



**Bosnia and Herzegovina
Communication Regulatory Agency**



**Benchmarking of Emerging Technologies and
Applications
Internet Related Performance Measurements
in Bosnia and Herzegovina**

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About Communication Regulatory Agency

❑ Establishment

- ❑ Established on March 2nd, 2001 combining the competences of the Independent Media Commission and the Telecommunications Regulatory Agency, which had previously operated separately.

❑ Competence

- ❑ Regulator with combined competencies and reflects the convergence of technologies in telecommunications and broadcasting in a way that can respond to market needs.

❑ Mission and vision

- ❑ Mission is to regulate the market for electronic communications and audiovisual sector in Bosnia and Herzegovina and to manage and control the frequency spectrum.

❑ Goals

- ❑ The goal is to create the conditions for the application of new technologies, the development of a competitive sector of electronic communications and the provision of quality services, in the best interests of the end user, as well as the continuous development of media freedom for the benefit of citizens and society.





Regulatory framework in Bosnia and Herzegovina

- ❑ **Law on Communications of Bosnia and Herzegovina ("Official Gazette of B&H" No. 31/03, 75/06, 32/10 and 98/12)**
 - ❑ Since 2018, CRA participates in the work of the study group for the drafting of the new Law on Electronic Communications and Electronic Media, in cooperation with the Ministry of Communication and Transport of Bosnia and Herzegovina and the Directorate for European Integration.
- ❑ **Policy of the Electronic communications sector in Bosnia and Herzegovina for the period 2017-2021 and the Action Plan for Policy Implementation ("Official Gazette of B&H" No. 46/17)**
 - ❑ Policy has set goals that need to be achieved in sector of electronic communications, deadlines and has identified the institutions in Bosnia and Herzegovina for their realization. CRA is one of them. The subject of the Policy are, inter alia, new technologies and creating conditions for their introduction.





Harmonisation of legislation

- ❑ **Stabilisation and Association Agreement between the European Communities and their Member States, of the one part, and Bosnia and Herzegovina (Luxembourg, 16 June 2008)**
- ❑ **Harmonization of legislation with the *acquis communautaire*** (regulations, directives and decisions, resolutions and opinions)
- ❑ **Priority – harmonisation with:**
 - ❑ Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code,
 - ❑ Directive 2010/13/EU of the European Parliament and of the Council of 10 March 2010 on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services (Audiovisual Media Services Directive),
 - ❑ Recommendations, Decisions, standards and strategies of ITU, CEPT, ETSI standards and other relevant international and European institutions.





New technologies and services in the Electronic communications Sector in Bosnia and Herzegovina

- ❑ Work in the progress
- ❑ Shared responsibilities of institutions in Bosnia and Herzegovina, complicated political situation, source of financing, implementation, etc.
- ❑ Policy of the Electronic communications Sector in Bosnia and Herzegovina for the period 2017-2021
 - ❑ Policy was the basic for creation of the CRA Strategic Development Plan and identifying strategic goals for the Period 2019 – 2021 (several different projects are planned, most of them includes different types of measurements, QoS, for some of project finances are approved few weeks ago).
 - ❑ CRA will undertake activities in order to carry out its responsibilities and obligations in area of new technologies and services in the Electronic communications Sector in Bosnia and Herzegovina.
- ❑ Transition from analogue to digital terrestrial broadcasting
 - ❑ CRA has the authority to establish a regulatory framework and assign licenses in accordance with the Strategy for switching from analogue to digital terrestrial broadcasting





New technologies and services in the Electronic communications Sector in Bosnia and Herzegovina

- ❑ **Introduction of Mobile Broadband Services and Fourth Generation Network - LTE (*Long Term Evolution*)**
 - ❑ Draft of the Decision on Issuance of LTE Licenses to Licensed Mobile Operators in B&H, Price, Method and Procedure for Payment of Licenses and Purpose of Payments is done, we are waiting for the opinion of the competent institutions and finally the adoption by the Council of Ministers.

