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P.O BOX 7289 KIGALI, Tel: +250 252584562, Fax: +250 252584563
Email: info@rura.rw
Website: www.rura.rw

GUIDELINE N° 01/GL/UAS-ICS/ RURA/018 OF 07/06/2018 ON MINIMUM BANDWIDTH FOR BROADBAND INTERNET CONNECTIVITY IN RWANDA

Table of Contents

LIST OF ABBREVIATIONS

ANSI/TIA	American National Standards Institute/Telecommunications Industry Association
CCI	Co-channel Interference
CENELEC	European Committee on Standardization
DHCP	Dynamic Host Control Protocol
GIS	Geographic Information Systems
LAN	Local Area Network
IPSec	Internet Protocol Security
ISO/IEC	Intentional Standardization Organization/ International Electro-technical Commission
ISP	Internet Services Provider
RSSI	Received Signal Strength Indicator (RSSI)
RS 452:2009	Rwanda Standards
SSL	Secure Sockets Layer
VPN	Virtual Private Networks
WPA	Wi-Fi Protected Access
WPA2-AES	Wi-Fi Protected Access 2 - Advanced Security Standard

INTRODUCTION

The mission of Rwanda Utilities Regulatory Authority (RURA) includes among others to promote efficient development of regulated sectors in accordance with Government economic and financial policy and to protect and promote consumers' interests;

This guideline is a complement to efforts undertaken by the Ministry of Information Technology and Communication in conjunction with Rwanda Development Board to improve the quality of broadband Internet access in Rwanda.

One of the resolutions of the 9th leadership retreat held in Gako in March 2013 was to improve quality of service delivery;

Rwanda Utilities Regulatory Authority (RURA) by issuing this guideline seeks to enhance efficient utilization of broadband Internet connectivity in Rwanda by setting minimum requirements for bandwidth in order to improve service delivery in a bid to attain fast broadband Internet access. The availability of bandwidth and the deployment of both high capacity and wireless networks in particular remain at the forefront of the Government of Rwanda that has earmarked ICT sector as a growth engine and catalyst for the complementary sectors of its economy.

Pursuant to Law Nº09/2013 of 01/03/2013 establishing Rwanda Utilities Regulatory Authority (RURA) and determining its mission, powers, organisation and functioning, especially in articles 2, 4, and 20;

Pursuant to Law Nº24/2016 of 18/06/2016 governing information and communication technologies especially in article 72;

Pursuant to the Ministerial Instructions N°001/MINICT/2012 of 12/03/2012 related to the procurement of information and communications technology goods and services by Rwanda public institutions;

The Regulatory Board after consideration and deliberation in its meeting of 07th June 2018 hereby issues the following guideline:

1.0. GENERAL PROVISIONS

1.1. Purpose of this guideline

The purpose of this guideline is to provide a framework that governs the provision, operations, maintenance and quality of broadband Internet services in Rwanda.

1.2. Definition of terms

For the purpose of this guideline, the terms hereunder shall have the following meaning:

a) **"Bandwidth":** the amount of data transmitted over a network connection during a given time.

b) **"Broadband":** a network connection that is always on, available at home, at work and on the move, that delivers progressively higher bandwidths that are capable of supporting innovative and interactive content and services, as to enhance the user-experience;

c) "**Co-channel Interference, CCI**": a phenomenon where transmissions from one access point (AP) covers into the receive range of other APs on the same channel, causing interference and reducing the available spectrum and resulting performance;

d) **"Contention ratio":** a measure of the number of users simultaneously sharing the available bandwidth;

e) **Public areas**: facilities intended to be used by many people because of various activities carried out therein, including but not limited to markets, stadium, and recreational parks;

f) **Public building:** building intended to be used by many people because of various activities carried out therein are considered to be in the general interest;

g) **Public institutions:** organs, which the State allocates funds or self-funding in order for it to carry out, specialized activities for public interest including Commissions and other specialized State organs established by a law;

h) **Private institutions :** refer to corporation, association, entities, individual registered by Government to carry out a specific activities in accordance to the law governing the matter;

i) **"RS 452:2009":** a standard adopted by Rwanda Standards Board intended to facilitate international communication in information processing;

j) **"RSSI"**: The Received Signal Strength Indicator (RSSI) is a measure of the RF power input to the transceiver. It is measured in decibels from 0 (zero) to -120 (minus 120). The closer to 0 (zero) the stronger the signal is which means it is better, typically voice networks require a -65 dbm or better signal level while a data network needs -80 dbm or better.

k) **"Virtual Private NETWORK (VPN)":** a private network that uses a public network (usually the Internet) to connect remote sites or users together. Instead of using a dedicated, real-world connection, such as leased line, a VPN uses "virtual" connections routed through the Internet from the company's private network to the remote site or employee.

