Chairman Julius Genachowski; Commissioner Robert M. McDowell, Commissioner Mignon Clyburn; Commissioner Jessica Rosenworcel; and Commissioner Ajit Pai.

Introduction

New York City government's internal IT and public-facing telecommunications systems and infrastructure, managed predominantly by the Department of Information Technology and Telecommunications (DoITT), withstood the worst Hurricane Sandy had to offer. Vital services such as the NYC 311 system and the City's official website, *NYC.gov* – which serve as lifelines for countless New Yorkers in need – were well-maintained and functioned with no interruption before, during, or after the storm. Internal systems – the City's Mainframe, Unix, Wintel, email, data, and radio systems – also remained up and running at all times.

However, systems administered and maintained by private sector companies – which either support City systems or provide services directly to the public – were negatively impacted by network and access failures. For example, due to flooding of critical Verizon facilities supporting landline voice traffic in lower Manhattan, for a time there were fewer than 200 telephone lines available for incoming calls to 311, and wait times increased to an average of more than seven minutes during and following the storm. The fact remains that in the modern, networked world, impacts to one or more systems – if they are substantial enough, or last long enough – will eventually cascade to the other systems that rely upon them.

In the days and weeks after the storm, DoITT aimed to assess the performance of its own systems as well as those of the city's private telecommunications providers, and is now participating in a citywide working group that will offer an assessment and recommendations for improvement as part the City's comprehensive Hurricane Sandy "after action" review.

While this review is still underway, it is clear that the City's telecommunications providers will need to make significant enhancements to their infrastructure, their information sharing practices, and their disaster recovery planning. Their charge must be not solely to restore capability and service to pre-storm levels, but to ensure sufficient resiliency and hardening so that the public – and the City agencies that serve them – may confidently rely on these systems in future catastrophic events.

While the telecommunication carriers, New York State, the Department of Homeland Security, the Federal Emergency Management Agency, FCC, and many others tirelessly worked shoulder-to-shoulder with the City of New York during and after the storm, it is critical that regulatory steps be taken to harden communications networks in the future. The City, its residents, and its business community, are dependent on communications services to report emergencies, interact with first responders, and maintain continuity of business and daily life before, during, and after any storm or disaster. With that reality comes the responsibility to make improvements gleaned from the hard lessons learned.

This statement focuses on the impact of various telecommunications outages on the City of New York; outlines the steps we took to prepare City systems for the coming storm; describes the efforts made to support the restoration of vital services in the wake of Hurricane Sandy; and concludes with some recommendations about the areas the FCC should focus on to improve the telecommunications infrastructure across the five boroughs – and anywhere vulnerable to the kind of devastation Sandy caused.

What New York City Experienced

While City-run radio, data, and telecom networks performed remarkably well during the storm, there were major impacts on the commercial telecommunications infrastructure in New York City that resulted from a lack of sufficient backup power and, in some cases, destruction of key system infrastructure. From the field, from the Office of Emergency Management (OEM), and from our technical headquarters in Brooklyn, my team and I witnessed:

- Flooding of two critical central offices, or "COs" – both located in a flood plain in lower Manhattan – leading to severe outages of the Centrex service
- Call surges on public telecommunications networks
- Persistent network, telecom, and phone outages in services provided by the private sector to City agencies
- Lack of fuel for primary generators
- The need to establish a supply chain to ensure safe gas deliveries to backup generators at cell sites across the five boroughs.

Hurricane Sandy's impact on the public's ability to communicate, and the City's ability to communicate with it, was significant. Network outages, service degradation, and overload in call volumes were problematic throughout the emergency. These commercial networks, when operational, serve as a vital link for New Yorkers in need of help and aiming to conduct their daily lives and businesses.

Among the most critical communications systems today are wireless networks. Wireless carrier infrastructure throughout the five boroughs consists of thousands of sites that rely both on continuous availability of antenna facilities and on backhaul connectivity via various transport media (i.e., fiber/wireline). We believe that wireless carrier networks providers experienced outages of approximately 25% throughout the duration of the hurricane.

