CC HUAWEI 5G gNodeB V100R015C00SPC108 Security Target

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1. Introduction

1 This Security Target is for the CC evaluation of Huawei 5900 Series 5G Core gNodeB Software, the TOE Version is V100R015C00SPC108.

1.1. ST Reference

Title	CC HUAWEI 5G gNodeB V100R015C00SPC108 Security Target
Version	V1.1
Author	Song Zhuo, Zhang Jiansheng
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1.2. TOE Reference

TOE Name	Huawei 5900 Series 5G gNodeB Core Software
TOE Version	V100R015C00SPC108
TOE Developer	Huawei

1.3. Product Overview

2 3GPP 5G, is the latest standard in the mobile network technology tree that produced the GSM/EDGE, UMTS/HSDPA and LTE network technologies. It is a project of the 3GPP (3rd Generation Partnership Project), operating under a trademarked name by ETSI (European Telecommunications Standards Institute), which is one of the associations within the partnership.

3 First-release 5G does not fully support all the 3GPP 5Gfeatures. According to the definition of 3GPP, 5G has two networking modes: SA and NSA. Currently, only NSA (Non-Standalone) networking for TOE is implemented.

4 According to the 3GPP Release 15 standard that covers 5G networking, the first wave of networks and devices will be classed as Non-Standalone (NSA), which is to say the 5G networks will be supported by existing 4G infrastructure. Here, 5G-enabled UEs will connect to 5G frequencies for data-throughput improvements but will still use 4G for non-data (control plane) duties.

5 Huawei 5900 series 5G gNodeB is the base station in 5G radio networks. Its coverage and capacity are expanded through multi-

antenna technologies, its maintainability and testability are improved, and thus it provides subscribers with the wireless broadband access services of large capacity and high quality.

1.4. TOE Overview

6 The TOE is the core part of the software that is deployed into a 5G gNodeB base station since it provides the communication with the UE/Terminal, the communication with the EPC/Backhaul network, the management interfaces and other security related functionality. The ST contains a description of the security objectives and the requirements, as well as the necessary functional and assurance measures provided by the TOE.

7 The ST provides the basis for the evaluation of the TOE according to the Common Criteria for Information Technology Security Evaluations (CC).

1.4.1. TOE usage

8 The TOE can be widely used to support the access control and events records for the product used for the broadband wireless access of home and enterprise users. Besides, it is used to support mobile broadband access.

1.4.2. TOE major security features

9 The major security features implemented by the TOE and subject to evaluation are:

- Management network:
    - Identification and Authentication.
    - Access control.
    - Communications security.
- Radio network: Uu-U interface protection (5G NSA only related Uu-U user plane).
- Telecom network: S1-U and X2 backhaul interface protection.
- Resource management: session establishment mechanisms and VLAN separation.
- Security function management: command groups, trusted channels, users, etc.

- Digital signature: for the verification of updates.

- Auditing of security events.

1.4.3. TOE type

10 The TOE is the core part of the software that is deployed into a 5G gNodeB base station since it provides the communication with the UE/Terminal, the communication with the EPC/Backhaul network, the management interfaces and other security related functionality. 5G gNodeB base station is the wireless access node in 5G/SAE system.