- ❑ **National broadband policy and implementation plan**
 - ❑ CRA has only the authority to define the technical framework for the use of broadband access systems in B&H in the scope of the foreseen European Common Use Scheme, RF spectrum release from existing users in the digital dividend bands and other bands intended for the introduction of mobile broadband services and fourth generation networks - LTE, necessary bandwidth in order to provide wireless broadband access in urban, suburban and rural areas in B&H, while respecting the neutrality principle of technology.

- ❑ **System of monitoring and for measuring of the Service Providers' Quality of Services in order to protect users**





QoS (Quality of Service) regulatory framework

- ❑ One of the important role of the CRA in Bosna and Herzegovina include the monitoring of the Service Providers' Quality of Service (QoS).
- ❑ CRA has set very ambitious objectives for the telecommunications sector in future, as stated and developed within the Strategy Plan for 2019-2022.
- ❑ In this context, CRA's QoS regulatory framework in place needs to be improved.
- ❑ CRA has a goal to adopt the regulation that has to be strongly related to the competition level between operators in the various market segments.





QoS (Quality of Service) regulatory framework

- ❑ **CRA is currently creating QoS framework and is planning to impose new QoS requirements on Service Providers. To conduct a full review of this QoS regulatory framework, CRA intends to have a better knowledge of best practices.**
 - ❑ First step for CRA is create a report detailed overview of regional and international practices with respect to QoS regulation and QoE (Quality of Experience) matters in the ICT sector.
 - ❑ Countries that have similar market conditions as in B&H, countries that have a long history of QoS regulation or high level of QoS, following innovative approaches, will be been chosen for analysis and benchmark in order to create a best model for QoS regulatory framework.





QoS (Quality of Service) regulatory framework

- ❑ CRA tend to specify own objectives with respect to QoS regulation.
- ❑ QoS regulatory framework in CRA will contain:
 - ❑ QoS policies and objectives,
 - ❑ KPI (Key Performance Indicators), targets and measurements,
 - ❑ Organisation and processes in CRA.
- ❑ The regulatory QoS approach will drive the definition of a set of KPIs and QoS measures based on objectiveness, transparency, standardized, accessible through certified measurement systems, etc. Performance monitoring methods will be classified as being either in-service or out-of-service.
- ❑ QoS violation need to be considered in a way that KPI should be easy to understand for end-users.





QoS (Quality of Service) regulatory framework

- ❑ **QoS regulation which will be adopted by the CRA in next step is for:**
 - ❑ Mobile and Fixed services
 - ❑ Broadband services
 - ❑ Internet
 - ❑ VoIP
- ❑ **Basic level of QoS is already defined in the user license.**
- ❑ **There are few rules and instructions for quality parameters of public electronic communications services according the Law for electronic communications.**
- ❑ **Telecommunications operators has to report CRA about the operational status of their networks and services in accordance with the requirements specified this do within the specified timeframe in licence and rules.**
- ❑ **After CRA decide what policy should apply in relation to reporting and publishing quality of service information, Telecommunications operators will be required to submit the quality of service measurement results at least once a year.**





