

# Opinion response to NTIA FirstNet conceptual network architecture & on one important application

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*Oct 31<sup>st</sup> 2012*

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## **Purpose**

The purpose of this document is to provide LiveU feedback and comments to suggested concept for FirstNet as depicted in the presentation to the FirstNet board of directors in September 2012.

In the last part of this document we shall shortly discuss live video from the field as one very important application required by first responders now and even more so in the future.

## Background

LiveU is a world leader in providing live video uplink solutions based on bonding together multiple cellular and/or other carriers, networks, and modems. This technology provides the highest availability possible, the maximum bandwidth available, top video quality and full mobility and coverage since it seamlessly uses all the available networks wherever they are. Our products have been very successfully replacing traditional satellite trucks in the TV broadcasting industry in more than 70 countries around the world, including the USA.

Recent major events where our products have been used to transmit live TV-quality video from the field include: Hurricane Sandy (all over), USA presidential campaigns, NY Giants around the Superbowl, their NY march and more, Japan Tsunami (including from helicopters above the affected areas), Arab spring demonstrations, London Olympics, Floods in Brazil and many more.

## Opinion Summary

We are firm believers that the right strategy and therefore architecture for FirstNet is in line with the presentation made to the board of directors in their 25<sup>th</sup> September meeting. By taking a very similar approach (on our much smaller scale), we believe we have actually field-proven this strategy. We've been very successful delivering tremendous values to our customers in live TV-quality video from the field: developing the right solution and eco-system at the application level on top of and using all existing and evolving cellular, WiFi and satellite networks.

AS such, we believe that our success story is a good use case to relate to.

LiveU believes that:

- Using existing resources, be it spectrum, commercially-available and evolving LTE infrastructure, operations, maintenance, COTS devices, software or others, is an essential success factor in meeting the needs of the US first responders nationwide
- Enhancing existing/evolving LTE cellular infrastructure sporadically (location based) and perhaps temporarily (time-based) where/as needed, shall provide the adequate delta required by FirstNet, mainly in non-commercialized coverage areas
- Shifting the concept and focus from building a massive nation-wide network to building an application/eco-system for FirstNet users, makes tremendous sense from all aspects: operational and economic
- This architecture shall be quicker to deploy, easier to maintain and evolve, and last much longer as a relevant and updated solution, rather than building a dedicated network approach
- Relying on existing networks enhanced as need, rather than becoming locked into a single network and technology, provides an immediate stable solution along with a healthy competitive darwinistic future evolution of the right solutions,

- rather than just towers and rather than being locked into any specific “wireless bit-delivery” technology for ages
- Incentives and/or regulations measures may be advisable to even further facilitate and align the commercial re-use to some specific needs of first responders
  - Accomplishing this utilization of commercial LTE and existing/evolving networks for FirstNet purposes is feasible, at least from the technological perspective
  - US stakeholders can make use of this interesting opportunity to spear-head world-wide standardization, development and deployment of application level and service level Public Safety related capabilities, via various tools such as 3GPP and IEEE standard bodies, industry bodies etc; by doing so they shall provide the added value for the allocated budget and at the same time extend the reach and potential market, as well as compatibility, to many other international markets, who at the end of the day have the same needs. So on one hand they shall focus the FirstNet resources where it matters – on the service level rather than on towers and core IP, and at the same time may extend their business case and enjoy even further from scale economics
  - Bonding-based solutions, i.e. using multiple networks and/or modems simultaneously is an important significant enhancer to this strategy in both the operational and economical dimensions
  - Bonding solutions have already proven both the technical feasibility and the economic value of this strategy. These have been very successful over the last years, deployed by TV and other types of customers to provide highest possible availability even when satellite communication doesn't work, full HD live uplink from almost anywhere, in a myriad of operational scenarios similar to Public Safety demands.

The benefits of this suggested strategy for US public safety are both operational and economical.