11 Figure 1 shows the position of the TOE in a 5G/SAE network for NSA scenario.

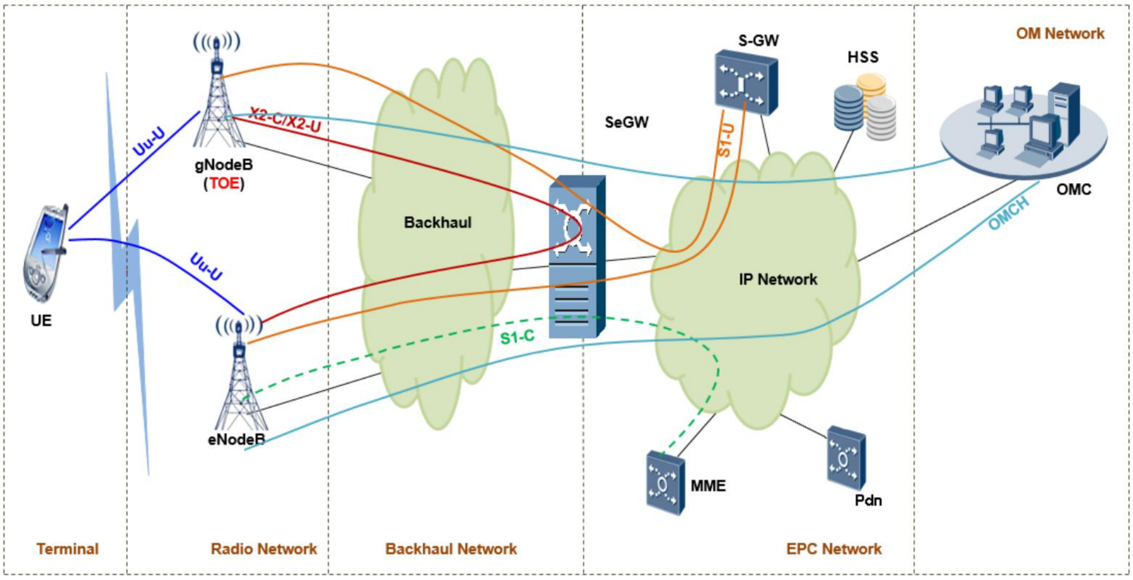


Figure 1 5G/SAE network for NSA scenario

12 The UE/Terminal is the subscriber terminal in the 5G network. With the UE/Terminal, the subscriber gains access to the services provided by the operator and Service Network.

13 The eNodeB is LTE base station, which provides control plane (signalling plane) service for the gNodeB.

14 The gNodeB is 5G base station, which provides wireless user plane (data plane) service for the UE/Terminal, the corresponding management interfaces and communication with other elements of the core network. 5G gNodeB base station is the wireless access node in 5G/SAE system.

15 The EPC network is the Evolved Packet Core network and consists of the MME (Mobility Management Entity), the S-GW (Service Gateway)

and PDN gateway. It performs functions such as mobility management, IP connection, QoS management, and billing management. The HSS (Home Subscriber Server) saves the account information of all the subscribers that sign the network service contracts with the operator.

16 The S1-U is used to transfer user plane data between gNodeB and S-GW.

17 The X2 interface (including X2-C and X2-U) is used to transmit the control plane and user plane traffic when the gNodeB works with the eNodeB in the NSA mode.

18 The OMC (Operations & Maintenance Centre) provides network management to 5G gNodeB. The OMCH (Operation & Maintenance channel) is used to transmit the BIN and MML commands as the operation and maintenance traffic between gNodeB and OMC (U2020) using the integrated ports. The OMCH is also used for local and domain user communications using the integrated ports. The SeGW （Security Gateway）, is located at the entrance of the gNodeB and the core/U2020 network. Provide IPsec Protocol (IP Security Protocol) tunnelling.

1.4.4. Non TOE Hardware and Software

19 The TOE runs into the BBU 5900 subrack. The structure of BBU5900 is shown in the following figure:

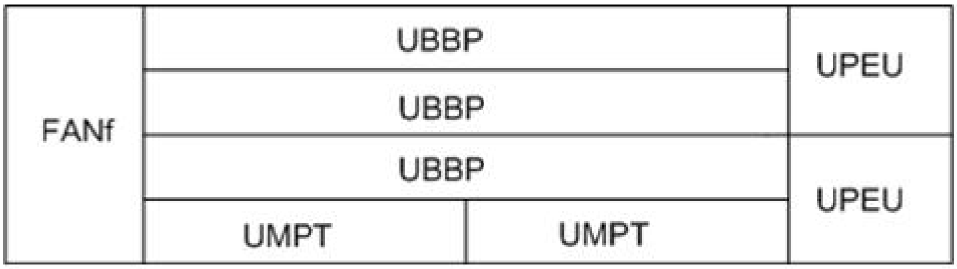


***Figure 2** BBU5900 subrack*

20 The BBU subrack contains, at least, the following mandatory boards:

- The 5G Baseband Processing and radio Interface Unit (UBBP), whose purpose is to provide an interface between BBU and Radio Remote Unit (RRU)/ Active Antenna Unit(AAU).
- The Main Processes and Transmission unit (UMPT), which is the main board of BBU. It controls and manages the entire Base

station system, provides clock synchronization signals for the BS system and provides the S1-U/X2/OMCH for transmission.

- The Universal Power and Environment Interface Unit (UPEU), whose purpose is providing power to the whole BBU subrack.
- The FAN unit of the BBU controls the fan speed, monitors the temperature of the FAN unit, and dissipates the heat from the BBU.

21 The TOE is deployed on the boards of base band unit (BBU). These hardware boards are TOE environment. The OS and part of BS software which is provided by Huawei’s particular products is also TOE environment.

