered in this trial for mission-critical applications. In South Korea, KT is also proposing drones in a new 5G use case involving holographic image processing; KT has already demonstrated how holographic processing done it in a fixed wireless environment, and it is now moving the use case to a mobile environment for the 2018 olympics 5G demos. The third use case of drone usage comes from Socionext which has not a traditional “cellular” platform but one consisting of a 24 Ghz radar chip as well as image stabilization, 360 video processing, and other location tracking and sensing capabilities. The company will be presenting their solutions next month at InterDrone2016, and we will bring the details of their reported use cases combining image processing and networking capabilities in future issues.

As far as 5G applications, new social media and private messaging chat apps continue to emerge, and we focus on P2P messaging apps as a new disruptive force in 5G. Their applications run from large venue sports, concerts to providing off-grid communications in time of natural disasters and emergencies.

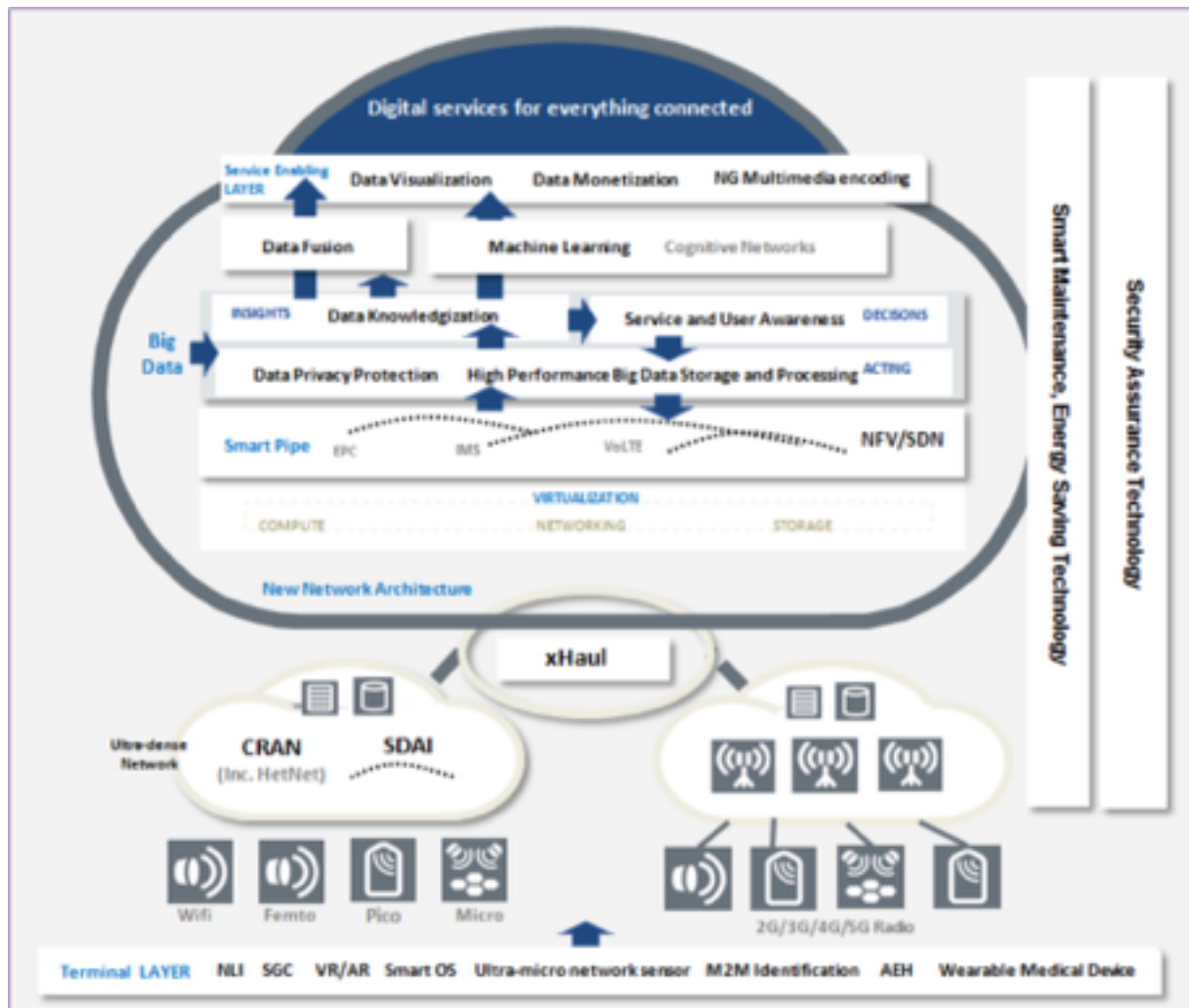
On the device side, we look at how the LinkNYC Project is transforming old pay phones into communications hubs that could be part of the 5G future. Also in the device area, we are giving this month our attention to the devices connecting the next 1 billion with the example and lessons learn from India’s ultra low-cost Freedom 251 smartphone.

