Input to the FCC of the USA on Resilience of FTTH Communication System (Feb 26,2013)

Dr Salah Al-Chalabi (salahalchalabi@aol.com) – Chaltel Ltd. (UK)

The FCC held on February 6, 2013 a workshop on network resiliency at Brooklyn Law School at the Forchelli Center. The workshop featured presentations from engineering faculty, industry researchers and network engineers addressing topics relevant to the Commission's ongoing examination of network resiliency in the wake of super storm Sandy and other major storms.
The workshop addressed questions related to the overall infrastructure, the impact of climate change on the frequency and severity of future storms, and on how to measure the effect of natural and man-made disasters on the communications infrastructure in real time. It also addressed how to improve the resiliency of the wired access networks and the Internet backbone and lessons learnt from storm Sandy.

Traditionally the copper based telephony, where the telephone is powered from the central office over the copper wire, offers 99.999% service availability, and sometimes described as "lifeline". This central powering solution has proved over the last 100 years to be very resilient and low cost.

However, the currently standardised Fiber-to-the-Home (FTTH) GPON and EPON technologies rely on battery back-up at customer premises to maintain the "lifeline" telephone service in case of power failure. This is an expensive solution that offers lower availability than the 99.999% (five nines) which copper based networks can deliver. To solve this problem, alternative technical solutions are proposed where optical power is supplied from the Central Office (CO) to customer premises over the optical fiber to support "lifeline" telephone. This way, high levels of lifeline service availability can be achieved at cost similar to that of copper systems. Dr. Salah Al-Chalabi has published in the last 18 months two papers in the IEEE Communications Magazine (Sept. 2011 and Aug. 2012) on optically powering the telephone over optical fiber titled:

- "Powering the telephone over optical links for high availability, low cost, and small carbon footprint"; S. A. Al-Chalabi, IEEE Communications Magazine, Sept. 2011, pp. 48-55.

- "Optically powered telephone system over optical fiber with high service availability and low risk of investment in FTTH infrastructure"; S.A. Al-Chalabi, IEEE Communications Magazine, Aug. 2012, pp. 102-109.

In the first paper Dr. Al-Chalabi shows that it is feasible to power the telephone at customer premises optically by sending optical power over the optical fibre connection. Very low power consumption optical communications systems must be used. The power consumption of a standard telephone apparatus in its different states is analysed, and a simple mathematical model is developed and used to calculate the power required to operate the telephone for different durations of different states. Optical power levels transmitted over optical fibre are limited by nonlinear effects, and safety standards. Current standard GPON and EPON equipment can not be powered over optical fibre, and must use battery back-up. A low cost telephone service with 24/7 availability over optical fibre provides the infrastructure to offer broadband and HDTV exploiting the more than 30,000 GHz capacity of the optical fibre.

In the second paper, Dr. S. A. Al-Chalabi states that optical communication systems can compete with traditional twisted-pair copper systems in delivering telephony. However, they must achieve the same levels of cost and availability, and must satisfy the same regulatory requirements. An innovative optical communications system that can meet these requirements is then described, where part of the received optical power is converted to electrical power using photovoltaic cells and an energy storage

device to drive the CPE. The reach of the system can be 10 km, which covers urban and rural areas in the USA. Delivering voice over fiber as a Universal Service at comparable cost with that of delivering it over copper removes the uncertainty in service take-up over fiber, and eliminates the investment risk in a FTTH infrastructure. Superfast broadband data and HDTV services can be added to this future-proof infrastructure, when requested by the customer, with much lower incremental cost than would be needed for copper-based systems. The proposed optical communication system consumes power comparable to telephone system over copper twisted pair connections.

The lowest cost upgrade strategy is to install the "lifeline" voice system as a foundation and add the superfast data and HDTV upgrades by posting low cost, standardised "plug-and-play" CPE that can be installed by the customer with the help of technical support over the "lifeline". This optical, future-proof infrastructure of more than 30,000 GHz can then be exploited to deliver the very high bandwidth advanced services, which twisted pairs and coaxial cables can not deliver over distances of 10 km.

Telephones connected to such optical systems can be powered optically to provide "lifeline" telephony. This offers a low-cost, environmentally-friendly way of deploying an optical local network for POTS.

Obviously these technological innovative solutions are very relevant to several FCC strategic goals, see Annex I. They are also relevant to provision of Universal Service "lifeline" telephony and the ability to make E911 emergency phone calls in case of emergency, which proved to be extremely valuable during and after storm Sand which caused major power outages which lasted for several days, and some cases several weeks.