## **Values & Benefits of the proposed concept**

Using existing networks while enhancing them if/where/when needed, especially if bonded and used together as needed, provides:

- Coverage: best current coverage, future coverage by commercial networks enhancements, future coverage enhancements as needed by FirstNet either directly or via incentives to commercial operators in a competitive way. Further, it remains to be explained how coverage in highly used yet highly difficult to deploy and penetrate such as high rises, metros, etc., and how can such deployment shall become resilient, or even just equally resilient to using multiple well-established commercial networks.
- Highest availability: FirstNet, if built as a nation-wide dedicated network, is arguably going to be fully resilient and redundant. On the other hand, relying on multiple existing networks and being able to work on all of them (either by switching between them or by bonding several of them for seamless higher

- quality operations), provides the highest possible availability. Further, such design further allows using other, non-LTE communication networks and operators as needed. For example, working with BGAN or VSAT satellite communications (again – by switching between networks as currently depicted in the FirstNet presentation, or by bonding them together with cellular or others), allows working in the most remote areas. Similarly, bonding WiFi, be it muni-WiFi, commercial operators' WiFi, or even private individual WiFi if needed (better than no communications at all), is both possible by bonding and very effective operationally and economically
- Further, no network is resilient to faults. Experience shows that blackouts do occur, even due to software problems. See how many and what type of network failures happened in the first commercially-deployed LTE in the USA since it was launched, analyze the impact of similar failures on a FirstNet users fully dependent on such network, and then multiply that due to the fact that after all and with all due respect, that commercial operator is a much more experienced and equipped entity than a new FirstNet deployment.
  - Bandwidth and quality: Using commercial networks allow using their available resources, which shall continue to evolve due to the huge, exponentially growing, commercial need. Further, bonding several modems mainly from different networks provides the highest possible bandwidth available at that location at any given point in time.
  - Economics: Building a cellular LTE network costs a lot of money. Much more than \$7B. Even more so – nationwide network, bullet-proof and resilient, with special features and capabilities for a limited number of users (First responders). Maintaining it requires a lot of annual investment. Upgrading it is a major task, both operationally and financially. On the other hand, using these existing resources and developing mainly software on the device side and just for the delta of the specific needs for first responders, seems a much more flexible, quick, efficient, time-proof and overall economical effort.
  - LTE technology: LTE technology and global vendors continuously offers new capabilities. Such relevant ones include Quality of Service (QoS) to ensure prioritization and service guarantee, full IP core allowing IP-based cloud and other services, and others. These are driven by the commercial operators and FirstNet is in a position to enjoy that as the operators shall introduce the constantly evolving and improving network capabilities. This shall probably not be the case if building own dedicated FirstNet network.
  - The special features for public safety, e.g PTT, group calls (voice and future video), encryption and data safety etc are relatively minor in comparison to the overall scope of the LTE standard and implementation. Therefore, addressing these capabilities should be relatively easily resolved by vendors who have incentives. Anyways, these same capabilities have to be supplied regardless of whether going with a dedicated FirstNet or when relying on existing networks, so why not do it the “right way” via the standard bodies.
  - Timeline and evolution: Relying on existing networks, with bonding or without it, provides an almost immediate solution. Building a dedicated network shall take several years, perhaps a decade. There is a risk that by the time it becomes even

partially operative, there shall be better technologies which shall not be implemented in the dedicated FirstNet. The result might be similar to the current situation with LMR, a dedicated, antiquated network not adequate to modern public safety needs. The only difference might be just that a dedicated FirstNet shall be several orders of magnitude more costly to deploy and maintain than LMR due to its complexity and shorter coverage range.

- As for bonding, this technology has already field-proved to provide highest QoS for the most demanding application of all being that of live uplink video from anywhere, at a fraction (several orders of magnitude) that of satellite communications. Being a software technology, cost can be further reduced such when using COTS devices, as is currently being released by LiveU (bonding WiFi & Cellular or dual cellular when using an iPhone, to transmit live video up from the field)

### Bonding multiple networks

The figure below shows the solution level architecture of the LiveU TV-quality (up to full HD and even 3D) live video from the field, one of if not the most demanding application of all.

The resemblance to the architecture proposed to the NTIA board is striking. We have been adding just one software element to the proposed solution: bonding – using any set of the existing networks together rather than just switching between them.