As the 5G ecosystem continued its feverish activity so have we. We are happy to report that the US Government ISSN Issuing Authority has granted the 5G Magazine online as well as print ISSN numbers. We are also working to expand the 5G Magazine community and topics. Stay tuned.



## China Mobile, Ericsson Demo 5G Mission-Critical Apps with Basestations, Drones, and Cloud

China Mobile and Ericsson combine drone and cloud technologies technologies to trial 5G low-latency, distributed network supporting mission-critical use cases. The trial is a demonstration of 5G-enabled drones flying over China Mobile’s cellular network, and using them to do handoffs between cell sites. It is important to notice that the handoffs are being performed between cell sites that are simultaneously used by mobile phone users, i.e. cellular infrastructure is enhanced with drone infrastructure to meet enterprise mission-critical application requirements.



ChinaMobile 2020 Technology Vision – 5G (Image: Global TD-LTE Initiative)

China Mobile Communications Corporation (CMCC) is one of the world’s largest telecommunications service providers. The size of its network, its subscriber base and its market capitalization make it the largest mobile operator worldwide. At the end of July 2016 CMCC had

over 838 million mobile subscribers, operated more than 2 million base stations and covered over 99% of China's population as they look to expand their global footprint in APAC, Europe and the US. Their primary business is mobile services and the company has been creating a vision to manage rapid traffic growth, new service deployments and innovation.

Ericsson says that it has been collaborating with China Mobile in the China National Key 5G projects since the beginning of 2016, focusing on user-centric 5G network architecture evolution. China Mobile's vision for network evolution to 5G is summarized in their recently issued "More than Connected" 2020 strategy white paper. One of their aims is to optimize latency for mission-critical use cases, by dynamically deploying part of a network through distributed cloud close to the radio edge. The drone trial is therefore an important step toward 5G networks in which part of a network can be distributed and dynamically deployed at the cellular edge in order to reduce end-to-end latency, and to serve a range of 5G use cases at the same time.

One of the stated goals is to optimize latency for mission critical use cases, using an aerial 5G-enabled drone to distribute part of the network to the cellular edge. According to Ericsson, "The drone trial is therefore an important step toward 5G networks in which part of a network can be distributed and dynamically deployed at the cellular edge in order to reduce end-to-end latency, and to serve a range of 5G use cases at the same time."

5G will require up to 20 Gbps data throughput, 1 millisecond or lower latency, support for 500 km/hour device mobility and device tracking within 1 meter. We see in this trial a clear proposal to use cloud capabilities and distributing computing at the cellular edge (Mobile Edge/Fog Computing) to achieve these requirements using drone platforms. At the time of this writing, we are not aware of details regarding how Ericsson and China Mobile are architecting the integration between ground basestations and drones to provide computing resources, storage capacity and connectivity as a traditional radio network infrastructure would. Additionally, we see this trial as a landmark example of enabling 5G services to enterprises. Governments, enterprises or other organizations have access to 5G capabilities that can be tailored to their applications and services for enhanced user experience such as the one covered in this trial for mission-critical applications.

## Holograms at the Center of KT's 5G Vision

Continuing exploring the future of video in the context of mobility and 5G, we are focusing in Holograms in light of the news out of South Korea that its No. 2 mobile operator KT Corp. is seeking leadership in both 5G and the hologram business. And it is wakening the talk with ongoing holographic theaters. It is also touting state-of-the-art video services which include a “Hologram Live” mobile services with 5G enabled drones.