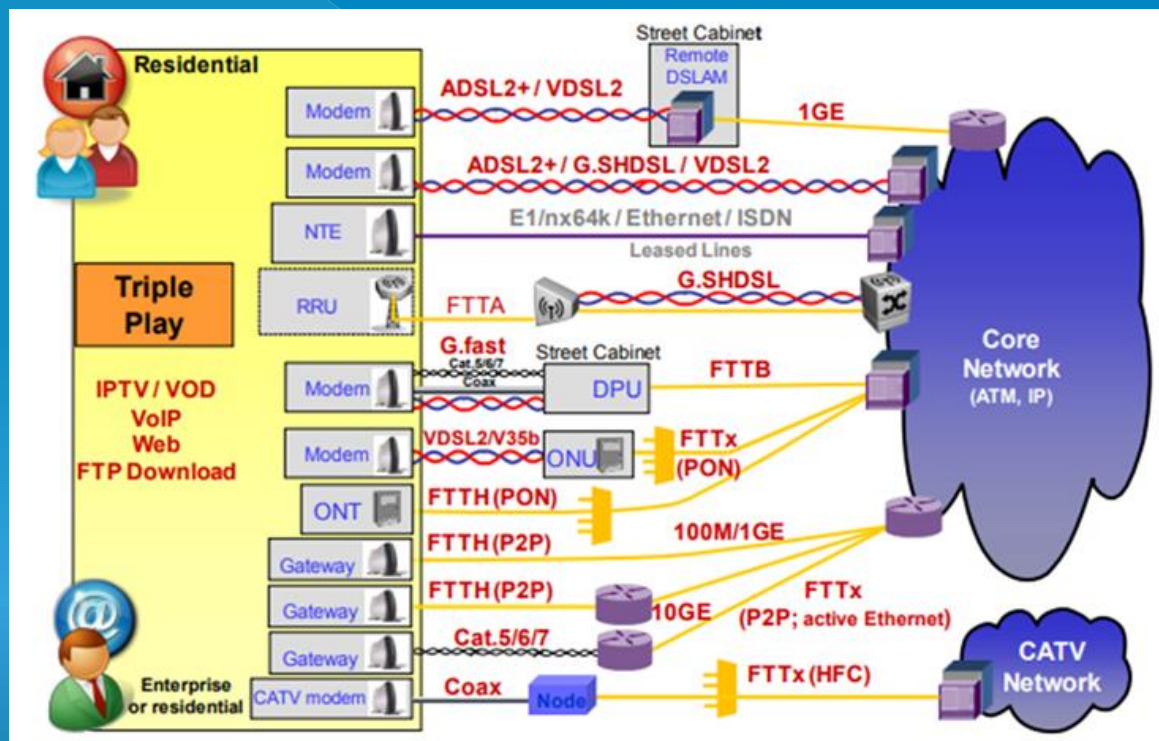
CRA Radio monitoring Department

- ❑ **Radio monitoring Department provides general measurements which are used to compliance with rules and international radio traffic regulation such as:**
 - ❑ license conditions and
 - ❑ technical and operational standards.
- ❑ **The overall goal of spectrum monitoring activities is to support the proper functioning of the general process of spectrum management. Central objectives for spectrum managers include the following:**
 - ❑ Spectrum efficiency in determining planned and actual frequency usage and occupancy, assessing availability of spectrum for future uses,
 - ❑ Compliance with national spectrum management regulations to shape and sustain radio environments and user behaviour, maximizing the benefit of the spectrum resource to society,
 - ❑ Resolution of interference problems for existing and potential users.
- ❑ **Department for radio frequencies control and monitoring measure and analyze radio parameters using Rohde & Schwarz test and measurement equipment (e.g. Network coverage, Network availability, Failure calls, Dropped calls, Call setup time Quality of speech, SMS send success rate, Signal strenght for DVB-T2, etc.) in a way to control compliance with any of the conditions attached to the licence, rules and regulations.**
 - ❑ CRA monitoring equipment include radio receivers, spectrum and network analyzers, direction-finding equipment and antenna categorized by frequency range (HF, VHF, UHF, etc.) and signal type – analogue or digital.
- ❑ **CRA has not yet done benchmarking in a way to public reporting of measurement result on its website.**