1.3. Scope of this guideline

This guideline applies to public institutions and private institutions concerning minimum bandwidth for broadband Internet services that should be availed therein.

2.0. BROADBAND INTERNET CONNECTIVITY

2.1. Wireless Internet

Every public and private institution should have a wireless Internet in public areas, guest rooms, conference room, offices and public space.

2.2. Physical Layout

The communication network in public and private institutions shall have standardised structure as per Rwanda Standards, RS 452:2009 ISO/IEC 2382-25:1992 Information Technology – Vocabulary Part 25: Local Area network adopted by Rwanda Bureau of Standards or ISO/IEC 11801-1, Generic Cabling; ISO/IEC 11801-2, Enterprise; ISO/IEC 11801-3, Industrial; ISO/IEC 11801-4, Homes; ISO/IEC 11801-5, Data Centre. The list of applicable ISO/IEC standards and their equivalent standards are in appendix A.

2.3. Virtual Private Network

The institutions shall establish the virtual private network through the use of dedicated equipment and large-scale encryption. An institution shall connect multiple fixed sites over a public network such as the Internet. Each site will need only a local connection to the same public network, thereby saving money on long private leased-lines. A site-to-site VPN built between offices of the same institution is said to be an intranet VPN, while a VPN built to connect the institution to its partner or customer is referred to as an extranet VPN.

2.4. Network stability, security and performance

2.4.1. The institutions should invest in network equipment with a minimum of routers, switches and firewall to provide Internet traffic as well as basic security features to the network.

2.4.2. The institutions need to have a server room for its core network infrastructure. The server room needs to have proper air conditioning, protection, safety and environmental mechanisms against physical unauthorized access or fire outbreak. Space requirements of the server room are subject to institutions' own physical allocated space.

2.4.3. Institutions should mount APs on (or in) ceilings and walls that do not allow easy physical access, or locate in secure areas, such as locked closets or server rooms. Use APs with tamper-proof chassis and mounting options that prevent physical access to ports and reset features. They should use a wireless monitoring system that can track and locate all wireless devices and report if one or more devices are missing.

2.4.4. Login and password shall be required to be able to log into the system. This requirement may be waived for enclosed areas like conference halls and free zones.

2.4.5. The pass phrase for public wifi shall be displayed in the visible areas for the public.

2.4.6. Institutions should ensure that encryption, malicious code protection software, personal firewall software, windows preferred network list (PNL), and wireless radio interface are installed and enabled at employees wireless clients.

2.4.7. The institution should ensure wireless clients/guests accessing the wireless LAN are installed with malicious code protection software.

2.4.8. In addition to encrypting and authenticating, wireless LANs using WPA (Wi-Fi Protected Access) and WPA2, wireless networks are considered public networks and the institution that owns critical applications such as payments applications should install and use encryption software such as VPN, IPSec, SSL and WPA2-AES to encrypt wireless data traffic at application layer. Regardless of types of security mechanism implemented at Access Points (APs), it is recommended that all wireless clients consider application layer encryption in protecting data that is transmitted over the wireless network.

2.4.9. Perimeter firewalls should be implemented between all wireless networks and the critical information/systems infrastructure. The firewall should provide basic security mechanisms against rogue WIFI; rogue DHCP (Dynamic Host Control Protocol), unauthorized access by guests to the institution's internal network and confidential information. This requires segmentation of the networks between the institutions' network(s) and the client's network(s). A rogue access point (AP) is any device that adds an unauthorized (and therefore unmanaged and unsecured) WLAN to the organization's network.

2.4.10. Public and private institutions should start planning to upgrade its circuit when peak utilizations average reach out to around 80% as per QoS guidelines, which would allow them a few months of growth to arrange for the circuits to be ordered and installed.