These storm-related, commercial wireless network outages derived from three primary factors:

Backhaul transmission infrastructure: One of the most significant problems experienced in Hurricane Sandy and its aftermath was related to the failure of transmission and backhaul infrastructure, which supports connectivity to key central offices. This infrastructure was severely impacted by utility power failures as well as damage due to flooding. Much of this essential infrastructure is controlled by wireline telephone companies such as Verizon or other operators, and was beyond the control of the wireless carriers.

Electrical power to antenna sites: Operation of cell sites is dependent on commercial power. Commercial wireless carriers are not currently mandated to provide backup power at cell sites or throughout their infrastructure. Although industry best practices and feedback from the wireless carriers suggests that many do seek to provide backup power for up to eight hours, the actual backup power practices in place proved insufficient in some locations to sustain the fallout from a storm such as Hurricane Sandy.

Call volume: In addition to physical and equipment challenges, even where network sites were fully operable, call blocking was experienced by end users due to saturation and high volume of call traffic.

What New York City Did

As Hurricane Sandy approached New York City, DoITT took measures outlined in its continuity of operations plan to brace its systems – websites, phone systems, and networks – for the worst.

NYC.gov – In anticipation of heavy traffic to *NYC.gov*, we moved to a static version of the website with plain HTML versions of all main portal pages, which were then cached to further increase capacity. As a result, the *NYC.gov* home page remained up and operational before, during, and after Hurricane Sandy. Between October 29 and October 31, *NYC.gov* handled 2.3 million visits, and 4.8 million page views. This is due to the City's multi-pronged approach to better accommodate peak-volume traffic in the wake of Hurricane Irene in 2011, including not only use of the cloud-based caching providers, but the doubling of Internet bandwidth as well as upgrading our servers – and adding new ones – to increase the number of users that could simultaneously access the portal.

NYC 311 – The City's non-emergency government information and services system (NYC 311), located in lower Manhattan, was connected to OEM headquarters throughout the event for updates and communications, and had staff onsite at OEM as well. We pre-positioned a generator in the days leading up to the storm to power the NYC 311 call center should the surrounding area lose power. When it did – as well as when all landlines in lower Manhattan went down, which I will describe below – NYC 311 remained operational and accessible throughout the storm, with service to the public, while at times slow, uninterrupted throughout.

Calls to 311 during the storm were four times greater than the 2012 daily average, peaking as high as 274,000 in one day. Although average wait times to speak with a call taker increased during the Sandy period, 74 percent of all inquiries were resolved via Interactive Voice Response (IVR) messages within two minutes' time. Visits to 311 Online, the web counterpart to the call center, were seven times higher than the daily average for 2012, contributing to increased 24/7, self-service access to critical citywide information, services and assistance. NYC 311 personnel staffed the call center continuously, overcoming the MTA transit shutdown, power outages, and, for a time, a lack of heat and water. Many worked multiple shifts, staying at the call center when they were displaced from their own homes due to Sandy's impact.

While power outages and transit shutdowns could have reasonably been expected given the recent history of large storms hitting New York City, what was not expected was the duration of the power outage and the destruction of telecommunications infrastructure in lower Manhattan. I will describe this now, impacting as it did our otherwise well-prepared NYC 311 system and wireless networks.

First, the telecommunications infrastructure: At approximately 8:30 Monday evening, October 29th, when the power outages began in lower Manhattan, NYC 311 seamlessly failed-over to its pre-positioned generator as its staff continued taking calls with no impact to the public.

At approximately 9:15pm, Verizon's Broad Street Central Office – or "CO" – began experiencing various failures. The Broad Street CO is one of two that supported landline voice traffic to Manhattan south of Canal Street, and was key to NYC 311 operation as it provided half the total call-taking capacity of NYC 311.