Internet related performance measurements

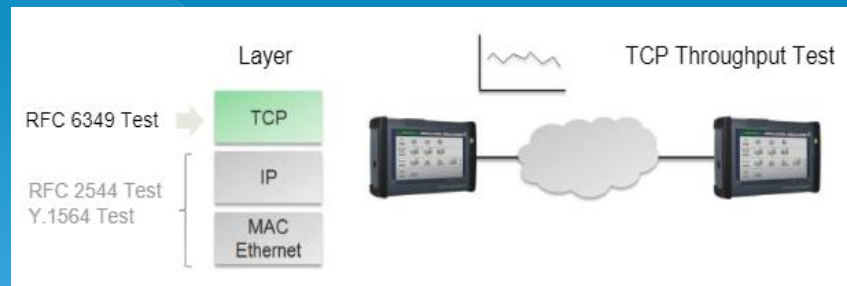
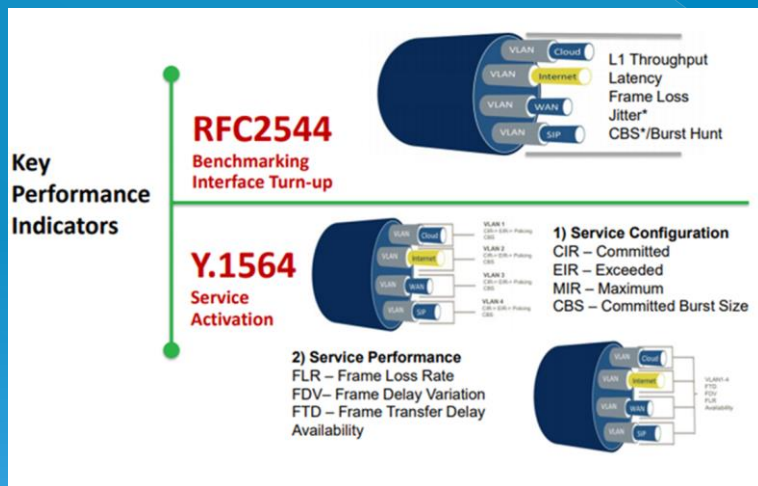
- ❑ CRA has just procured basic set of equipment for QoS measurement of Broadband Internet access and staff training was carried out.
- ❑ CRA purchased VIAVI equipment for QoS measurements over fixed line: copper, cable and fiber.





Internet related performance measurements

- ❑ The Next step for CRA is to adopt the Rulebook for Fixed broadband QoS which is a prime concern for both operators and end users.
- ❑ Measurement equipment supports Enhanced RFC2544 and ITU-T Y.1564, TCP testing, turn-up acceptance, SLA/performance monitoring and reporting, and test and troubleshooting with both hardware and virtualized software regarding RFC6349 for edge and access networks.





Internet related performance measurements

- ❑ **RFC 6349 recommends always conducting a Layer 2/3 turn-up test before TCP testing. After verifying the network at Layer 2/3, RFC 6349 specifies conducting the following three test steps.**
 - ❑ Path MTU detection (per RFC 4821) to verify the network maximum transmission unit (MTU) with active TCP segment size testing to ensure that the TCP payload remains unfragmented,
 - ❑ Baseline round-trip delay and bandwidth to predict the optimal TCP window size for automatically calculating the TCP BDP,
 - ❑ Single and multiple TCP connection throughput tests to verify TCP window size predictions that enable automated “full pipe” TCP testing.





TCP testing and troubleshooting

- ❑ **Problems detected by Y.1564 include:**
 - ❑ Network misconfigurations - VLAN ID and priority, IP TOS, max throughput
 - ❑ Poor quality of service - too much latency, jitter, or loss
 - ❑ Services not working well together on the same network under load conditions
- ❑ **Integrating RFC 6349 with Y.1564:**
 - ❑ Multiple services field turn-up and installation test to meet customer SLAs
 - ❑ Automated end-to-end, multi-Ethernet/IP service test using loopback on the far end
 - ❑ Ideal for LTE/4G IP services and triple-play testing





TCP testing and troubleshooting

❑ Problem:

The bursty nature of TCP applications can stress network QoS and cause performance issues that remain undetected when running a pure Y.1564 test.

❑ Solution:

Integrating RFC 6349 with Y.1564 provides an automated configuration of the appropriate number of TCP sessions for the network conditions based on CIR which is specified by users.





Future QoS crowdsourcing platform

- ❑ **Plans for QoS crowdsourcing platforms for fixed networks and mobile Internet connection:**
 - ❑ Follows the BEREC recommendation on internet coverage and quality.
 - ❑ Certified broadband access measurement tool in fixed networks.
 - ❑ Allows users verification and analysis of the quality of Internet access services and the flow rate at the selected point network by measuring performance of broadband system of fixed and mobile devices:
 - ❑ Mobile internet connection (EDGE, UMTS, soon be able and LTE)
 - ❑ Fixed lines connection (DSL, LAN, fibre-optic)
 - ❑ WiFi connection
 - ❑ Provide transparent and understandable information about the quality of the Internet connection used to the end user.