Those low power communication systems are also relevant to the efforts of the FCC and USA government to reduce the power consumption and carbon footprint of the communications sector. The traditional telephone apparatus to provide "voice grade access (CFR 47 Part 54 – Universal Service)", is specified in CFR 47 Part 68 and technical standard TIA 968. According to these standards, the telephone apparatus should consume less than 1 mW in the quiescent/idle state. The telephone in the USA is used on average about 30 minutes per day, which means that the telephone should consume less than 1 mW for at least 23 hours per day. Currently standardised broadband and VoIP telephones consume more than 1 W in this idle state. This will obviously have an impact on the environment and Carbon footprint of the telecom sector. Almost every home in the USA has at least one telephone, an increase of 1 W per home will be considerable at national levels.

One important technological area which the FCC should support and participate in is providing regulatory requirements to technical standards making bodies in the area of public communication networks. A particularly important regulatory interface that needs special attention is the "Network Termination Point", which is the regulatory interface between the customer and the public network. This should be defined by the regulator through a technical standard, as is done in the case of telephony over copper, but obviously not in the case of FTTH. Defining this regulatory point will determine where the lifeline is provided.

I will be very happy to provide the FCC more useful information about my optical technology which should provide access to emergency service over fiber at low cost and with high availability. This should protect the US citizen much better than currently standardised optical technologies for the access network. Of course, the deployment of FTTH to provide broadband services is relevant to other FCC policies such as Universal Service, Connect America and Broadband Plan.

Annex I

FCC Activities and US Regulations Impacted by FTTH Infrastructure Supporting Regulated Voice

Universal Service Fund (USF):

"In October 2011, the Commission adopted its first rulemaking decision to implement the principles of the informally called "USF/ICC Transformation Order." The Commission established the following goals:

- Preserve and advance voice service
- Ensure universal availability of voice and broadband to homes, businesses and community anchor institutions
- Ensure the availability of mobile voice, and broadband where Americans live, work or travel
- Ensure reasonably comparable rates for broadband and voice service
- Minimize universal contribution burden on consumers and businesses

One of the key elements of the Order was to expand the public interest obligations for eligible telecommunication carriers to deploy infrastructure that can provide broadband service in addition to voice service. In addition, the Order created the "Connect America Fund" to replace all existing high-cost support mechanisms. One of the goals of the Connect America Fund is to extend broadband to those Americans that lack service today, while preserving voice service. Another one of the goals of the Connect America Fund is to help make advanced mobile services – including mobile voice and broadband – available in areas that would not otherwise have those services. Implementation of this goal will be through incentive-based, market driven policies such as phase one of the Mobility Fund which uses a competitive bidding process to help expand 3G and 4 G mobile wireless networks in areas where it would be cost effective to develop with a one-time investment from the Connect America Fund."

Connect America Fund

"Broadband has gone from being a luxury to a necessity for full participation in our economy and society – for all Americans. For that reason, the FCC has adopted comprehensive reforms of its Universal Service Fund (USF) and Intercarrier Compensation (ICC) systems to accelerate broadband build-out to the 18 million Americans living in rural areas who currently have no access to robust broadband infrastructure. This reform will expand the benefits of high-speed Internet to millions of consumers in every part of the country by transforming the existing USF into a new Connect America Fund (CAF) focused on broadband.

Consumers everywhere – both urban and rural – will benefit. Reform will not only drive economic growth in rural America, but will expand the online marketplace nationwide, creating jobs and businesses opportunities across the country."

REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING
(USF/ICC Transformation Order)
Adopted: October 27, 2011 Released: November 18, 2011

A. Universal Service Reform

17. *Principles and Goals.* We begin by adopting support for broadband-capable networks as an express universal service principle under section 254(b) of the Communications Act, and, for the first time, we set specific performance goals for the high-cost component of the USF that we are reforming today, to ensure these reforms are achieving their intended purposes. The goals are: (1) preserve and advance universal availability of voice service; (2) ensure universal availability of modern networks capable of providing voice and broadband service to homes, businesses, and community anchor institutions; (3) ensure universal availability of modern networks capable of providing advanced mobile voice and broadband service; (4) ensure that rates for broadband services and rates for voice services are reasonably comparable in all regions of the nation; and (5) minimize the universal service contribution burden on consumers and businesses."