Maple Story Hologram Musical Is a Hologram Version of the Online Game (Image Source: KT)

KT has been looking at holograms as part of business case which includes revenue diversification strategy, and ahead for the planned 5G commercialization in 2020. Back in 2014 KT opened the world's first hologram performance hall, K-Live, in Seoul. The hall has since attracted more than 250,000 visitors, with 44% being foreign tourists, according to KT. Content wise, their strategy is to use well-known story plays into the holograms, and to raise awareness of the technology. Based on the success so far, the company is planning to expand the business opening hologram-devoted entertainment theaters nationwide, and expanding them overseas.

KT is betting that the hyper-realistic, virtual content industry will be a key revenue source for 5G, and it is pushing ahead with a plan to demo 5G and its holographic capabilities at the upcoming Pyeong Chang Winter Games in 2018, for the first time in the world.

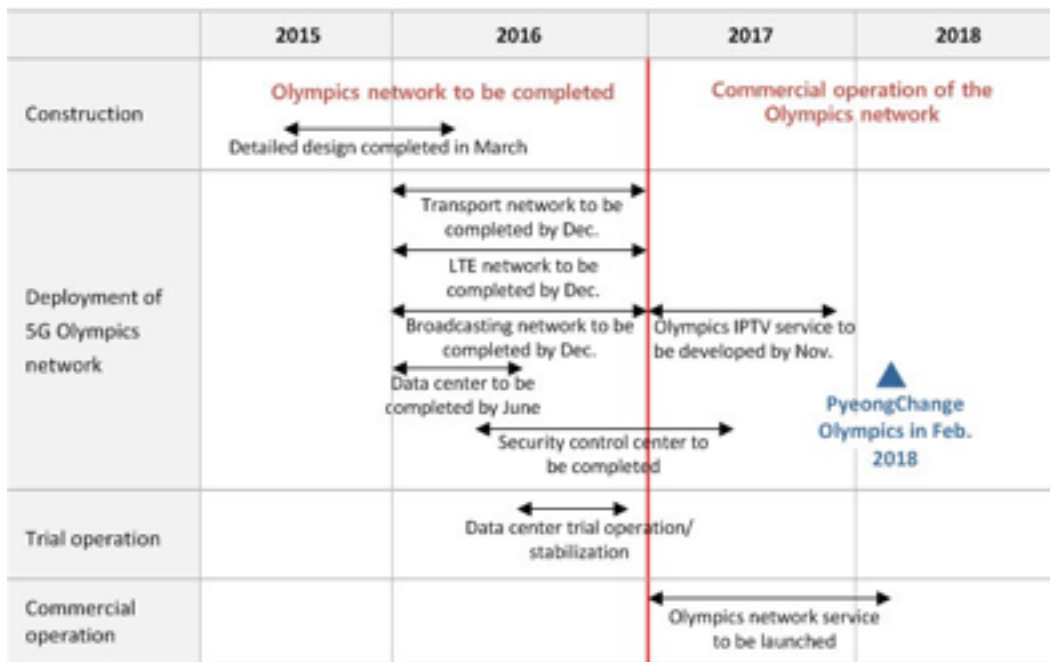
KT will be the official network service provider of the 2018 PyeongChang Winter Olympics and plans to have the services

***“... the birth of future frequency-based industries such as remote medical diagnoses based on visual telecommunication service and security checks.”***

**JIN SUNG-BAE**

**HEAD OF FREQUENCY POLICY, SOUTH KOREA**

featured during the games including a handful of other state-of-the-art services such as 360 degree virtual reality. As far as holograms, KT says that it will demonstrate the Hologram Live service. One of the capabilities of this service will allow athletes to conduct interviews straight from the ski slope through holograms.



KT 5G Olympics Timeline (Image Source: KT)

South Korea Government is also helping to ensure that bandwidth to deliver Virtual Reality, 3D-Video, IoT and such is readily available in licensed and unlicensed schemes. At the end of 2015, it designated K-ICT unlicensed frequencies:

- 262-264 MHz (2 MHz bandwidth);
- 24-27 GHz (3 GHz bandwidth) in the extremely low band, and 64-66 GHz (2 GHz bandwidth);
- 122-123 GHz (1 GHz bandwidth); and
- 244-246 GHz (2 GHz bandwidth).

