UBBA Business Working Group
Commercial Roaming Position Paper

I. Introduction

Utilities across the country are in the early stages of planning and deploying their own utility grade private LTE networks to enable modern data-dependent applications for managing the electric grid. The driving, over-arching value of these networks is utility control: control over system resiliency and restoration, the network security features implemented, the bandwidth allocated to specific applications, and the type and capabilities of devices, among other important aspects of network management.

Utilities have a longstanding, "traditional" relationship with commercial carriers as subscribers on commercial LTE networks. As the industry evolves and utilities build out their own private LTE networks, however, utilities and carriers must work together to accommodate basic changes in utility requirements—including the requirement that the utility control devices that belong to its private LTE network.

Utilities that deploy private LTE will make use of commercial network coverage in at least three situations: where a utility is in the process of building private network coverage, where utility network coverage exists but carrier coverage is desired for failover during maintenance outages, and where it is cost prohibitive for utilities to extend private network coverage to certain parts of their service areas. Carriers and utilities could address these needs through a range of mechanisms, including "roaming" (the capability of a device that belonging to one network to connect to a different ("visited") network) and the use of dual-SIM or electronic SIM ("eSIM") devices that can receive service in either or both network(s). As utilities begin to deploy devices "homed" on their own private LTE networks, the industry would benefit from carriers allowing utility network devices to roam onto carrier networks under these specialized circumstances. This "utility roaming" would be a new capability carriers could offer utilities, enabling them to take advantage of carrier coverage while helping utilities meet their requirement of device control.

This position paper is a product of the UBBA Business Working Group. It serves to highlight the business challenges of the topic and offer possible solutions. The goal of the paper is for utilities to come together as a unified industry to work with commercial carriers, either directly and/or through roaming service aggregators, to identify and implement business and technology solutions, which allow utilities that build private LTE networks to control the devices that connect to those networks even as those devices benefit from commercial carrier coverage.

II. Utilities' Relationship with Commercial Carriers

Commercial carriers are the default provider of wireless communications; they must provide nondiscriminatory service to all customers. They also have invested tremendous sums in deploying network coverage by which they provide wireless connectivity throughout the country. However, carriers are profit-seeking entities and therefore their principal business driver is to grow revenues through those investments.

A. Traditional Subscribership

Commercial carriers have adopted a subscription model to offer traditional consumer wireless connectivity: a customer purchases a subscription and a device that can attach to the carrier network, but the carrier manages that device and that subscription, ensuring that the device may connect only to the carrier's network or to other networks that have roaming agreements with the carrier. In 4G LTE technology, this means that the device's Subscriber Identity Module (SIM) on the universal integrated circuit card (UICC) must include an International Mobile Subscriber Identity (IMSI) number that identifies the subscriber as belonging to the carrier network. Thus, the carrier-issued IMSI prevents use of the device on other networks without a roaming agreement with the carrier. Historically, electric utilities have simply purchased subscription service from the carrier, using devices that the carrier controls.

B. Change in the Industry Requires Change in the Relationship

As utilities face the imperative of modernizing their grids, they are also recognizing the importance of security and control of their critical communications networks. And with the availability of broadband spectrum appropriate for critical applications, utilities are increasingly planning and deploying their own private, utility-controlled LTE networks using the same technology as the carrier networks but built to utility reliability and resilience standards on dedicated spectrum. Control means that the utility can implement network hardening and resilience standards, repair network issues and set the network maintenance schedule to meet its own needs, implement LTE features that may not be a good fit for a commercial carrier's broad subscriber base, and establish coverage where the utility needs it.

In the modern-grid world, the missions and business drivers for utilities and commercial carriers are diverging; carrier subscription service no longer meets the utilities' needs. Commercial carriers have vast, loosely controlled populations of subscriber devices; carriers are driven by market forces to balance service, security, efficiency, convenience, and price. Today's energy realities (distributed, intermittent generation, bi-directional energy flow and electric vehicles) are forcing change in the utility industry. Utilities now require monitoring and control over a limited, tightly regulated population of network devices that can access their private LTE networks, driven by a mandate to provide essential electric service reliably, efficiently, and safely. It was this same mandate that led utilities long ago to cease reliance upon carriers for wireless voice communications, instead deploying their own narrowband radio networks for line crews to use in restoring power after a storm. Utilities need to control their network and devices to ensure network security, performance, prioritization of critical traffic, unfettered access to devices, and—in the event of a network outage—prioritization of restoration of coverage in areas critical to utility operations.

