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News article 3 June 2014

Blueprint for next-generation quality-enabled network interconnection

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The internet has become essential to both the economy and society, and is driven by technological progress and innovative services. But development of the internet ecosystem is hampered by the massive investments in infrastructure required to meet ever-increasing internet traffic, as well as users' expectations in terms of quality of experience, say EU researchers.



The three-year FP7 ETICS

project investigated technical solutions able to ensure end-to-end connectivity with guaranteed characteristics. The project also proposed new business models favouring a fairer distribution of revenues among actors delivering end-to-end assured quality services.

The internet connects people and devices, but in a service and quality-agnostic manner. Behind the scenes, this is made possible by interconnecting networks of multiple operators. While a network operator controls the quality in its own network, network quality across multiple operators is unpredictable. This results in unmet market needs for:

1. [end-users](#), who cannot specify the service quality levels they wish to receive, and experience unpredictable performance;
2. [network operators](#), who cannot differentiate their product offerings and suffer from a continuous erosion of profit margins;
3. [content and application providers](#), who have to limit their product offerings due to the lack of true end-to-end guarantees.

Led by Bell Labs in France, ETICS gathered leading European telecom operators¹, equipment and software vendors², research centres and universities³ specialised in in business modelling, game

theory and optimisation, network routing and management.

Together, the team defined a new product type, the Assured Service Quality (ASQ) path, which allows operators to collaborate to a) ensure end-to-end coherent data flow treatment in multiple domains according to pre-defined service characteristics, and b) agree on charges for transporting traffic with such a defined level of quality.

An ASQ path delivers aggregated traffic while respecting performance constraints (availability, delay, packet loss rate, etc.) and routing policies (e.g. geographic constraints).

"ASQ traffic complements the 'best effort' traffic already exchanged between operators, and ensures them an additional source of revenues," explains ETICS project coordinator Nicolas Le Sauze. "It provides incentives for operators to invest in quality infrastructures, as well as for users and service providers to pay attention to the way they consume network resources. It should thus increase social welfare."

Focusing on business and residential applications – virtual private networks (VPN), high-quality multimedia interactive services, and cloud gaming – the project estimated that a reasonable penetration of ASQ services could bring in €6 billion within a year.

Projections from the project also showed that revenues could triple within the following three years thanks to higher penetration and the introduction of new, high-quality applications enabled by ASQ connectivity services.

Incentives for quality

Previous research on inter-domain quality-of-service routing has not yet had the impact expected. This is not necessarily because of the technical solutions proposed, but is also due to a lack of incentives to collaborate. Stagnation in the number of new broadband users, increasing traffic and the economic context are now restricting operators' revenues. Finding new models will be fundamental to better exploiting operators' infrastructures in the future.

ETICS developed ASQ-related business models that will allow operators to secure future investments and network operation. In particular, the 'Sending Party Network Pays' (SPNP) proposal attracted significant attention, for example from the European Telecommunications Network Operators' association (ETNO) and the GSM Association. Under this principle, the operator sending assured quality traffic will financially compensate the recipient operator for the IP packet transport, which makes the transaction suitable for ASQ agreements.

Within the ETICS model, SPNP is only used at the wholesale level, for aggregated 'premium' traffic among operators. Additional business models address the retail level.

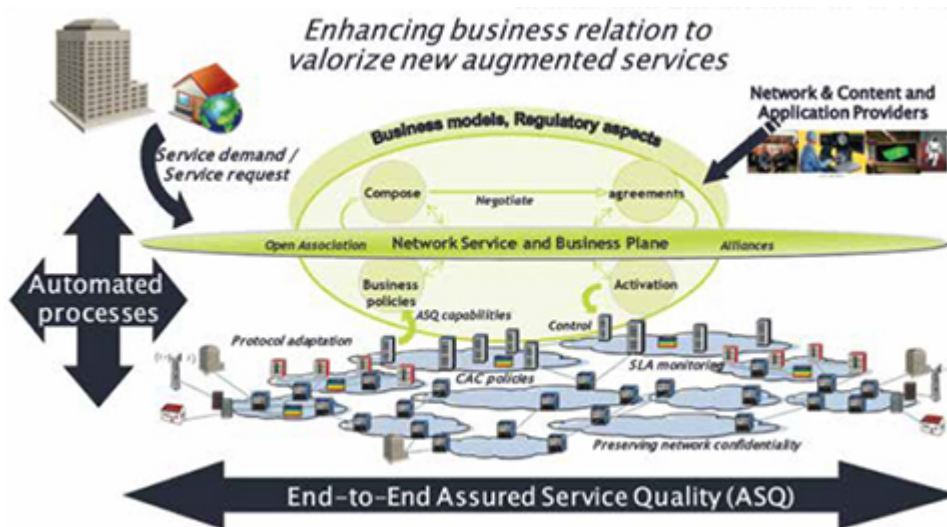
ETICS defined an evolutionary collaboration framework compatible with the different business constraints that arise when ASQ path services are introduced, and in which interaction type (bilateral or multilateral) and the level of information exchanged between operators (technical and business details) are likely to evolve. An ETICS technical and business roadmap proposes to synthesise the frameworks, taking into account the level of trust between operators, their technological preferences, and the level of maturity of the new ASQ market.

