SECTION A:	***QUALIFICATION DETAILS***																	
QUALIFICATION DEVELOPER (S)	New Era College of Arts, Science and Technology																	
TITLE	Bachelor of Engineering (Honours) in Network Engineering													***NCQF LEVEL***		*8*		
FIELD	Manufacturing, Engineering, and Technology			***SUB-FIELD***		Networking Engineering								***CREDIT VALUE***		600		
New Qualification					✓	*Review of Existing Qualification*												
SUB-FRAMEWORK	*General Education*					*TVET*							*Higher Education*			✓		
QUALIFICATION TYPE	*Certificate*	*I*		*II*		*III*		*IV*		*V*			*Diploma*		*Bachelor*			
	Bachelor Honours		✓	*Post Graduate Certificate*									*Post Graduate Diploma*					
	Masters							*Doctorate/ PhD*										
RATIONALE AND PURPOSE OF THE QUALIFICATION																		

RATIONALE:

The requirement for developing this qualification emanated from a labour market survey done by HRDC the nation's human resource development agency which identified the need for Network engineers who are able to provide solutions and services through analysis, design, evaluation, implementation, deployment and coordination of problems and services needed in the domain of Information and Communication Technology (Human Resource Development Council (HRDC) Top 20 Occupation report, 2016). The HRDC report highlighted networking engineering skills as needed in all industrial sectors. The Vision 2036 strategic report: Sustainable Economic Development (Pillar 1) calls for economic diversification through use of science, technology and as an enabling technology. ICT through computer networking and internet technologies shall facilitate "efficient product and service delivery across all economic sectors including the delivery of government services" Vision 2036(pg27".

The Botswana National Strategic Development Plans 9, 10 and 11 (NSDP) and the Vision 2036 plan informs on the need to establish the Botswana's ICT industry that should facilitate economic diversification of the country from a resource driven economy to a knowledge based economy. In turn this would enable realization of an information society as advocated by the National Development Plan strategic report "...ICT provides a much needed environment for the Botswana economy to prosper…. Unfettered access and ease of flow of information through modern technology will attract big companies into this country and the end result will be job creation, income generation and asset base expansion" (Botswana Mid-Term Review NDP10, P.48 & P.49, 2013).

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The National Development Plan strategic reports (9, 10 and 11) have strategized the implementation of advanced state of the art Telecommunications infrastructure. Currently Botswana's has seen the introduction of three mobile network operators (MNOs) – MASCOM Wireless (an affiliate of South Africa's MTN), Orange Botswana (backed by Orange Group) and be Mobile (a subsidiary of the fixed-line incumbent BTC). These MNO have implemented the underdeveloped broadband sector with different strategies including 4G and 3G mobile, LTE, WiMAX, and bundling with fixed-line (DSL) services. BoFiNet completed two undersea fibre network expansion link costing BWP200 million. This infrastructure has been implemented what remains is the human resource development to maintain and utilise this infrastructure and upgraded to latest observations and hence the need for skills development in network engineering.

Botswana 2013 Mid-Term Review of National Development Plan 10 Report "...Human Capital Resource Development is critical in order to realize the full benefits of ICTs….." which include "Implementation of the e-Government strategy… quality of Government's IT service will be improved by strengthening the Government Data Network and information systems, and purposefully designing and building Government Data Centre, implementation of IT Security framework and building Government's organizational capacity in IT" (Botswana Mid-Term Review NDP10, P.48 & P.49, 2013)

Networking engineering skills were identified and justified by the Botswana industry as requirement, as justified by the Human Resource Development Council (HRDC) top priority occupations for industry of Botswana.

Networking has been clearly stated as a Top 20 occupation of priority in the sector of Information and Communication Technology by the HRDC TOP OCCUPATIONS IN HIGH DEMAND report (December 2016).