Thus, the old model where the carrier controls the network, subscription, and device is no longer acceptable to many utilities. On private LTE networks, the utility will control the devices: the IMSI in the SIM will identify the device as belonging to the utility network. This approach will increase the security and control of the grid, and utilities will resist compromising that benefit by ceding control of devices to commercial carriers.

Though substantial, the changes in the industry do not necessarily signify an end to the carrier-utility customer relationship. Rather, they should affect a change in that relationship, one where the utility compensates the carrier—whether with a fee or an in-kind swap of services—not for service delivered

via carrier-controlled devices, but rather for the ability of utility-controlled devices to take advantage of the carrier's extensive network coverage. In short, utilities and carriers should work to enable "utility roaming"—permission for devices that belong to the utility LTE network to roam onto the carrier's LTE network.

III. Three Use Cases for Utility Devices Roaming onto Carrier Networks

Though utility private LTE networks will meet utilities' requirements for secure, reliable communications for grid management, there are three general cases in which a utility that possesses such a network would nevertheless want its devices to be able to roam onto the carrier network. These use cases could arise fairly frequently, and it will be helpful for utilities to obtain the carrier's help in meeting them through equitable and mutually-beneficial business arrangements. But in the absence of such help—if the carrier refuses to allow utility roaming—utilities will likely be forced to cease to subscribe to those carrier services in a meaningful way.

A. During Build-out

Utility private LTE networks are not deployed overnight. Once the network planning is complete, it can take years for a utility to implement that plan and bring the new network into full operation. Implementation will typically be conducted in phases, growing the network coverage in steps until the network is operational in its entire planned coverage area.

Even before private network coverage is complete, however, the utility may desire to deploy devices in areas where the private network is not yet operational. In that period between device deployment and availability of private network coverage for that location, it would benefit the utility and its customers if the deployed devices were able to use existing carrier coverage, effectively "roaming" on the carrier network until the utility private network were able to provide that coverage.

Without "utility roaming" in this case, one of the utility's alternatives would be to deploy a carrier-controlled device to the location, and then when utility private coverage is operational dispatch a service vehicle to replace the carrier device with a utility-controlled device. If "utility roaming" is permitted, the utility device would be the only one deployed, and it could, through Over-the-Air device management or automated solutions, be switched from roaming on the carrier network to its "home" connection on the utility private network without need of a truck roll. Another alternative is to deploy dual-SIM devices with carrier and private network SIMs, or eSIM devices with a similar capability.

B. Failover

Even after the utility's private network is completed and is providing coverage in a particular area, "utility roaming" in that area will still be useful. All networks—including utility-grade private LTE networks—occasionally require maintenance. This maintenance is conducted during planned, specified time periods in which a portion of the network coverage is taken off-line. Though controlled, designed, and scheduled by the utility to minimize disruption, these maintenance outages nonetheless would temporarily pause communications to and from grid devices.

"Utility roaming" would limit the pause in device connectivity during outages of the utility private LTE network in a given area ("in-footprint"). When a private LTE outage begins, the utility device (if so configured) could automatically switch to the carrier network; when the private LTE network coverage is again available, the utility device could automatically switch back to its "home" network, the utility's private LTE network. Similarly obviating the need of a truck roll, the device could be prodded remotely to switch back and forth through Over-the-Air device management or automated solutions. This "in-footprint" roaming is not the standard for carrier roaming and is not typically allowed, but for fixed data devices, the exception should be made. This "utility roaming" would thus be helpful in managing temporary outages and provide a further backstop to enhance overall system reliability.

C. Coverage Gaps Within and Connectivity Outside Utility Service Area

Despite building their own private LTE networks, utilities may require device connectivity in areas where the utility does not have coverage. In one such use case, a utility device would be used on its "home" network but occasionally travel to locations outside the "home" network's coverage as in the case of mutual aid for disaster recovery. In this case, "utility roaming" would be useful if the carrier network provides coverage in the desired area.

In the fixed use case, the utility may desire connectivity in parts of its service area that are not slated for private LTE coverage because they are challenging or expensive to reach. Because the utility will desire to control its own devices and "home" them on its private LTE network, devices in such areas would effectively be in "permanent roaming" status on the carrier network that provides coverage there. Again, this is not a typical commercial carrier use case, but it is technically viable and would serve the greater good by helping utilities meet their service mandate.