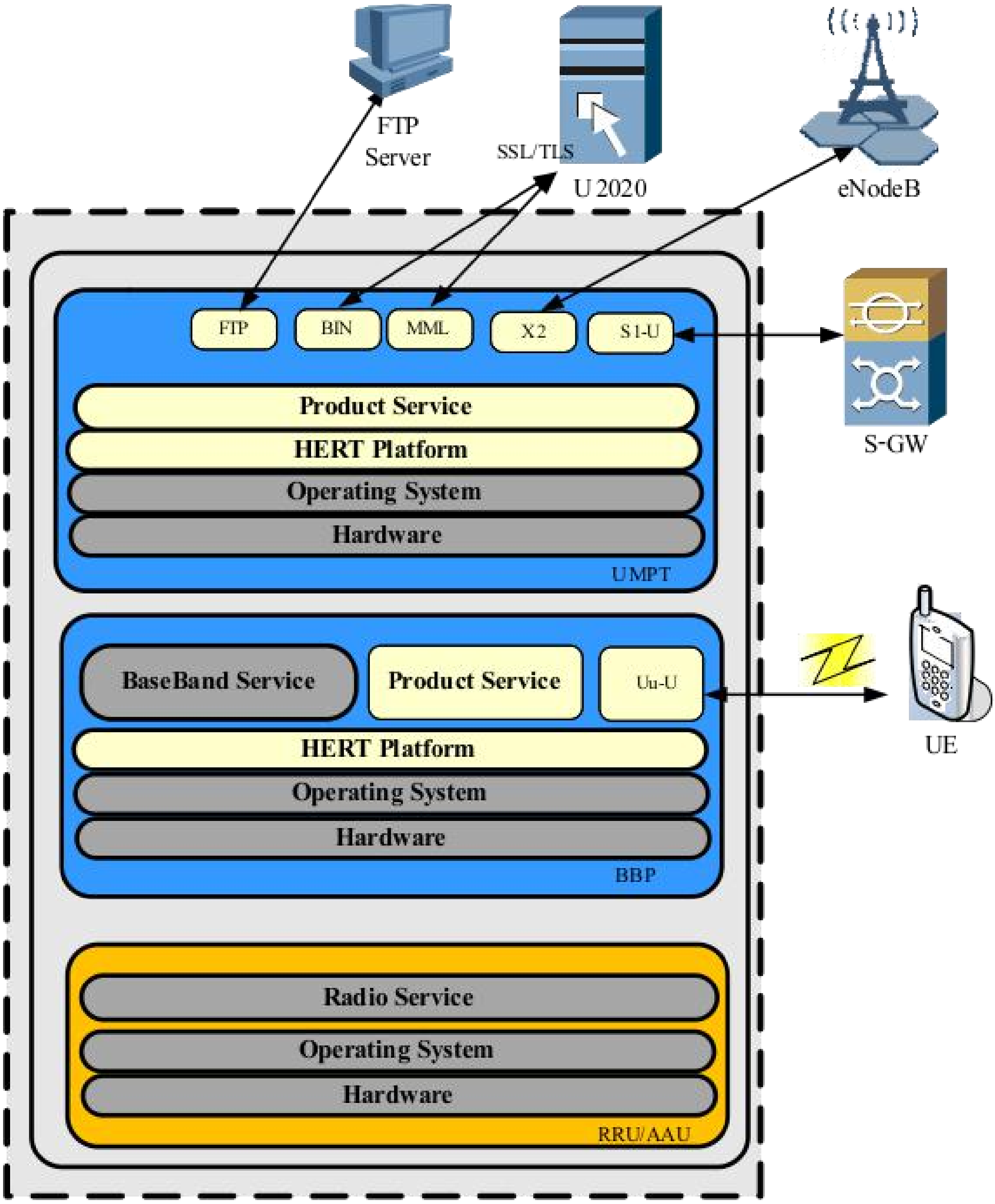
22 

Figure 3 Non TOE hardware and software environment

23 In the above diagram, the yellow area belongs to the TOE while the grey box area belongs to the TOE environment.

24 The components of the TOE environment are the following:

25 Note：The TOE environment components are not evaluated, given that they are not part of the TOE and therefore there is no assurance regarding these components.

- Physical networks devices, such as Ethernet switches, interconnecting various networking devices.

- A Public Key Infrastructure (PKI) which is a set of policies, and procedures needed to create, manage, distribute, use, store, and revoke digital certificates. There exists a well managed protected public key infrastructure. The certificates used by the TOE and its client are managed by the PKI.

- 5G gNodeB Operating System: RTOS V200R001C00SPC509

- The eNodeB is LTE base station, which provides control plane (signalling plane) service for the gNodeB.