The 24 GHz bandwidth can work with small output radar and 5G mobile telecommunications repeaters. Ultra-high 60 GHz bandwidth will be chosen for uncompressed high-volume video and high-resolution short-range radar in the 5G era. Jin Sung-bae, Head of the Frequency Policy Department of the Ministry of Science, ICT and Future Planning says that their expectation is to see "... the birth of future frequency-based industries such as remote medical diagnoses based on visual telecommunication service and security checks."

## The Pay Phones of the 5G Era Debut in NYC

New York City is getting a smart city uplift. A consortium that includes industry experts such as Alphabet's Google and Sidewalk Labs, and Qualcomm is introducing LinkNYC, a project to transform old public phone booths into broadband access points and data hubs for everyone to use. Its technology roadmap sees sensors, interactive capabilities being added to support future 5G services.

LinkNYC is a partnership between the City of New York and CityBridge, a consortium that includes among others leading internet and mobile communications players such as Google and Qualcomm. The project creates a network to cover New York City (NYC) with free WiFi and internet service access points. The hubs are old pay phones which are getting a technology uplift to bring them into the 21st century. According to Wikipedia, LinkNYC intends to be the largest and fastest public wifi network in the world, with an estimated 7,500 kiosks installed throughout the New York City metropolitan area. LinkNYC is also emerging as a model service for the future city smart whose digital infrastructure with next-generation communication technologies, connected cars, smart grids and such.





The LinkNYC booths are nine-and-a-half feet tall curbed monoliths installed all around New York. The booths started to rollout at the beginning of 2016 and the project is in beta phase with a few hundred booths presently operational. The City Government does not pay for the system; installation, ownership, and operations is done by the above mentioned private consortium, CityBridge, which is also responsible for building the new optic backhaul infrastructure under the streets. CityBridge's business plan to bring \$500 million in ad revenue for the city over the next 12 years with no cost to the city.

A Technology Roadmap to take LinkNYC from Today's WiFi/Data Access Points into 5G : The current capabilities include WiFi and Internet connectivity, phone charging, and the digital OOH advertising network which provides brands with a rich, context-aware platform to reach New Yorkers and visitors. The evolution of these services is currently under consideration, also under consideration are hardware and software upgrade roadmaps. Additional hardware might include sensors to measure environmental data such as pollution levels and noise congestion. The city is working with Argonne National Labs to discuss how to put sensors in the kiosks and how to measure information such as congestion, noise pollution, etc. Other ideas for future services include video calls and even outfitting the booths with polling capabilities.

## Mobile Messaging P2P Apps Disrupt 5G

Will mobile messaging apps with peer-to-peer capabilities forever distrust the world of mobile communications in 5G? Peer-to-Peer (P2P) messaging apps gained worldwide attention for the first time in 2014 when it was reported that Hong Kong's pro-democracy movement was relying on a mobile messaging app, to communicate without using cellular or Internet service. The news went viral and reportedly the messaging app – FireChat - was downloaded 100,000 times in just one day. Since then P2P messaging apps have become more popular, and more feature-rich. For example, FireChat added earlier this year support for alerts, a first alerting service to leverage P2P mesh networking enabling organizations to reach people on their smartphone, even during natural disasters or emergencies when cellular networks and Internet access are unavailable. There is no question that these apps will continue adding capabilities with the potential to disrupt future 5G services and communications that count on your smartphone being also your network.

P2P messaging apps use a unique combination of communication technologies available in smartphone platforms, in radio technologies, and in networking to create connections between peered devices to transfer messages (text, pictures, etc.) In the case of OpenGarden's FireChat, these messages are transferred to nearby phones via mainly Bluetooth, until they reached the desired user(s). Messages can only move to other phones which have the application installed and are within range (a few hundred feet.) At the time of the Hong Kong protest, the application was in version 2.0 supporting multi-hop WiFi mesh networking and channel bonding. In the case of Apple's iOS, devices support this application via their Multipeer Connectivity Framework without requiring any special customizations. Their most popular use case is large venues, crowded events, densely populated areas, and emergency communications when no Internet, no Cellular would mean no problem.