D. The Challenges of Change

In order to accommodate the three roaming use cases described above and effectuate the required change in the traditional utility-carrier relationship, carriers must agree to roaming agreements that permit authorized utility-controlled devices automatically to switch to the carrier networks when the utility's own private LTE network is unavailable. The utility would procure and deploy devices with this capability already installed and activated using widely available and mature technology.

Roaming agreements among carriers are common, but they are also detailed and complex. Though "utility roaming" is not essential to utilities' realizing the substantial benefits of private LTE, it would be very useful to have; carriers' resistance to the idea may simply be an effort to extend the traditional utility-carrier business relationship and discourage utilities from building their own networks.

IV. SIM-based Approaches

Though utility roaming is the preferred long-term solution, another shorter-term approach is available. As explained above, the IMSI number in the device's SIM determines the network to which the device belongs—and the entity that manages the device. Typically, devices contain only a single SIM with a single IMSI number and thus can belong to only a single network. Devices can, however, include two SIMs, each reflecting a different IMSI, effectively enabling the device to belong to either or both networks—in this case, a named carrier's network and/or the utility network. Devices can also contain

an electronic SIM ("eSIM")—either instead of or in addition to a traditional SIM—that can be remotely configured to change the device's "home" network, including changing of the represented IMSI.

A. The "Dual-SIM" Approach

If a utility were to deploy dual-SIM devices, such a device could belong to the specified carrier network during build-out of the utility's private LTE coverage, perhaps under the traditional carrier subscriber model. Once the utility network coverage is operational, the carrier could terminate the device on its network and the utility, using the other SIM, could activate it on the utility's private LTE network—all remotely, without need of a truck roll.

Though dual-SIM devices tend to be more costly than single-SIM models, this approach could be implemented today without substantial change to the traditional carrier-utility business relationship. Depending on device capabilities, this approach may not be well-suited to rapidly switching back-and-forth between carrier and utility coverage as required by the "failover" and "coverage gap" use cases described above. However, some devices do support an automatic and rapid SIM switching capability which could be deployed to support those use case.

B. The "eSIM" Approach

An eSIM is an embedded SIM that (depending on the type) can be remotely or locally configured to subscribe a device to a particular network. So, for example, a utility that has not finished building out its private LTE network could deploy devices with eSIMs that are configured for subscription to a commercial carrier's service. When it comes time to migrate that device to the utility's own private LTE network, the utility can implement that change over-the-air, switching the IMSI in the eSIM to reflect the utility network without need of physical contact with the device.

Today, not every LTE device offers eSIMs, but the ecosystem is growing. And though the eSIM approach does not provide the seamlessness of true utility roaming, it is the most flexible short-term solution to provide connectivity while utilities work to complete private LTE networks.

V. Call to Action

Utilities are now planning for their own private LTE networks, so this is the time to resolve the issues associated with enabling utility devices to benefit from commercial carrier coverage. The terms of a roaming agreement or the decision to deploy dual-SIM or eSIM devices, for example, could impact any number of aspects of the utility's deployment, from build-out timing to device selection.

To highlight the broad application of this issue in meeting the grid modernization challenge, utilities should undertake a concerted effort to approach the carriers—and if necessary the Federal Communications Commission—speaking with one voice as an industry. This is an issue on which utilities can and should collaborate, working with carriers to understand their business drivers and to carriers that it is in their interest to accommodate the changes utilities require in order for the utilities, in turn, to meet their own mandate. And in their own discussions with carriers, utilities should reflect this collaborative effort, raising these issues in a consistent and uniform fashion and advocating similar agreement language, with specificity. This is an important and solvable challenge, and as an industry, we should be able to work creatively with the carriers to achieve a mutually advantageous resolution.

Carriers have long served critical infrastructure industries like ours, and they wish to continue to do so. But as our industry changes, we must help them hear and appreciate our requests for alterations in the business relationship; the traditional approach no longer fits the changing industry or meets our heightened standards to facilitate the safe and efficient provision of electric service.

UBBA is pleased to lead an initiative to bring utilities and commercial carriers together to pursue a mutually beneficial resolution. We urge utilities to join us in this effort.

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About the Utility Broadband Alliance (UBBA)
UBBA is a collaboration of utilities and ecosystem partners dedicated to the advancement and development of private broadband networks for America's critical infrastructure industries. Members have access to resources that accelerate their journey towards a secure, resilient, and future-proof grid. For more information about UBBA Working Groups or joining the Alliance visit our website or contact us at info@ubba.com