Institutional consultations with the Telecommunication industry, former and current students of the qualification identified the hard and soft skills needed in the industry. The industry needs telecommunication graduates' skills in designing, maintenance, configuration deployment and testing of gadgets, plants and infrastructure. In addition, they also need soft skills in verbal and written communication skills, analytical and problem solving skills, managerial skills, among others. Because technology is ever changing the graduates need to be lifelong learners who can combine technical expertise with context-sensitive soft skills in order to cope with complex situations in real life. The above show that there is need for Botswana's institutions of learning to develop telecommunication engineering qualifications that are closely aligned to local, regional and global industry needs.

PURPOSE:

The purpose of the Qualification is to produce graduates with highly specialized knowledge, skills, and competences to:

- Execute industrial tasks allied to analysis, design, implementation, deployment and maintenance of complex computer network setup, internet set up and maintenance and security implementation of information and ICT infrastructure.
- Analyse network system types and optimize operations using testing and measuring network equipment.
- Take responsibility and accountability of work done in a networking engineering or multipurpose project.
- Originate computer and other digital devices networking infrastructure to solve industrial problems and needs.
- Track costs associated with project design and part procurement for computer and other digital devices networking system design and set up.
- Cooperate with other engineers of various disciplines towards solving complex engineering issues.

ENTRY REQUIREMENTS (including access and inclusion)

Minimum admission requirement

- Certificate IV, NCQF level 4 (BGCSE) or equivalent.
- There will be use of alternative forms of entry such as recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) is accepted, using ETP policies, in line with the national policies.

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
LO 1. Formulate Highly specialized judgments with complete resourceful information for solving network engineering problems in business environment.	1.1. Design networking technologies by using various network topologies, network software, network equipment in context of required ICT communications requirements by clients. 1.2. Work in a composite project which would require networking engineering solutions. 1.3. Install networking devices, network cables and various software patches from multivendor to realise clientele requirements and specifications 1.4. Deploy and commission various network topologies and equipment for various business functions. 1.5. Document commissioned networking technologies for future reference and maintenance installed network.
1. Conceptualize and solve computer network problems based on models for networks and evaluate performance with proper regard given the underlying assumption, limitations and optimal solution for those problems.	2.1. Apply appropriate design software to create networking models for specified clientele requests 2.2. Interpret network models to build the required telecommunication infrastructure. 2.3. Maintain and configure a network topology based on telecommunication model. 2.4. Modify and upgrade network topology, devices, network media based on network software based models from clientele requirements 2.5. Communicate and inform on needed network types requirements using models.

LO 2. Analyse network systems types and optimize operations using testing and measuring network equipment	3.1. Identify appropriate tools for analysis and maintenance of networking types. 3.2. Calibrate network measuring and testing upkeep equipment for maintenance and configuration of digital network infrastructure. 3.3. Monitor operation and status operation and optimise its operation by adjusting and setting relevant operational parameters 3.4. Compute statistical functional elements of a network infrastructure and report on operational status and recommend any modifications. 3.5. Simulate functional operation of deployed network and note discrepancies for purposes of maintenance and calibration
LO 3. Apply hardware and software tools to solve hybrid and simple network types in any business organisation.	4.1. Develop software codes or software patches to upgrade functionality of networking equipment and networking types for small to large scale networks infrastructure. 4.2. Upgrade installed software in network devices for enhanced functionality. 4.3. Install and configure using software all network devices that are from different vendors or the same manufacturer 4.4. Trouble shoot complex network which hybrid in structure using intelligent devices 4.5. Interpret and maintain hybrid network infrastructure using auto generated reports from intelligent monitoring devices
LO 3. Derive network schematics based on various network topologies for specific clientele needs.	5.1. Apply computer network skills relating to network topologies for telecommunication implementation. 5.2. Select appropriate and relevant network devices for selected network topologies for designing purposes. 5.3. Design network technologies in context of available resources 5.4. Analyse and simulate network designs for optimal performance 5.5. Select appropriate tools for network design and simulations
LO 4. Specify necessary computer hardware, network devices and network software based operational requirements of a business environment	6.1. Evaluate and inform on relevant computer hardware and software needed for network infrastructure 6.2. Specify computer hardware and software specifications for implemented network infrastructure