Shortly after 9:15pm, as DoITT and NYC 311 staff began working on contingencies should the Broad Street CO fail, it was fully expected that the other lower Manhattan CO, on West Street, would sustain throughout the worst of the storm.

Early on the morning of Tuesday, October 30, at approximately 1:00am, Verizon's Broad Street CO suffered catastrophic failure due to seawater flooding into the site, immediately reducing by 50% the amount of simultaneous calls NYC 311 could handle. This was a highly suboptimal situation – wait times would necessarily increase significantly and some callers would experience busy signals – but NYC 311 was still taking and servicing calls. The worst, it was thought, was behind us.

At approximately 3:30am, however, Verizon's West Street CO began to fill with water. Despite a truck from the Department of Environmental Protection arriving within an hour to assist with pumping water out of the facility, by 8:30am the West Street circuits serving NYC 311 became completely unavailable as the facility powered down.

While the West Street CO would begin coming back online by Wednesday afternoon, with full service restored on Friday morning, if not for the remarkable improvisational talents of our NYC 311 and telecomm staff members – as well as those from Verizon – NYC 311 would have been unavailable to the public after 8:30 on Tuesday morning, October 30.

Instead, when the Verizon circuits failed, we employed a manual, coordinated effort and redesign to reroute the calls. Using the Verizon Customer Redirect Service, we directed Verizon to route all NYC 311 call traffic over "Citynet" (the City's institutional fiber backbone), to the Verizon Bridge St CO in Brooklyn to maintain business continuity.

Wireless Technologies – Among the most heavily-used DoITT-managed services during Hurricane Sandy were its wireless technologies, which provided a communication lifeline to City agencies during response and recovery activities. In preparation for the storm, we ensured fueling of generators and hardening of infrastructure at key network sites, and worked with our vendors to ensure technicians were readied in each borough to support restoration efforts as needed.

Performance of Citywide Radio Systems – DoITT maintains two distinct mission critical radio systems – 800 MHz and the Citywide Radio Network (CRN) – supporting more than 40 City agencies and some 25,000 radios with internal and interoperable communications among various jurisdictions (i.e. health care organizations/OEM, National Guard/Department of Health and Mental Hygiene). There was heavy reliance on these systems during and after Hurricane Sandy, as they were among the only reliable means of voice communications for critical response efforts in and around the impact zones.

DoITT was particularly involved with administering the communications system for the Healthcare Evacuation Center (HEC), a multi-jurisdictional agency operation at OEM that coordinated amongst hospitals, nursing homes, and adult care facilities during evacuation operations. Mission critical radio communications was essential in support of the HEC's goal of coordinating the safe movement of patients/residents between evacuating and receiving facilities before, during, and after the storm. While cell phone networks and landline phones were down in many hospital areas across the City, we ensured available and effective radio access as many hospital administrators had no way to communicate with OEM save for DoITT's radio system.

All told, system utilization increased by 116% for the 800 MHz system and by 262% for CRN, and each system scaled to meet this demand without incident. DoITT deployed more than 900 radios in total to approximately two dozen agencies, including OEM, Fire Department, Mayor's Office, Office of the Chief Medical Examiner, Department of Sanitation, Parks Department, and the National Guard. These radio systems maintained 100% uptime and reliability throughout the emergency, which can be attributed to backup generators and digital microwave technology that lessened dependency on power and telecommunications providers.

Performance of Citywide Broadband Network – The New York City Wireless Network, or NYCWiN, the City's dedicated high-speed broadband network for public safety and service, performed as designed during the storm and its aftermath. It exceeded public safety standards for resiliency, telecommunications redundancy and backup power. During the hurricane, uninterrupted network accessibility was provided as bandwidth utilization and number of connected users increased 33% and 23%, respectively, compared to the week prior.

