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Enabling Secure QoE Measures for Internet Applications over Radio Networks is a MUST

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The acceptance of applications provided via the Internet greatly depends on the Quality of Experience (QoE) their users perceive. In case the QoE was negatively impacted by characteristics of the underlying network, even a theoretically greatest application would fail to attract users. As new Internet applications emerge and existing ones get enhanced, Quality of Service (QoS) requirements for network connections rise constantly to provide the individual acceptable QoE levels. In parallel, users' expectations to receiving best QoE from the networks' they are using, no matter where they are or how they move, are growing. The overall trend to higher QoS requirements is very unlikely to stop any time soon. The mobile industry is currently laying out the foundations for 5G, ambitiously pushing frontiers. This allows and even demands for revisiting older approaches.

In Internet terms, a Radio Access Network (RAN) is nothing but a link layer – but it has very special characteristics clearly distinguishing it from networking technologies relying on cables. At times the available throughput capacity, latency, jitter, and packet loss of radio links might be good and stable - at others those parameters might be so bad that the Internet is virtually unusable. In real-life scenarios, most of the time RAN characteristics lie somewhere between great and bad, while they may jump from one extreme to the other in the blink of an eye. This is largely due to the following reasons:

- Radio signal paths are ever-varying; radio channel conditions are subject to frequent and abrupt changes. Even when mobile terminals aren't moving themselves, the environment changes constantly, influencing the radio link quality.
- Terminals in radio networks experience handovers while moving around. Although radio technologies are engineered to do handovers between cell sites as transparent as possible, they also happen between different mobile telecommunications technology generations. This may lead to sudden and huge changes in characteristics of the utilized RAN. The possible jump in throughput magnitude might e.g. be from LTE with up to 300 Mbit/s to GPRS with 40 kbit/s.
- The "air" is a shared media. The resulting impact can often be experienced when using mobile Internet in a huge crowd like a full football stadium. In such hotspots, network operators usually utilize every tweak RAN technologies have to offer – while the best option might be to make the radio cells extremely small. Yet, in many cases this is not a viable commercial option, also as crowds might build up and dissolve in an unpredictable and dynamic manner. Users move in and out of areas with high mobile terminal density all the time, while hoping to enjoy a steady mobile network connection with pleasant QoE for the applications they are using.

With the advent of ubiquitous encryption, many traditional QoE enhancement techniques like content caching or media transformation by the network will soon be history in their current form. The lack of insights in conveyed traffic types negatively affects existing network optimization means. The economical impact for operators is perceived as significant, and especially in lesser developed parts of this world it will likely have a cost impact for mobile Internet usage. Just in those countries, mobile networks are often the only option for the general public to go online and enjoy the well-known benefits of Internet communications.

Leaving its congestion signaling capabilities aside, neither mobile users nor networks benefit from packages dropped or delivered too late. Though, video streaming, WebRTC and other real-time communications greatly suffer from dropped or otherwise delayed Internet packages. Any increase in the click-to-load time negatively affects the QoE of interactive applications like web browsing, social media and the like. While it is most important that the Internet is robust, at the same time it has to cater for the need of the most popular use cases in a mobile world.

The mobile industry is searching for measures enabling the delivery of the individually required QoE for modern and future Internet applications to all mobile users globally. This needs to be achieved while fairly and meaningfully distributing the available resources to those sharing the same network. Existing resource reservation technologies like RSVP[1] are not suitable for this purpose as they were never designed to detect and react on such sudden changes in the link layer as they happen in radio links. Most likely, everybody reading this paper is aware of the general trust issues techniques like DiffServ[2] suffer from. Therefore innovative new ways MUST be discussed in the Internet community without prejudice, and it MUST be possible to develop useful, secure, and privacy-aware protocols respectively protocol enhancements.

With SPUD[3] and Mobile Throughput Guidance[4] there are already existing discussions around providing means for the network and the application to exchange information for mutual benefit, leading to enhanced QoE for the user. Also other means like heuristics, when successfully applied in the network, have a huge potential to support fair distribution of the Internet bandwidth available in mobile networks. All Internet players, users, network operators, service providers, need to have the technology to agree on trustful and secure technical means for working together. In a human rights context[5], encryption and anonymity enable individuals to exercise their rights to freedom of opinion and expression. Therefore, naturally all QoE enhancing measures must respect the degree of security and privacy desired by the humans using a particular Internet application. Only robust and trusted collaboration based on widely acceptable standards will enable the use of the future technologies needed to enable managing of radio networks in an encrypted world.

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[1] Resource ReSerVation Protocol (RSVP): RFC 2205

[2] Differentiated Services (DiffServ): RFC 2474

[3] Substrate Protocol for User Datagrams (SPUD): https://datatracker.ietf.org/wg/spud/

[4] Mobile Throughput Guidance: https://tools.ietf.org/html/draft-sprecher-mobile-tg-exposure-req-arch and https://tools.ietf.org/html/draft-flinck-mobile-throughput-guidance

[5] United Nations, Human Rights Council, Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression, David Kaye, May 2015: http://ap.ohchr.org/documents/dpage_e.aspx?si=A/HRC/29/32