	6.3. Install and configure computer hardware and software, network devices to facilitate complete network operations 6.4. Derive and substitute with equivalent network parts and systems in case scarcity of OEM parts and systems 6.5. Derive a BOQ for specified network setup with minimum errors
LO 5. Apply network engineering principles to design networks to unfamiliar ill-defined problems including the choice of technology and possibly in other engineering disciplines	7.1. Work in multidiscipline project were networking solutions are needed 7.2. Integrate seamlessly the functionality of networking solutions with other engineering disciplines 7.3. Provide sound and feasible networking solutions in multi-disciplined projects
LO 6. Test network infrastructure parameters of operation based on electronic and electrical equipment provided.	8.1. Apply key functional skills in electronics and electrical engineering to test and measure networking equipment 8.2. Interpret electronic and electrical values in measuring and measurement of networking equipment 8.3. Service networking equipment using electronic and electrical datasheets for replacement of components and devices.
LO 7. Research using numerical and statistical knowledge to compile operational reports for a networking infrastructure	9.1. Use numerical analysis skills to test, create documents and also maintain networking equipment 9.2. Apply scientific methods and tools to maintain and calibrate networking equipment 9.3. Communicate and presents conceptions and models based research and experimental findings in the field of networking
LO 8. Communicate effectively within to disseminate and assembly information on networking engineering problems and solutions to relevant stakeholders	10.1. Create documents using relevant tools for communicating in an engineering working environment. 10.2. Relate and communicate interpersonal and intrapersonal 10.3. Present and articulate any telecommunication concept using relevant tools. 10.4. Undertake research in the discipline of networking to solve problems and create new knowledge.
LO 9. Observe cultural, ethical and professional matters that prevail and govern given environment in the best interest of working with all stakeholders	11.1. Practice professional ethics in discipline and register 11.2. Create conscience in ethical practice and liaise with subordinates

in developing computer networking solutions.	11.3. Apply principles of ethical and professional practice in conducting network engineering activities in particularly when dealing with different clients 11.4. Sensitize and respect cultural norms of various eco systems related to area of occupation and location 11.5. Abide to legal statues to guide the operations and conduct of network engineering duties in any given context. 11.6. Respect and honour working relationships od subordinates and superiors to maintain good working relationships in any give working environment
LO 10. Manage small to medium network engineering projects demonstrating fundamental knowledge and insight work ethics and managerial functions that constitute good engineering practice	12.1. Manage small projects like research project 12.2. Interact with other stakeholders in research projects 12.3. Manage time and account for delivery
LO 11. Observe cultural, ethical and professional matters that prevail and govern given environment in the best interest of working with all stakeholders in developing computer networking solutions.	13.1. Practice professional ethics in discipline and register 13.2. Create conscience in ethical practice and liaise with subordinates 13.3. Apply principles of ethical and professional practice in conducting computer networking engineering activities in particularly when dealing with different clients 13.4. Sensitize and respect cultural norms of various eco systems related to area of occupation and location 13.5. Abide to legal statues to guide the operations and conduct of computer networking engineering duties in any given context. 13.6. Respect and honour working relationships od subordinates and superiors to maintain good working relationships in any give working environment

SECTION C	***QUALIFICATION STRUCTURE***					
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***				***Total (Per** Subject/ Course/ Module/ Units)*
		Level [5]	***Level [6]***	***Level [7]***	***Level [8]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	*End User Computing*		*10*			*10*
	Engineering Mathematics I	*10*				*10*
	Engineering Science I	*10*				*10*
	Introduction to Programming Principles		*10*			*10*
	Professional Communication & Skills for Engineers	*10*				*10*
	Engineering Drawing	*10*				*10*
	Engineering Mathematics II		*10*			*10*
	Engineering Science II		*10*			*10*
	Engineering Ethics	*10*				*10*
	Network Fundamentals		*15*			*15*
	Engineering Mathematics III		*10*			*10*
	Industrial Attachment			*50*		*50*
	Electronics and Communication Workshop	*10*				*10*