Moving beyond DoITT-managed systems, the storm had a significant impact on commercially-provided voice and data services to City agencies – and thousands of their employees – located in lower Manhattan, and required that these agencies relocate their staff to available office space elsewhere. While DoITT-managed Voice over Internet Protocol (VoIP) phones allowed flexibility to redirect "down" work locations to alternate work sites, outages in private sector-provided Centrex phone systems limited our ability to route calls to other work sites since they run only through a single CO.

Since the storm, DoITT has facilitated the provisioning of network data and voice services at these new locations. We deployed hundreds of VoIP phones to maintain or restore business continuity, and we continue to migrate thousands of users for many of the agencies that are dependent on Verizon Centrex and may still be without phone service. This includes the New York City Board of Elections, which was required to facilitate voting for millions of New Yorkers on Tuesday, November 6.

In the days following Sandy, DoITT also:

- Distributed more than 700 wireless devices – in addition to the aforementioned 900 radios – to City agencies working on recovery efforts, including Blackberrys, MiFi hotspots, mobile phones, tablets, and iPads.

- Conducted calls with Verizon several times daily to discuss the status of restoration operations and the state of its network. These discussions allowed us to ensure that the City offered Verizon whatever it required to restore service, such as, for example, facility access for technicians making repairs, provision of pumping equipment, etc.

- Worked with telecom providers, cable companies, and several agencies to implement network and telecom components of the Disaster Assistance Centers in Brooklyn, Queens, and Staten Island. This included establishing broadband access to these locations, networking computer equipment and printers so that they could assist impacted communities.

- Helped coordinate with the city's major wireless telecommunications providers "National Disaster Recovery teams," OEM, New York City Police Department, New York State Division of Homeland Security and Emergency Services, and the Federal Department of Homeland Security to deploy mobile cell platforms, such as Cells on Wheels (COWs), and Cells on Light Truck (COLTs) to areas where mobile service was either non-existent or significantly diminished. Additionally, we worked with these teams to secure emergency generators and charging stations to affected areas so that residents in the Rockaways and Staten Island could charge their mobile devices as well as provide a level of wireless service while main systems were being restored.

What New York City Needs

We are mindful that Hurricane Sandy was unprecedented in many ways, and equally cognizant that no system – however expensive, well-managed, or well-designed – will function flawlessly in every conceivable scenario. Still, even in a major emergency event, infrastructure can be designed to withstand water, wind, and sustained power outages. As we work with our telecommunication provider partners in the rebuilding process, now is the time to make the improvements necessary to ensure these systems are made as sturdy as the New Yorkers they serve.

1) Multiple & Affordable Communications Options

The single biggest thing we can do is to ensure that New Yorkers, especially our most vulnerable populations, have multiple, affordable ways of staying connected to the information and services available to them. This is important at all times; it is indispensable during emergency events.

This is so important because, as we saw during Hurricane Sandy, there is no sure way to predict which parts of the total telecommunications infrastructure will be impacted during a citywide event. As I described above, when COs supporting NYC 311 went down, the City was able to reroute landline voice traffic to NYC 311 call takers using VoIP, ensuring seamless continuity in service for New Yorkers. We were able to do so because that infrastructure, *that option*, was in place.

Similarly, when commercial wireless systems and networks failed after generators exhausted fuel supplies, or failed to work in the first place, government entities citywide were able to rely on DoITT-provisioned radios and other wireless devices to communicate. They were able to do so because our systems remained up and running, affording us the option to deploy them as required.

As it was for City government and the agencies we serve, so too must it be for the commercial carriers and the New Yorkers they serve.

Today, New York City enjoys a competitive marketplace, boasting 18 high-capacity and information services franchisees providing dozens of options to businesses in the City and three cable franchisees which, in addition to video service, provide broadband and phone to residents. But competition alone does not guarantee resilient, affordable service in an infrastructure-dependent network industry.

