Emerging Network Technologies and Network Neutrality Conformance

Ramneek, Patrick Hosein, Woojin Seok, Jai-seung Kwak and Alexandr Ni

APNOMS 2017 : The 19th Asia-Pacific Network Operations and Management Symposium

Presented By: Alexandr Ni

28 August 2017

What is Network Neutrality?

- Network Neutrality principle states that in order to preserve the openness of the Internet, the end users should have equal access to all the content on the Internet, and the Internet Service Providers (ISP) should be prohibited from discriminating or blocking the content from any of the application providers.

- The decision for a non-discrimination rule has important implications: Non-discrimination rules affect
  - how the core of the network can evolve
  - how network providers can manage their networks, and
  - whether they can offer Quality of Service.

Policies and Regulations

□ Governments

  ■ The law making bodies from different parts of the world, including Brazil, India, Chile, Canada, Netherlands, U.S., etc. are currently in the process of framing Network Neutrality rules and policies.

□ Federal Communications Commission

  Open Internet Rules

    1) there should be no blocking of the legal content, applications, or services,

    2) there should be no content or application based throttling of the internet traffic by the ISPs

    3) there should be no provision for providing preferential treatment to a certain set of traffic over the other

□ Another example is Europe, where the Council of Ministers and European Parliament approved the first version of the telecom package in 2009, allowing the national telecom operators to ensure *some minimum quality of service* to the end users, and to *transparently* provide QoS information to them.

Challenges in Monitoring Network Neutrality Conformance

Network Neutrality Violation Detection

▫ Techniques such as Deep Packet Inspection (DPI), priority based scheduling, port blocking, application based flow control, Multi-Protocol Label Switching (MPLS), etc, can be employed by the ISPs for controlling the traffic flow through their network in order to maximize their revenue.

▫ Difficult to figure out the cause of difference in performance and can misinterpret it as network congestion.

▫ Different mechanisms for discrimination can be used by the ISP in different situations (e.g. based on time of day)

Challenges in Monitoring Network Neutrality Conformance

Traffic and Network Management

□ ISPs have a legitimate right to use various network management techniques and policies.

□ It must be ensured that such practices do not discriminate the traffic from different sources.

□ For e.g. the permission to block spam, malware and viruses for security reasons can be misused by the ISPs.

□ There can be many other reasons such as congestion management, optimal allocation of resources, QoS, etc. for which the ISPs can control the traffic or give preferential treatment to certain types of traffic.

# Challenges in Monitoring Network Neutrality Conformance

Pricing

- Different pricing strategies are being adopted by the ISPs in order to achieve more control over the network resources (Congestion Control, QoS).

- Differential or tiered pricing on the basis of overall data allowance, or the base performance for each service class is accepted.

- However discrimination on the basis of the application or content being accessed by the user is unacceptable.

- It is challenging to ensure that the reason for the lower performance is due to the service class and not due to the discrimination by the ISP.

Emerging Network Technologies

- Giga-LTE

- LTE-U/ U-LTE/Licensed Assisted Access (LAA)

- LTE Broadcast

- LTE Wi-Fi Aggregation (LWA) and LTE Wi-Fi aggregation using IPSec tunnel (LWIP)

- MulteFire

Giga-LTE

- Giga-LTE is an emerging high-speed wireless network technology, capable of providing up to 1.17 Gbps data rates, based on the combination of two heterogeneous wireless technologies: LTE and Wi-Fi.