	Research Methods in Engineering			*10*		*10*
	Engineering Mathematics IV			*10*		*10*
	Entrepreneurship and Economic development				*10*	*10*
	Engineering Mathematics V			*10*		*10*
	Project Management for Engineers				*10*	*10*
CORE COMPONENT *Subjects/Courses/ Modules/Units*	*Introduction to Switching and Routing*			*15*		*15*
	Networking with LANs and WANs			*15*		*15*
	Structured Programming using C		*15*			*15*
	Network Security			*15*		*15*
	Digital Electronic Systems		*15*			*15*
	LAN Switching and WAN Networks			*15*		*15*
	Wireless Networking			*10*		*10*
	Introduction to Python Programming		*15*			*15*
	Network Systems Administration			*15*		*15*
	C++ Programming		*15*			*15*

	Network Operating Systems		*10*			*10*
	Data Communication and Networking		*10*			*10*
	Measurement Systems				*15*	*15*
	Optical Communications				*10*	*10*
	Java Programming			*15*		*15*
	Mobile Network Systems				*10*	*10*
	Group Project			*15*		*15*
	Network Architecture and Design			*15*		*15*
	Enterprise Applications Systems and Technologies			*10*		*10*
	Router Security Technologies				*10*	*10*
	Multimedia Compression Technique			*10*		*10*
	Microwave Satellite Communication				*10*	*10*
	Individual Project - I				*15*	*15*
	Network Planning and Optimization				*10*	*10*
	Individual Project -II				*15*	*15*
	Ethical Hacking				*10*	*10*

	Software Engineering		*10*			*10*
Elective/Option COMPONENT ***Subjects/Courses/ Modules/Units***	*Internet of Things /* *web Applications*				*15*	*15*
	Artificial Intelligence / *Distributed Systems*			*10*		*10*

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
NCQF Level 5 Modules	*60*
NCQF Level 6 Modules	*155*
NCQF Level 7 Modules	*245*
NCQF Level 8 Modules	*145*
TOTAL CREDITS	*600*

Rules of Combination:

(Please Indicate combinations for the different constituent components of the qualification)

The qualification rules constitute a combination of:

(a) Elective modules

(b) Core modules which are compulsory

(c) Fundamental modules which are also compulsory

(d) To graduate a candidate should have completed 590 credits

Qualification Combination Rules Based on Module Status per NCQF designation of: Fundamental, Core & Electives:

- Core modules have **350** credits
- Fundamental modules have **225** credits
- Elective modules have **25** credits

ASSESSMENT ARRANGEMENTS

Assessment Arrangements:

Learners shall be evaluated based on summative and formation evaluation approach which considers attainment of qualification learning outcomes.

Assessment Strategies, Requirements and Weightings:

All assessments, formative and summative, leading/contributing to the award of credits or a qualification should be based on learning outcomes and/or sub-outcomes.

The contribution of formative assessment to the final grade is **50%**

Summative assessment

Summative assessments contributing towards the award of credits should be based on exit qualification learning outcomes.

Candidates may undergo assessment including written final examination for each module which contributes 40 % of the final mark for that module.

The contribution of summative assessments to the final grade is 50%

Assessment shall be carried out by registered and accredited Assessors from any reputable organisation.

MODERATION ARRANGEMENTS

Moderation Arrangements:

The following shall apply for both internal and external moderation in accordance with applicable ETP policies and regulations:

Appointment and Personnel Responsible for Internal and External Moderation:

In conducting the internal and external moderation the following personnel should be appointed for the tasks:

- Internal moderation shall be done by appointed and selected institution assessors and moderators who have been registered with BQA as certified and accredited assessors and moderators.
- External moderation to be done with external moderators from other institutions or industry. External moderators should be accredited with BQA as moderators. The external moderation is done with assistance of internal moderators who should provide all logistical and operational requirements per external moderators' requests and based on the ETP moderation and assessment policy.