This is especially true as, in the wake of Hurricane Sandy, portions of the legacy copper infrastructure in New York City is being replaced by state-of-the-art fiber optic lines. While we welcome fiber optic infrastructure as a replacement to some of the damaged infrastructure in the City – especially in lower Manhattan and in Brooklyn – we need to ensure that upgraded technology does not lead to increased prices for comparable services, reduced options, or constrained competition. Customers who cannot afford fiber simply must – must – have affordable, resilient communications options available to them. Therefore, the rebuilding efforts now underway should not supplant an otherwise orderly transition to newer technologies along with preservation of the best aspects of long-established, lower-cost alternatives.

We must also ensure that awareness of service options for consumers and business is widespread. Commercial carriers and the public sector must do a better job of notifying their customers and constituents of options for restoration of telephone, cable television, and Internet service after emergency events. This is especially true if, in fact, such information will mean a faster restoration of these services for New Yorkers who need them most.

2) Resiliency & Backup Power

When there are significant, sustained power outages, the city's external telecommunications providers must have the equipment and protocols in place to ensure interoperability between their networks. And they must be able to quickly and smoothly coordinate deployment of excess capacity to affected areas. While full data capability may understandably take time to restore, New Yorkers, at a minimum, need to rely on the availability of uninterrupted voice and texting services for the duration of future citywide emergencies.

Indeed, New Yorkers need always, in an emergency, to be able to contact, by either wired or wireless phone, 911 and 311; and they need to be able to reach, via phone or text at least, their families and friends.

Therefore, in advance of future citywide events carriers should assist local officials and their communities in the planning for (and, as needed, the pre-staging of) telecommunications support assets such as COW, COLTs, and charging stations. This also entails helping identify and secure the physical areas for placement, as well as protocols to facilitate quick deployment, activation, re-fueling, etc. Once determined, the planned locations of these resources should be regularly and aggressively marketed by all telecom carriers via email, text, regular billing statements, etc.

Consideration should also be given to moving above-ground utility and telecommunication wiring below ground. Undergrounding some or all of the currently above-ground wiring can help better protect this infrastructure from damage caused by wind, ice, falling tree limbs, etc.

Beyond these considerations, in an age of increasingly severe weather events and related outages it is no longer enough to rely wholly on industry best practices as regards battery backup. To this day it remains unclear exactly how many hours of backup power commercial mobile wireless carriers provided their customers during the storm. And since the providers are not required to share this information with the City, as a general matter they do not. The balancing of costs against need is a valid exercise for the industry, but given the widespread dependency on communications systems, I submit that commercial communications providers *must* assure the public of resilient, robust networks capable of continuous service in emergencies – without passing those costs onto customers.

3) Information Sharing on Outages

While the City appreciates the informal information sharing its commercial telecommunications carriers have engaged in during and after the storm, it is crucial that any information on outages in an emergency be required as a matter of course, and, at a minimum, be given to first responders in affected communities at the very moment the information is divined. As such, the City believes that "carrier reporting," pursuant to the FCC's Disaster Reporting Information System, should be a requirement and not a voluntary exercise; moreover, that the FCC should ensure any relevant information collected that affects a severely-impacted community be shared immediately with first responders responsible for serving those impacted communities. This information should also be made publicly available to consumers so they may track the status repairs, obtain reasonable estimates as to when service might be restored, and compare performance across competing carriers.

Conclusion

In what were exceedingly challenging circumstances during and after Hurricane Sandy, New Yorkers came together to persevere through some very dark hours. For their parts, the City of New York, as well as the city's commercial telecommunications providers – despite some extraordinary factors both within and beyond their control – have worked tirelessly to maintain service where possible, and restore it quickly where not.

We can always do better. With the areas of focus I have offered here – multiple redundant and affordable communications options for the public, necessary investments in hardening network infrastructure and failover capabilities, and expanded information sharing – together we can work with our commercial providers, the FCC, and others to ensure a more prepared, resilient telecommunications infrastructure for New Yorkers.