- This service, developed collectively by the Korean telecommunication corporation KT and Samsung, is based on the Multi-Path Transmission Control Protocol (MP TCP), and supported over KT's existing Wi-Fi network.
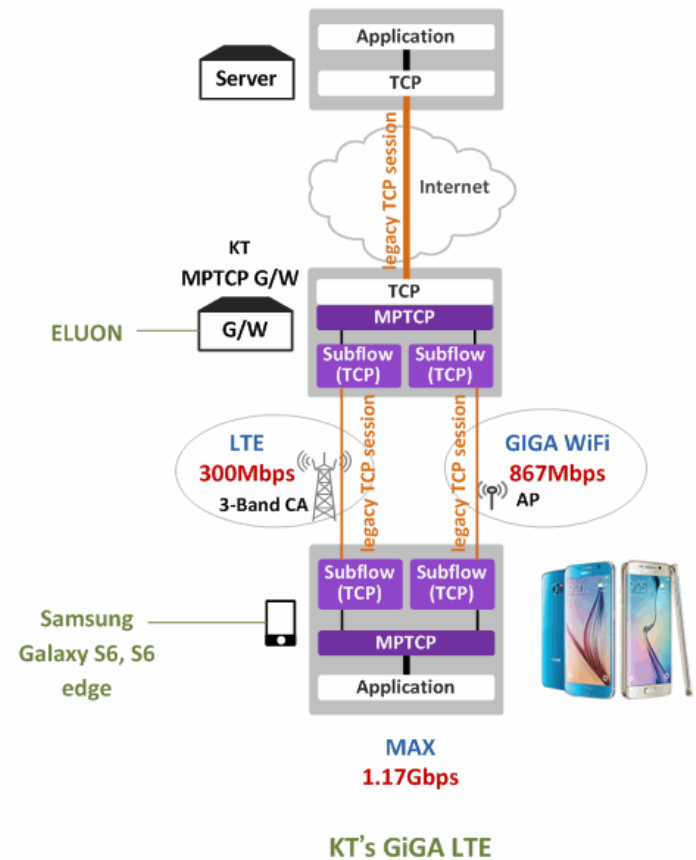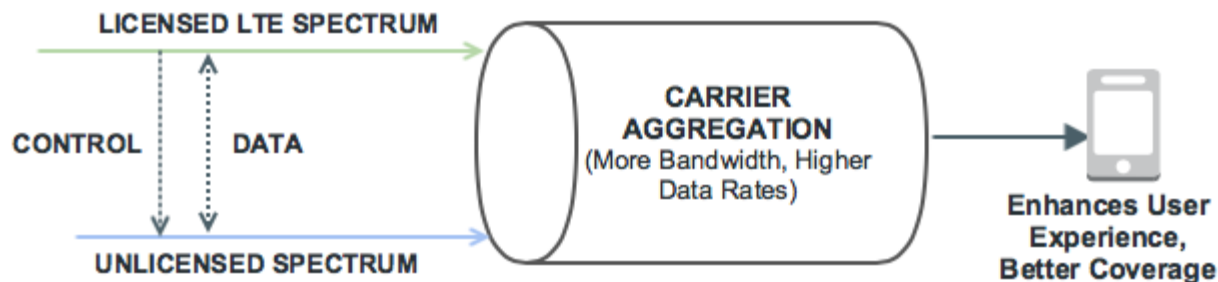
Giga-LTE : Network Neutrality Conformance

- Service Providers can build LTE networks based totally on the free 5GHz unlicensed spectrum, instead of hybrid mechanisms.

- Wi-Fi users can experience a loss in the quality of experience, and there can be unfair distribution and use of the unlicensed spectrum among the contending parties.

- Giga-LTE is currently available for use only with a handful of the Samsung devices (S6 and S6 edge) and the users with other devices cannot experience the advantages provided by this cutting edge technology.

- Similarly, other operators can pair up with their partners and in this way the end user would lose the freedom of choosing the operator and device of his choice while enjoying the benefits of high data rate and benefits provided by such technologies.

LTE-U/ U-LTE/Licensed Assisted Access (LAA)

- LTE in Unlicensed spectrum (LTE-U) is a technique that was originally proposed by Qualcomm and Ericsson for using LTE in Unlicensed spectrum as a proposal for solving the 1000x challenge (Mobile data traffic is expected to increase 1000 times in the next decade).

- It is based on the concept of carrier aggregation, where the unlicensed spectrum, generally used for Wi-Fi networks and the licensed LTE spectrum are aggregated, either for downlink (SDL Mode-Supplemental Downlink) or for both downlink and uplink (TDD-Mode)

- LTE-U is designed to enhance the coverage provided by LTE in the licensed spectrum utilizing small-localized cells operating at 5GHz, as shown:

LTE-U/ U-LTE/LAA: Network Neutrality Conformance

• Unrestricted use of unlicensed spectrum can lead to degradation in the quality of connection in home and office Wi-Fi networks.

• As the mobile operators can move their customers between LTE-U and only LTE at their own will, they can control the quality and hence attract more customers to use their service as compared to other carrier Wi-Fi options or home networks.

• As LTE is designed for use in the paid licensed spectrum, hence all the traffic is managed by a single operator and such management may not operate fairly with other users in unlicensed bands as compared to co-operative networks such as Wi-Fi.

LTE Broadcast

- The usage of LTE Broadcast can help mobile operators manage the network capacity by broadcasting the popular con- tent such as mobile TV, video streaming, etc.

- LTE Broadcast is based on the evolved Multimedia Broadcast Multicast Service (eMBMS)

- With the evolution of LTE, many features including the dynamic switching between broadcast and unicast, etc., have been evolved, making LTE Broadcast more robust and scalable.

LTE Broadcast: Network Neutrality Conformance

- LTE Broadcast data will be given higher priority and hence higher QoS as compared to other applications over the top.

- The eMBMS standard allows network operators to reserve up to 60 percent of a channel for LTE Broadcast content.

- Although LTE Broadcast has been proposed as an effective technology to be used in congested scenarios, there are no specific rules to define a congestion situation.