Future Web tool for QoS measurements



1. Plan



2. Produce



3. Distribute



4. Analyze



(Repeat)



START



History



Map



Statistics



Help





Future QoS crowdsourcing platform for fixed networks

- ❑ Measuring the speed of access to fixed networks by certified broadband access measurement tool in fixed networks.
- ❑ It is necessary to create and publish document which describes:
 - ❑ The necessary preconditions and procedures for measuring the maximum available speed,
 - ❑ Definitions of the terms used and the methodology of service quality measurement are outlined,
 - ❑ Access through the appropriate web application,
 - ❑ Methods of gathering information on the user's computer and the environment in which the computer is located during execution measurements.
- ❑ Under the “Established Condition” measurement results can be used in complaints cases to operators, and properly performed measurements are evidence in case the dispute between the user and the operator.





Future QoS crowdsourcing platform for mobile networks and WLAN

- ❑ Measuring the speed of access to mobile and wireless networks represent the current state of the user's Internet access quality because the user environment in which measurement is started and performed is not taken into account.
- ❑ If the measurement result differs greatly from the parameters of the service the operator announces, this does not mean that the operator automatically does not fulfill its quality commitment. In most mobile tariffs, the advertised speed is not guaranteed, or is only achievable under certain conditions (the appropriate signal level, device model, and current network traffic load).
- ❑ These measurement results are informative and only may indicate the current quality of mobile or wireless Internet access. Therefore, are not evidence of a dispute.





Goals, ideas and plans

- ❑ Like any other developing country, Bosnia and Herzegovina face constraints which make ICT evolve at a slower pace.
- ❑ In order to accelerate the Digital process and harmonize with Region and EU, CRA will:
 - ❑ create QoS regulatory framework for mobile and fixed networks in a way to stipulates minimum standards for the quality of service,
 - ❑ provide education and training of employees,
 - ❑ implement the regulation and projects which foster an enabling environment for the ICT in line with EU Strategies, like Digital Europe,
 - ❑ apply for the funds, EU instruments such as Instrument for Pre-Accession Assistance (IPA), Development Co-operation Instrument (DCI), European Neighborhood Partnership Instrument (ENPI), etc.





Goals, ideas and plans

- ❑ **CRA will**
 - ❑ conducts continual measurement campaign and control, such as Mobile Benchmarking tests (GSM, UMTS, LTE, LTE-A), QoS in DVB-T2 networks,
 - ❑ develop a web tool, which allows users to examine the quality of broadband services (ping, delay, jitter, packet loss, packet error) and to measure the speed of transmission of useful data.

- ❑ **Operators will be aware of the seriousness of QoS guarantees through rules, licenses, and contracts.**

- ❑ **The end users will be more aware whether the speed and other QoS parameters prescribed in the contract is actually delivered and they use it as basis for complaints.**





LIST OF REFERENCES

- ❑ ECC Report 195 “Minimum Set of Quality of Service Parameters and Measurement Methods for Retail Internet Access Services”.
- ❑ Regulation (EC) No 2006/2004 (as amended by Regulation (EC) No 2006/2004 and Regulation (EU) No 954/2011) of the European Parliament and of the Council of 27 October 2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws (Regulation on consumer protection cooperation).
- ❑ Regulation (EU) 2015/2120 of the European Parliament and of the Council of 25 November 2015 laying down measures concerning open internet access and amending Directive 2002/22/EC on universal service and users’ rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on public mobile communications networks within the Union.
- ❑ BEREC, A framework for quality of service in the scope of net neutrality, Document no. BoR (11) 53, 2011.
- ❑ BEREC, Guidelines for quality of service in the scope of net neutrality, Document no. BoR (12) 131, 2012.
- ❑ BEREC, Report on monitoring quality of Internet access services in the context of net neutrality, Document no. BoR (14) 117 2014.
- ❑ BEREC Guidelines on the Implementation by National Regulators of European Net Neutrality Rules, Document no. BoR (16) 127, 2016.
- ❑ BEREC Net Neutrality Regulatory Assessment Methodology, Document no. BoR(17) 178, 2017.
- ❑ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “A digital agenda for Europe” COM(2010) 245 final/2.
- ❑ ETSI and ITU documents...





Thank you for your attention!



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