

# Community Networks and the Quest for Quality

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Sustainable Development Goals [UN, 2015] outline a transformative vision for economic, social and environmental development which addresses the need for a global society with more justice, equality, freedom and peace. Telecommunications play an essential role in implementing this vision while Internet stands out as an enabler of social change. Such an infrastructure provides means to reduce gaps that preclude people from content access and free exchange of knowledge. Community networks have provided an alternative infrastructure to bring connectivity to those places which lack of commercial interest and have urgent needs to be part of such a transformation. However, the expected social change has yet not fully occurred due to the nature of these networks which lack of resources to provide means for a complete user experience as in other fully funded networks.

According to RFC 7962 a Community Network (CN) is a “non-centralized, self-managed network sharing some characteristics” such as: organic growth, open participation, generally centralized, built with diverse hardware with wired and wireless links, have a participatory administration model, and their infrastructure is neutral, free, and open. These characteristics promote that community members “usually keep the ownership of what he/she has contributed or leaves the stewardship of the equipment to the network as a whole (the commons), even loosing track of the ownership of a particular equipment itself, in favor of the community”. It is evident that such an infrastructure poses mid- and long-term challenges of administration, growth, and quality.

When analyzing the characteristics of Guifi.net – a community network in Cataluña, Spain- Vega et al. (2016) noted that “... as is the case in any social community, the knowledge and involvement of individuals can vary; therefore, there are no guarantees of connectivity or quality of service. Furthermore, the quality and state of the heterogeneous hardware also influences the stability of the links and network performance”. This conclusion suggests that user experience in the network is strongly dependent on the inherent characteristics of the network and the organic growth model that defines *per-se* the community network. As a community driven deployment, it is not always understood and accepted by its members that the CN model gives no quality-of-service guarantee resulting in a poor perception of the performance and utility of the network. User expectations about availability, bandwidth and stability strongly vary due to knowledge on the limitations of the network. In general, it has been observed that a learned user is more tolerant to these, and usually the individual is more active in providing solutions to overcome limitations in network performance. Also, such resilient users show higher tolerance if they have been active part of the construction and evolution of the network. In contrast, some rural community networks in highly undeveloped areas pose limited knowledge on the network as it was provided by organizations aiming to increase connectivity by supplying an already tested standardized model of infrastructure, administration, and funding. Such philanthropic actions result in poor technical knowledge in the community and eventually an abandonment of the network due to an alleged lack of quality or the appearance of another network, either commercial or non-lucrative, providing better user experience.

As Wicks and Roethelin (2009) suggest “No consensus has been reached on a definition for quality; the term is defined differently for products and services, for different industries, and for different levels of dimensionality”. Quality may be defined as “the summation of the affective evaluations by each customer of each attitude object that creates customer satisfaction”. When analyzed the perception of the services provided by the network it can be observed that user experience is related to quality of the network. RFC 8802 discusses quality in communications as dependent on four measurable parameters: latency, jitter, bandwidth and packet loss. Of course, these concepts are well understood by engineers and technical staff when designing, implementing and operating a network. However, as explained above technical knowledge within a community network is highly heterogeneous and usually the infrastructure is poorly maintained, resulting in

non-satisfying user experiences when using the community network for simple tasks such as information retrieval or email.

ITU E.800 (2008) defines “Quality of service (QoS)” as the totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service. When compared to the definition of Wicks et al., it can be observed that both definitions share the integrality of the evaluation, however the subjective part related to the perception of network performance (i.e., affective evaluation) is not explicit under the ITU recommendation nor in IETF 2386 where Quality-of-Service (QoS) is defined as a “set of service requirements to be met by the network while transporting a flow”. In essence, the philosophy of a network built and maintained by a community for the community needs cannot be guaranteed under current QoS definitions. However, the solution is not to develop a new definition of QoS which may include user experience but the recognition of a new definition of quality that incorporates such a subjective evaluation related to a set of minimal parameters of network performance.

Bermudez et al. (2016) describe the Quality of Experience (QoE) as “a subjective measure of the quality of a telecommunications service when experienced by a user”. They argue that the evaluation of QoS based upon objective and measurable parameters is aimed at the optimization of the network assuming that quality, as perceived by the user, will be effectively satisfied. However, QoE is based upon user satisfaction in terms of content access and use of applications. An evaluation of the perception of quality in a community network partially managed by a WISP in Mexico shows that although measurable parameters on the user end such as bandwidth and latency are acceptable under network best practices, the user experience is non-sufficient because of poor network administration practices (v.g. throttling or non-neutrality). Hence, neutrality of the network should be part of a set of minimal requirements of a network that put user experience in a relevant place.

RFC 6390 defines QoE “in a way similar to the ITU ‘QoS experienced/perceived by customer/user (QoSE)’ section of [E.800], i.e., ‘a statement expressing the level of quality that customers/users believe they have experienced’. Although, IAB Workshop Report: Measuring Network Quality

for End-Users (cfr. RFC 9318) discussed the issue starting from a “broad focus on the state of user Quality of Service (QoS) and Quality of Experience (QoE) on the Internet today” (2022) and the conclusive statements show relevance of the recognition of subjective parameters when measuring network performance, the spirit of generalization prevails over the recognition of individual or community needs; as the “no-consensus-reached statements” show when recognizing localization as an existing problem.

We propose that due to the recognized model, limitations and adopted practices of community networks, QoE must be addressed in more detail related to the nature and expectations of end users. Further research is required to learn about user expectations of the network performance translated to several performance indicators. These factors may suggest additional design factors when sizing and configuration of the network is performed. Also, IETF may suggest additional maintainability considerations under observed practices and needs in community networks. In principle, community networks do not substantially differ from other networks however, the service they provide already stresses the capabilities of well proven hardware and software. A conclusion of the 2022 IAB workshop summarizes the needs expressed in this paper: “Bandwidth is necessary but not alone sufficient”.

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