3.0. MINIMUM BANDWIDTH AND COVERAGE REQUIREMENTS

3.1. Bandwidth for Public and Private Institutions

3.1.1. For the purpose of this guideline and in accordance with the Rwanda Broadband Policy, a broadband service is defined as "service or system requiring transmission channels capable of supporting rates greater than the primary rates of 2 Mbps".

3.1.2. The public and private institutions shall abide by the minimum bandwidth that is hereto attached in appendix B.

3.1.3. For purposes of monitoring the progress, the Regulatory Authority shall publish in partnership with other stakeholders, on a periodic basis, technical characteristics that take cognizance of relevant technological advancements for a network connection to be deemed a broadband service.

3.1.4. The Regulatory Authority in consultation with other stakeholders may update from time to time the minimum bandwidth capacity standards for public and private institutions in Rwanda.

3.1.5. The broadband applications that require more bandwidth like video conference and live streaming bandwidth will require the extra minimum bandwidth as shown in appendix C.

3.1.6. The institutions most widely utilizing advanced applications for e–government services like Geographic Information Systems (GIS) with multiple layers of high resolution images and graphics and require an abundant amount of data storage for the network and a connection will require more superfast broadband as shown in appendix C.

3.1.7. Most e–government services, such as filing taxes, purchasing permits do not involve large amounts of data transfer. The speeds become an issue for these services only in the case of institutions, like institutions that have multiple applications. Multiple and simultaneous use of applications negatively impact network performance, download and upload speeds, and user satisfaction with the connection. The institutions will need higher–speed connections to support the growing use of simultaneous applications.

3.1.8. The line speed and capacity of the universities and schools' connection has to be modelled to meet the educational, management and communication usage, which are dependent on the size of the university and school, the applications being used to deliver teaching and learning and to support the management and operation of the school. Universities and schools will need the minimum bandwidth as specified in appendix D.

3.1.9. The public and private institutions that have the videoconference facilities and conference rooms should require additional bandwidth on demand covering the period of events in order to cater for applications that require high bandwidth or accommodate a large number of wifi connections as shown in appendix E.

3.2. Wireless network coverage and network monitoring

3.2.1. Access points and hot sports shall be deployed and well positioned to guarantee acceptable signal strength. The normal range in a network would be -45 dbm to -65 dbm depending on power levels and design.

3.2.2. The channels shall be well separated in order to avoid co-channel interference (CCI), channel access delays as well as collisions in transmissions.

3.2.3. The public and private institutions shall request from ISPs the client software or web-based tool to monitor the broadband received compared to the broadband subscribed to.

3.2.4. As per guideline for broadband Internet quality of service in force, the monthly average bandwidth should not go below 95% for dedicated bandwidth and 80% for non-dedicated bandwidth of the subscribed bandwidth.

4.0. COMPLIANCE

The public institutions in charge of services delivery in public and private sector shall coordinate and establish a joint stakeholder's inspection team that shall monitor the compliance to this guideline in terms of quality of broadband services delivery within public and private institutions.

The local administration's one stop centres are hereby advised to ensure that the local area network is well structured and designed when applying for building construction permit and ensure that the technical standards, as may be changed from time to time, are met when issuing the occupation permit for offices and commercial buildings.

The Regulatory Authority will conduct compliance checks to this guideline while handling consumer protection matters and will continue to monitor people's experiences with matters covered by this guideline.

5.0. FINAL PROVISION

5.1. Repealing provision

The guidelines N°003/ICT/RURA/2014 of 16/04/2014 on minimum bandwidth and other requirements for Internet connectivity in hospitality industry is hereby repealed.

5.2. Entry into force

This guideline shall come into force on the date of its signature by the Chairperson of the Regulatory Board.