"This bootstrapping approach will first occur within an open association context, favouring bilateral interconnections with simple technical parameters to minimise disruption at the introduction step. It may then evolve to a more collaborative and dynamic market allowing global business and technical optimisations to occur within alliances of operators," suggest the project partners.

Acknowledging technological diversity

In addition to the lack of business incentives, the sheer range of technical solutions used by operators to ensure an acceptable level of service has also limited market adoption. When traffic and revenues were growing side by side, network over-dimensioning remained the preferred option. However, in today's economic climate, it is no longer viable; nor it is realistic to impose a new end-to-end technology on all operators.

Instead of re-architecting the internet, ETICS acknowledged this technological diversity and defined a new Network Service and Business Plane (NSBP), on top of the IP infrastructure. It enables the exchange of macro information on operators' quality capabilities, and maintains both confidentiality on operators' infrastructures and their freedom to choose their preferred technology.



The NSBP makes it possible to bind together ASQ offers from the different operators to assure end-to-end quality in a coherent manner along the ASQ path. Key building blocks have been implemented in a test-bed interconnecting the networks of five laboratories in France, Germany, Italy and Spain. The tests have demonstrated the feasibility of the NSBP combined with commercial routers from different vendors. This result was presented to industry at the 2013 MPLS and Ethernet World Congress, where ETICS had the event's only research booth.

Net neutrality and ASQs

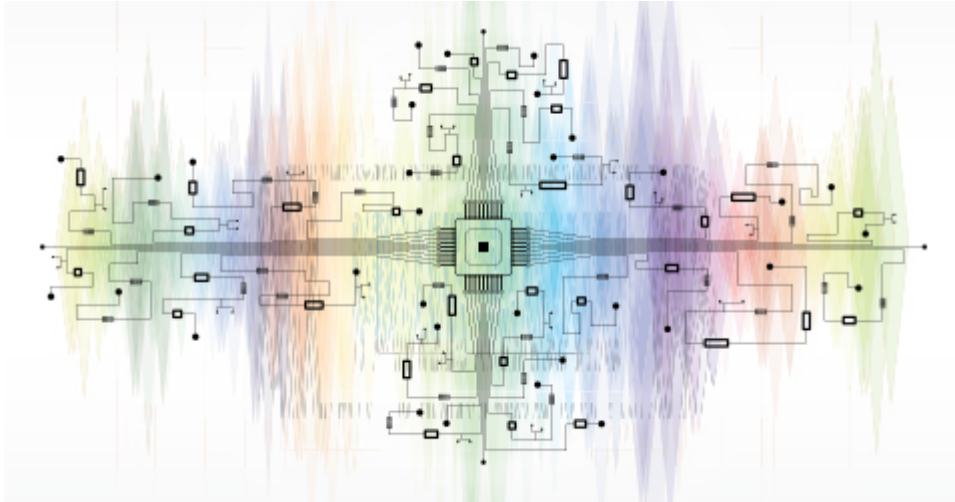
In the context of the EU's Digital Agenda for Europe, the debate on net neutrality has gathered pace, along with discussions on the possible negative effects of the traffic management techniques used to optimise resource use and reduce network congestion.

Having examined various socio-economic studies, and interacted with several national regulators to discuss pros and cons of differentiated services, the ETICS partners found that coherent conclusions from various studies on the impact of traffic management on net neutrality remain elusive. Safeguards exist thanks to regulation and market monitoring by consumer associations, which should prevent any abusive use of ASQs. The project investigated best practices and business policy rules and concluded that it would be wise to allow consumers and the market to decide on the relevance and value of QoS management in a competitive environment.

In September 2013, the European Commission adopted regulatory proposals for a single EU telecoms market under its Connected Continent⁴ strategy. This strategy explicitly recognises ASQ agreements as a potential new source of growth and innovation in Europe, but which must operate alongside a

well-functioning best-effort internet access service⁵.

By studying existing limitations and proposing both new business models and a flexible architecture able to adapt to a maturing interconnection market based on QoS, ETICS has established the basis for developing network interconnections and the internet of the future.



In addition to the more than 50 papers published in key scientific conferences and journals, and the more than 20 contributions towards new standards for specific technical solutions, the project made concrete proposals that could help operators to better manage their infrastructures and increase return on their investments.

Considering industry challenges and trends, as well as new regulatory proposals, the ETICS toolkit – with its various charging principles and technical deployment scenarios – opens the way for ASQ-based services to become a reality over the coming years. These capabilities will create an even better internet that serves society according to its constantly increasing needs.

More info

- www.ict-etics.eu [1]

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1. BT, Deutsche Telekom, Orange, Telefonica, Telenor, Primetel
 2. Alcatel-Lucent Bell Labs France, Alcatel-Lucent Italia, RAD data communication, Marben, Nextworks
 3. Athens University of Economics and Business, Telecommunications Research Center Vienna –FTW–, Institut Telecom, Politecnico Di Milano, University of Versailles Saint Quentin, Technion and University of Stuttgart
 4. COM(2013) 627 final.
 5. The final text is still under discussion with the European Parliament

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