Internal and External Moderation Documentation

All necessary documents including qualification document, alignment matrices, assessment instruments and assessment criteria/rubrics should be available.

Internal and External Pre-Assessment Moderation

Before administering any assessments that contribute towards the award of credits, moderation must take place.

RECOGNITION OF PRIOR LEARNING

Assessment and moderation shall be carried as per ETP's policies, which are aligned to BQA/ National policies. The ETP will engage only BQA accredited assessors and moderators to carry out assessment and moderation.

CREDIT ACCUMULATION AND TRANSFER

There will be provision for awarding of the qualification through RPL mode which will be in line with the national RPL Policy.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal articulation:

- Bachelor of Engineering (Honours) in Electronics Engineering.
- Bachelor of Engineering (Honours) in Telecommunications Engineering.
- Bachelor of Engineering (Honours) in Computer Engineering.
- Bachelor of Engineering (Honours) in Electrical and Electronics Engineering.
- Bachelor of Engineering (Honours) in Software Engineering.

Vertical articulation:

- Master of Engineering in Electronics Engineering.
- Master of Engineering in Telecommunications Engineering.
- Master of Engineering in Computer Engineering.
- Master of Engineering in Electrical and Electronics Engineering.
- Master of Engineering in Software Engineering.

Employment Pathways:

- Computer Network Support Specialist.
- Computer Security Specialist.
- Computer Support Specialist.
- Corporate Security Manager.
- Data Communications Analyst.
- Database Administrator.
- Disaster Recovery Analyst.
- Network and Communications Manager.
- Network Manager.
- Network Engineer.
- Network or Computer Systems Administrator.
- Network Security Administrator.
- Network Security Analyst.
- Network Security Specialist.
- Network Systems Analyst.
- Network Systems or Data Communications Analyst.

QUALIFICATION AWARD AND CERTIFICATION

Qualification award:

To be awarded the qualification a learner must attain 600 credits. The following conditions of attaining credits for graduation should be fulfilled.

Certification:

The qualification in **Bachelor (Honours) in Network Engineering** will be awarded together with an official transcript.

REGIONAL AND INTERNATIONAL COMPARABILITY

Regional and International Comparability

The qualification was compared to one Regional and three international qualifications:

- University of Pretoria (South Africa)
- Glasgow Caledonian University (GCU) UK
- RMIT University (Australia)
- Suffolk University (UK)

The qualification is regionally and internationally comparable and transferable on the strength of 95% to 100% similar learning domains in the proposed qualification of Bachelor of Engineering (Honours) in Network Engineering. It covers most of the networking engineering domain being optical communications, wireless and wired networking technologies, cyber security, network operating systems, Routing and Switching and electives that deal with 4th industry revolution technologies like cloud commuting, Internet of Things, Artificial Intelligence etc. The qualification does share the same national qualification level which is NCQF level 8 with the South African qualification which is the regional qualifictaion. The assessment strategies all emphasize workplace (Internship) and embrace a drilldown on practice of the trade to enhance kills and competencies.

Similarities

- All qualification have the same sub-field of learning; Network Engineering implying commonality to intent and purpose of the qualification from the title of the qualification
- All qualifications consider main domain knowledge, competencies, and skills as centered on core areas networking engineering, wireless communication, mobile communication, and computer networking engineering.
- All qualifications consider industrial experience or internship as important before graduation
- All qualifications consider dissertation or research as critical for skill acquisition to outright skills in networking engineering
- All qualifications consider emerging technologies in networking engineering and use of science and mathematical in masterminding networking engineering concepts
- All qualifications tone down on the same employment pathways or carrier pathways

Differences

- The total credits awarded at the completion of the qualification are different because of the different credit framework used
- Some qualifications are eligible for professional qualification upon completion of the study with the engineering body of the that country

REVIEW PERIOD

Every five (5) years.