Done at Kigali, 07/06/2018

RWANDA UTILITIES REGULATORY AUTHORITY
REPUBULIKA Y'U RWANDA

Dr. Ignace Gatare
Chairperson of the Regulatory Board

APPENDIX A: TECHNICAL STANDARDS

To ensure a high specifications and compliance to environmental conditions and QoS anyone responsible for the design, specification, planning or installation of structured cabling infrastructure should adhere to, the standards associated with data/telecommunications cabling which include:

- Telecommunications equipment and telecommunications cabling - Specification for installation, operation and maintenance.
- Information Technology - Generic Cabling Systems

Types	CENELEC/EU	ISO/IEC	ANSI/TIA/USA
General Requirements	EN 50173-1	**11801-1 (11801)**	568-0.D, 2.D, 3.D, 4.D
Office & Commercial Premises	EN 50173-2	**11801-2 (11801)**	568-1.D
Industrial Premises	EN 50173-3	**11801-3 (24702)**	1005-B
Homes	EN 50173-4	**11801-4 (15018)**	570-D
Data Centres	EN 50173-5	**11801-5 (24764)**	942-B
Distributed Building Services	EN 50173-6	**11801-6**	862-B

EN50173-1, ISO/11801, or equivalent ANSI/TIA

- Applicable to ICT generic cabling systems for multipurpose applications with the concept of environmental classification M.I.C.E rating (Mechanical, Ingress, Climatic and Chemical, Electromagnetically) for the cabling to be ideally suited to the environment. MICE is defined in three degrees of severity (1 to 3).
- Specify channels for balanced and optical fibre cabling media. Balanced cables Class from A , B, C, D, D, E, E_A, F, F_A, I, II from 0.1 MHZ up to 2000 MHZ. Channel of a given class will support all applications of lower class.
- Provide list of applications supported by generic cabling systems.

EN 50173-2, 11801-2 or ANSI/TIA 568-1.D

The generic cabling system for offices or commercial buildings, providing specifications on building backbone, building distributions and floor cabling systems for copper and optic fibres for multipurpose usage (voice, video and data).

EN50173-3 / ISO 11801-3 or ANSI/TIA 1005-B

The generic cabling systems for Industrial Applications consists of various cabling subsystems that are realised as follows:

Primary cabling subsystem which represents the backbone cabling subsystem) and made of:

- optical fibre cable
- copper cable (telephony)

Secondary cabling subsystem (Building backbone cabling subsystem):

- optical fibre cable
- copper cable (telephony, compensating lines connecting adjacent floor distributors)

Tertiary cabling subsystem (horizontal cabling subsystem):

- optical fibre cable (depending on application)
- copper cable;

Note: Installations with twisted-pair cables are not allowed outside of buildings.

It can also have cabling subsystem for special applications.

NB: Compliance

The Telecommunications Cabling System shall be compliant with the CENELEC EN 50173 or ISO 18001 Standard.

The applicable version of the EN 50173 or ISO18001 standards shall be the latest version of the standard that is current when any tender or other document is prepared.

All of the Structured Telecommunications Cabling System components must be chosen to suit their working environment, and their installation or use must not contravene any national Building Regulation, Health and Safety Regulation or Fire Regulation current at the time of installation.

EN 57013-4 or ISO 11801-4 or ANSI 10050

In addition to the basic standard in EN 50173-1 or ISO 118001-1 or ANSI/TIA 568 on general requirements, Information Technology - Generic Cabling Systems - for Homes or residential building contains supplementary specifications for cabling in residential buildings, including the mandatory number of connections.

EN 50173-5, ISO 11801-5 or ANSI/TIA 942-B

Generic cabling system for Data centres provides requirements on a wide range of subjects related to the design of data centres among them:

- Requirements for computer rooms and entrance rooms (e.g., door sizes, lighting, temperature, humidity, floor loading)
- Supporting circuits (T3, E3, T1, E1, TIA-232 & TIA-561 serial console, and data centre fabrics)
- Energy efficiency considerations
- Access providers (demarcation, information to provide to carriers)
- Provides requirements for the data centre telecommunications cabling system (Minimum of Category 6 for twisted pair cabling except at the external network interface (entrance room) also permits Cat 6A, 7, 7A
- Provides guidelines for cabling of a wide range of intelligent building systems used in all types of buildings, especially in data centres (e.g., security, electrical, HVAC, energy management, lighting systems, wireless)
- Recently in 2017, Numerous changes to the rating tables including those that specify concurrent maintainability for Rating-3 (formerly Tier 3) and fault tolerance for Rating- 4 (formerly Tier 4).