"Carriers that elect to receive Connect America Fund must provide broadband with actual speeds of at least 4 Mbps downstream and 1 Mbps upstream, with latency suitable for real-time applications and services such as VoIP, and with monthly usage capacity reasonably comparable to that of residential terrestrial fixed broadband offerings in urban areas. In addition, to ensure fairness for consumers across the country who pay into USF, we reduce existing support levels in any areas where a price cap company charges artificially low end-user voice rates."

FCC 2012-2016 Strategic Plan

Goal 1: Connect America

Objective 1.2: Maximize availability of fixed and mobile broadband to all Americans and community anchor institutions, including in rural and insular areas and Tribal lands, while ensuring that universal service programs are efficient, effective, and impose no greater burden on consumers and businesses than necessary.

Goal 3: Protect and Empower Consumers

Objective 3.2: Act swiftly and consistently in the use of enforcement authority to protect consumers.

Among the Commission's most important responsibilities is protecting and empowering consumers. As communications networks and technologies become increasingly complex and essential to Americans' everyday lives, the Commission must be a vigilant watchdog for the consumer. The FCC will continue its vigorous enforcement of communications statutes and regulations, taking appropriate actions against those who seek to deceive consumers or otherwise violate the Commission's rules. The FCC will ensure that Commission proceedings take account of consumer interests, and that consumer protection and empowerment policies apply consistently and reasonably across technologies and bureaus at the FCC. We will continue to provide consumers with

up-to-date, user-friendly advisories concerning their rights, responsibilities, service options, and information to make informed decisions.

Goal 4: Promote Innovation, Investment, and America's Global Competitiveness

Objective 4.3: **Preserve the free and open Internet as a platform for economic growth, innovation, job-creation, and global competitiveness.**

One of the most important features of the Internet is its openness. It uses free, publicly available standards that anyone can access and build to, and it treats all traffic that flows across the network in roughly the same way. This design has made it possible for anyone, anywhere to easily launch innovative applications and services, revolutionizing the way people communicate, participate, create, and do business. The FCC is focused on ensuring that every American has access to open and robust high-speed Internet service. The FCC adopted Open Internet rules to ensure that the Internet remains a powerful platform for innovation and job creation; to empower consumers and entrepreneurs; to protect free expression; to promote competition; to increase certainty in the marketplace by providing greater predictability for all stakeholders regarding federal policy; and to spur investment in our nation's broadband networks. The Commission will continue to work to ensure the openness of the Internet, and will vigorously enforce its rules

Goal 6: Public Safety and Homeland Security

Vision: *Promote the availability of reliable, interoperable, redundant, rapidly restorable critical communications infrastructures that are supportive of all required services.*

Objective 6.1: **Promote access to effective communications services, including next generation services, in emergency situations across a range of platforms by public safety, health, defense, and other emergency personnel, as well as all consumers in need.**

The Commission continues to facilitate the deployment of 911 services and technologies and to pave the way for greater capabilities, including by helping define the system architecture and develop a transition plan to establish a digital, Internet Protocol (IP)-based foundation for the delivery of multimedia 9-1-1 "calls." 911 call centers could receive text, pictures and videos from members of the public, providing additional information to first responders as well as an additional means for persons who are injured, witness an accident or are disabled to contact a 911 dispatcher. The Commission will also take steps to ensure that all segments of the communications industry can provide effective and technologically up-to-date public alerts and warnings to the American public, including through the Emergency Alert System (EAS) and the Personal Localized Alerting Network (PLAN).

Objective 6.2: **Evaluate and strengthen measures for protecting the nation's critical communications infrastructure and facilitate rapid restoration of the U.S. communications infrastructure and facilities after disruption by any cause, including cyberattacks.**

The FCC is committed to ensuring the public's safety through the reliability of our nation's communications networks, including during natural and manmade disasters. The Commission will provide leadership in the protection of the Nation's critical communications infrastructure, including

working with public safety and stakeholders to maximize the availability, interoperability, and reliability of communications.

Objective 6.3: **Implement, maintain and conduct exercises for the FCC's Continuity of Operations Plans (COOP) and Emergency Preparedness Plans and act swiftly in matters affecting public safety, homeland security, and disaster management.**

The FCC must be prepared for incidents and disruptions to its own physical and network facilities. The FCC will continue to refine and enhance its COOP and Emergency Preparedness Plans, including fully participating in annual exercises with other federal agencies, reviewing and updating documentation of emergency procedures, and improving the readiness and redundancy of the FCC's high priority information systems. The Commission will also enhance preparations for specific types of events, reviewing its shelter-in-place procedures, improving the capabilities for mission-critical personnel to work off-site at an alternative work site or through teleworking, and addressing the possibility of a pandemic health event.