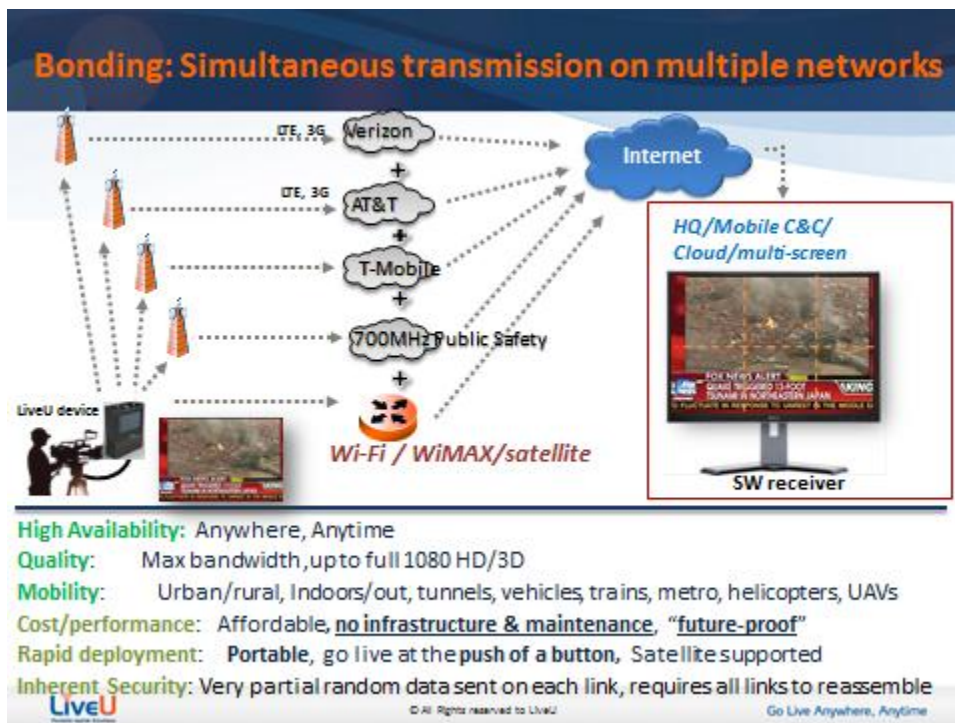


Figure 1 Bonding networks high level architecture

## Live video from the field

While being highly in demand for multiple public safety applications, live video from the field is one of the most demanding applications. Since for video sustainable link performance is required in several parameters (bandwidth, latency, error rate etc), since the wireless and cellular environments are inherently not providing that, and since the demand for high quality is continuously increasing, there is a need for an innovative solution.

While traditional public safety video from the field has either been non-existent, or very poor (as low as black and white with 1 frame per second up to 12 fps at most, non-continuous and non-mobile), or very costly (using dedicated wifi networks or satellite communications), the need has always been there and shall continue to grow. Now, for the first time, there is a technology that can overcome all those difficulties meet the real and evolving needs and enable new operations and missions based on these capabilities.

Further, we have proved that once a new networks was rolled out we were able to just add or replace the modems being used and immediately make use of these new networks. When we started there was no HSPA+ being deployed, so we added that when it came out. Then, in 2011, LTE was first commercially launched in Scandinavia and we were first to add a relevant modem into our deployed device and instantly make use of that network, in the location where it was used. Then, when commercial LTE came to the USA, again we simply replaced modems inside our devices and instantly started using these networks in bonding to the other ones. In Haiti, after the earthquake, two BGAN satellite terminals were bonded by our unit to provide enhanced video upstream as cellular was never a possibility there.

As for LTE by itself, we see the benefits it brings yet also see that by its own it can not support the demands for high quality, highly available, stable and consistent video transmission from the field. It must be bonded with more modems and/or with more cellular and other networks to do that.

Live video from the field becomes crucial for life saving and for effective management of complex events and situations, such as riots and demonstration management, mobile surveillance for various police tasks, border protection tasks, disaster management (while and after), terror attacks, multiple simultaneous events, fires and wild fires, Search and Rescue, remote medical centers and field health operation, early medical care in en-route ambulances and many more.

We believe that our very successful field proven technology is an enabler for all these applications.

While being a software in its base, we have both built our own devices (known as LU70, LU60, LU40), as well as recently used a COTS iPhone to bond its cellular and WiFi radios for this uplink video, used it on a laptop to bond any modem integrated or connected to it, and have other COTS devices implementations as well. Being a software solution it can be implemented on almost any other platform, even directly on a camera.



We've seen the demand for live quality video from the field continuously increasing in all of our markets. This trend is not likely to stop. We've been able to satisfy it transparently to the actual networks being used using our IP and application level. Other hardware optional enhancements that we have developed include small size antenna etc.

Here are some pictures of our bonding cellular-based products in use:



*Hurricane Irene;  
Even when satellites  
don't work*



*Japan Tsunami, Disaster management from helicopter*





*Mass accident*



*Demonstrations & riots – Arab Spring*



*Remote Tele-sonography, even from en-route ambulance (US)*