EN 50173-6, 11801-6 or ANSI/TIA 862-B

Generic cabling - Distributed building services", provides cabling infrastructures from "comms rooms/communications rooms" to outlets enabling the connection of wireless access points, surveillance cameras, door controls and environmental sensors and countless other devices. It provides implementation of a fully integrated building infrastructure solutions that consider service prioritisation with associated Quality of Service and service segregation.

EN 50173-6 and its ISO, ANSI/TIA equivalent uses the cables over the balanced and optical fibre cabling for connecting hardware, links and channels of the other EN 50173 standards to support a wide range of new services. It is applicable to all types of premises - even homes.

APPENDIX B: MINIMUM BANDWIDTH FOR PUBLIC AND PRIVATE INSTUTUTIONS IN RWANDA

ITU-T Recommendations I.113 & Y.1541 defines the Broadband as a service or system requiring transmission channels capable of supporting rates greater than the primary rates (2Mbps);

Min. Bandwidth (Mbps) = Primary rate (2 Mbps) x Numbers of rooms / Contention ratio

Therefore, the theoretical minimum bandwidth is calculated based on the number of rooms/devices as well as the primary rate of 2 Mbps; however, there is a need to estimate practical minimum bandwidth with a proper contention ratio, consequently the last column gives the practical minimum bandwidth and a contention ratio of 10:1 was considered:

Minimum bandwidth requirements for Public and Private institutions	
Average number of employees (using computers) per institution/ rooms per hospitality industry	Bandwidth (Mbps)
Between 1-10	2
Between 11-20	4
Between 21-30	6
Between 31-40	8
Between 41-50	10
Between 51-60	12
Between 61-70	14
Between 71-80	16
Between 81-90	18
Between 91-100	20
Between 101-120	24
Between 121-140	28
Between 141-160	32

Between 161-180	36
Between 181-200	40
Between 201-240	48
Between 241-280	56
Between 281-320	64
Between 321-360	72
Between 361-400	80
Above 400	Individual Case Basis

APPENDIX C: BROADBAND APPLICATIONS FOR PUBLIC AND PRIVATE INSTUTUTIONS IN RWANDA

S/N	Broadband and multimedia applications	Minimum bandwidth (Mbps)	Reference
1	Videoconference (Multi–end)	7-10	**www.researchgate.net/publication/270161880, FCC**
2	Telemedicine	25-50	**www.researchgate.net/publication/270161880, FCC**
3	Distance learning	25-50	**www.researchgate.net/publication/270161880, FCC**
4	Live streaming video/Internet TV (SD)	1.75-5.0	**Rec. ITU-T G.1080 (12/2008)**
5	Live streaming video/Internet TV (HD)	5.0	**Rec. ITU-T G.1080 (12/2008)**
6	Live streaming (4K)/Internet TV (4K)	16-24	**REC.ITU-T H.265 (10/2014)**
7	IPTV (SD)	1.75-5.0	**Rec. ITU-T G.1080 (12/2008)**
8	IPTV (HD)	8.0-18.1	**Rec. ITU-T G.1080 (12/2008)**
9	E-GOV (GIS)	10	**Akamai, 2011**

APPENDIX D: BROADBAND FOR SCHOOLS AND UNIVERSITIES IN RWANDA

School	Devices	Ratio	Bandwidth
University	500	10 : 1	100 Mbps
	250	10 : 1	50 Mbps
Secondary	100	30 : 1	7 Mbps
	50	30 : 1	4 Mbps
Primary	40	40 : 1	2 Mbps
	20	40 : 1	1 Mbps

APPENDIX E: ESTIMATION OF THE ON-DEMAND MINIMUM BANDWIDTH

As per international practice, the average contention ratio for on demand package is 20:1.

The required bandwidth = Numbers of planned participants x Primary rate (2Mbps) / Contention ratio for on demand package (20:1).

SEEN TO BE ATTACHED TO THE GUIDELINE N° 01/GL/UAS-ICS /RURA/018 OF 07/06/2018 FOR BROADBAND INTERNET CONNECTIVITY IN RWANDA

Done at Kigali, 07/06/2018

RWANDA UTILITIES REGULATORY AUTHORITY

Dr. Ignace GATARE
Chairperson of the Regulatory Board