The novelty of these apps is their off-grid feature that enables any two users to connect and communicate without an Internet connection even if they are far beyond WiFi and Bluetooth range from each other, i.e. they connected via a chain of P2P users between one user and a far-away Internet connection. These technologies might someday be used to tie together thousands of devices and make possible to be online without the need of a traditional network, or a network operator. They could also facilitate emergency

or disaster communications in the absence of Cellular towers and/or network connectivity. Yet from FireChat's style of communications to full mesh networking communications, it is a long way to go. For now, if you like do-it-yourself approaches, you could build your own off-grid like mesh network that operates on the 2.4Ghz range (with a HAM license) like HSMM-MESH does.

## Connecting The Next 1 Billion, A Report from India

Last month's news that a smartphone with a \$4 promotional price tag (\$6-7 after) was about to be released in India created country-wide expectation, and made news around the World. At the time of this writing, the \$4 smartphone - the Freedom 215- has not been realized as originally planned, yet the story of the phone itself and the lessons learned are worth noticing specially for those looking at connecting the next unconnected 1 billion mobile subscribers, perhaps with cost-effective 5G technology. For now, this is what we saw happening when the world's cheapest smartphone met the fastest growing mobile market: On the market side, it proved the huge appetite for low-cost mobile devices in developing economies; on the business side, it proved that if you lower the price of a smartphone from \$600 (approximately the price of the iPhone in India) to \$6, you can get overnight a 75 million order. There is no device maker in the world that could fulfill that order. Even the giants like Apple, Samsung, and Huawei would take months, could be close to a year to complete such a large order.

The technology specifications of the Freedom 215 smartphone correspond to an entry-level device with 4-inch 960x540 screen, 1.3 GHz quad-core processor, 1 GB of memory, 8GB of spendable storage, an 8-megapixel rear camera and 3.2 megapixel front camera, with Android 5.1 OS, with a dual-SIM. Experts say that the cheapest smartphone with these specifications would cost Rs2,500 to make. The OEM reported a phone's bill of materials of Rs1,250-1,400. Regardless of the exact figure, the phone was priced an order of magnitude lower than its production cost. How could this be feasible and sustainable?



Freedom 215 (Image Source: Times of India)

Freedom 251 maker Ringing Bells claims that the low-cost phone was possible with a business model that included economies of scale, pre-loaded apps, online marketing and e-commerce innovation. As part of their business development strategy, Ringing Bells management provided additional details which included requesting Indian Government subsidies and saying that "In order to digitally empower every Indian, if I can get government support under the Digital India program, I can ensure timely delivery of 'Freedom 251' phone to all citizens at the same price." In addition, Ringing Bells management also confirmed plans to make available at least 100 new apps online to the owners and charge them 1-3Rs per application to generate revenue.

Ringing Bells said that 60% of the components of the phone were made in India and the rest imported from Taiwan and China. Assembly and logistics were a 100% India-based out of the same location that manufactures the company's TVs. A 200 distributor network stood behind committed to deliver the phones across India.

Reportedly Ringing Bells got an order of 75 million units online, and it was committed to deliver 5,000 on day 1. After several launch date delays, the phone was released July 8, 2016. The company claimed that 5000 units available would be allocated on lucky draw basis. At the time of writing this article, it is not clear how many have been made available to customers who pre-order, and how many have been sold through the 200 available distribution channels. The fact remains that in India if you lower the price of a smartphone from \$600 to \$6, you get a 75 million units order overnight.

Will 5G Be Up to "Connecting The Next Billion" Challenge? Freedom 251 shows us that there is a real "unconnected" market, and serving it could require new cost-effective technologies and innovative business models. If 5G is up to this challenge, it could change India as well as other mobile markets in developing economies where coverage is not available, and where even current low-end smartphones are our to reach specially in poor rural areas.

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**Did you Know?** Our reader pools July 2016 results indicate that 40% of our readers will buy an iPhone as their next smartphone . Samsung and Xiaomi, with 20% came second in the pool results.

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