- Small cells operating in unlicensed spectrum can help increase the coverage, thereby enhancing the end user experience. In this way a large amount of data can be offloaded from licensed spectrum to the 5GHz unlicensed band, thereby localizing the broadcast capacity while maintaining the quality of experience for the end user.

- In such cases, it can have Network Neutrality repercussions similar to other techniques such as Giga-LTE and LTE-U operating in the unlicensed spectrum.

LTE Wi-Fi Aggregation (LWA) and
LTE Wi-Fi aggregation using IPSec tunnel (LWIP)

- LWA allows inter-networking between WLAN and LTE using the LTE dual-connectivity framework.
- The data payload of LTE is split and the base station or the eNodeB (enhanced Node B) splits the payload, which is transferred over Wi-Fi and LTE networks for the downlink data transmission.
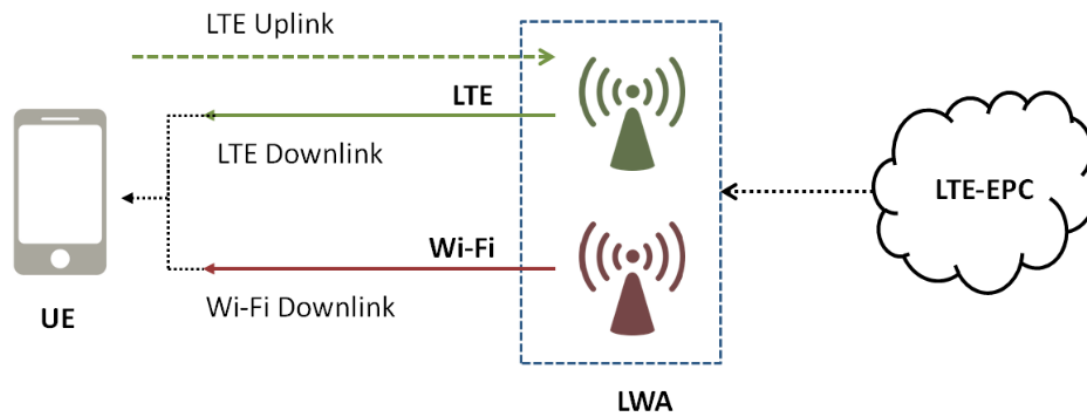
- The LWIP aggregation technique involves the use of IPsec tunnels to provide LTE-WiFi aggregation, without making any major changes to the wireless local area network (WLAN) infrastructure.

LTE Wi-Fi Aggregation (LWA) and LTE Wi-Fi aggregation using IPSec tunnel (LWIP)

- Although the LWA technology is based on the physical and MAC layers of the Wi-Fi network, which allows the sharing of unlicensed spectrum with other traffic, it can lead to the viola- tion of the Network Neutrality.

- The decision for routing the downlink traffic through LTE and Wi-Fi or only LTE is made by the base-station controlled by the operator.

- Hence, in case of high congestion in the cellular network, more and more data can be routed through the WLAN, resulting in un-fair use of the un-licensed spectrum.

- This is anti-competitive as the routing decision will be made by the operator with the main aim of optimization of its own net- work resources.

MulteFire

- MulteFire technology aims at combining the benefits of LTE- like high performance and Wi-Fi-like ease of deployment.

- It is aimed at implementing the LTE features entirely in the unlicensed spectrum.

- It supports many of the features of LTE including enhanced capacity and high data rates, seamless mo- bility, security, differential QoS, support for LTE applications such as Voice over LTE (VoLTE), etc.

- MulteFire technology is operated entirely in the unlicensed spectrum, it can easily co-exist with the li- censed LTE as well as other unlicensed technologies.

MulteFire: Network Neutrality Conformance

- Unlike the above techniques that partially utilize the unlicensed spectrum to provide higher data rates and to expand the capacity, the MulteFire technology is entirely based on the unlicensed spectrum.

- In addition, it uses listen before talk (LBT) procedure is used for effective co-existence with the other technologies, it overcomes many drawbacks of the other techniques that requires an anchor to the licensed spectrum.

- However, according to the specifications of the MulteFire Release 1.0, no special modifications are required in the 3GPP Public Land Mobile Networks (PLMN) for inter-networking with the MulteFire networks.

Conclusions

- In this paper, we mainly focused on fairness and Network Neutrality issues that arise from the co-existence of LTE and other technologies such as Wi-Fi in the unlicensed spectrum.

- For instance, the techniques such as LTE-U, Giga-LTE, LAA, LWA, etc. may involve shifting the traffic from unlicensed to licensed spectrum in case of congestion, resulting in reduced sensitivity to other technologies.

- In case of un- licensed only technologies, overuse of spectrum by one technology can result in a strong reaction from the other technologies.

- It is important to ensure that the carrier aggregation techniques that are anchored in licensed spectrum should not be able to use the unlicensed band in an unfair manner.

Thank You