- A U2020 server providing access to the management functions of the TOE via SSL/TLS. U2020 version must be iManager U2020 V3R19C00.

- U2020 Mediation Software: The U2020 server software consists of the main version software and mediation software. The main version software implements system functions, and the mediation software is used for the adaptation of different NE interfaces. The U2020 can manage new NEs after the corresponding mediation software is installed.

- The physical structure of 5G gNodeB includes BBU subrack and RRU/AAU. BBU subrack is based on HERT hardware platform. HERT BBU is a common platform for wireless multiple products, different boards can be configured according to each product. Beside the hardware support platform subsystem, in most cases only need to configure the Main Processes and Transmission board (UMPT) and 5G BaseBand processing (BBP). BaseBand Service is a physical layer conversion such as channel coding and modulation and demodulation.

- S-GW: Serving Gateway, Within the EPC the S-GW is responsible for tunnelling user plane traffic between the gNodeB and the PDN-GW. To do this its role includes acting as the mobility anchor point for the User Plane during handovers between BTS as well as data buffering when traffic arrives for a mobile in the 5G Idle state. Other functions performed by the S-GW include routing, Lawful Interception and billing.

- UE: User Equipment, by air interface data encryption, can share the wireless access through 5G network.

- RRU: The RRU is the remote radio unit (RRU) for Huawei Worldwide Interoperability for 5G gNodeB. The RRU mainly performs the following functions:
  - Amplifies weak signals from the antenna system, down-converting the signals to intermediate frequency (IF) signals, performing analog-to-digital conversion, digital down-conversion, filtering, and AGC on the IF signals, and transmitting these signals to the baseband unit (BBU) through the high-speed transmission link.
  - Receives the downlink baseband digital signals from the BBU, performing matched filtering, digital up-conversion, clipping on the signals, modulating the output I/Q differential signals to required TX signals, amplifying the signals, and transmitting them through antennas.
- AAU: The active antenna system (AAS) module is a new type of radio frequency (RF) module following the RFU and RRU. Featured by incorporating functions of RRUs and conventional antennas, AAS modules require less site resources. In addition, each AAS module has multiple transmit and receive signals. Beams from an AAS module can be adjusted on different planes. This improves wireless coverage and increases network capacity.

  Note: The CSP files will be the files downloaded from the FTP server to update the TOE software and this way exercise the digital signature mechanism implemented in the TOE. A FTP server is part of the Non TOE Hardware required.

26 The TOE can be deployed with the following physical configuration with no changes in the functionality, or in the installation procedures to be followed:

- DBS5900 5G: Distributed base station. The DBS5900 5G is characterized by its small footprint, easy installation, and low power consumption. Therefore, the DBS5900 5G FDD can be easily installed in a spare space at an existing site. The RRU/AAU is also compact and light. It can be installed close to the antenna to reduce feeder loss and to improve system coverage. With these characteristics, the DBS5900 5G fully addresses operators' concern over site acquisition and reduces network deployment time. Therefore, the DBS5900 5G enables operators to efficiently deploy a high-performance 5G network with a low Total Cost of Ownership (TCO) by minimizing the investment in electricity, space, and manpower.

The DBS5900 5G has flexible applications to meet the requirement of fast network deployment in different scenarios.

Note: The configuration used during the evaluation is the DBS5900 5G.

1.5. TOE Description

1.5.1. Logical Scope

27 This section will define the logical scope of the TOE. The TOE is pure software. It is the core part of the software that is deployed into a 5G gNodeB base station.

28 The TOE security functionality, as stated in the section **1.4 TOE Overview** is:

A. Identification and Authentication (Management network)

29 The TOE can be accessed by different entities, including local users, domain users and EMSCOMM users. All these accesses are done through a physical port (Ethernet) using the same logical ports (Integrated ports).

30 The Identification and Authentication of the users differ depending on the entity storing the credentials.

31 Local access to the TOE: refers to "Local users", which are the users whose credentials are stored within the TOE. These users access the TOE for executing device management functions and are identified by individual user names and authenticated by passwords. The roles that a "Local user" can have are: Administrator, User, Operator, Guest, Custom.

32 Remote access to the TOE: Is the access carried out by users that are controlled by an Element Management System (EMS), in this case, the equipment U2020. This kind of users are called "Domain users", and are users created and managed by the U2020, which means that their information is stored within the U2020. In this case, the identification and authentication is performed by the U2020 which will send the result of the authentication procedure to the TOE, which will grant or deny the access to the TOE for these users depending of such result. It also will send the operational rights to the TOE so it can exercise the access control policy.

33 EMS access: is the access to the TOE carried out by "EMSCOMM users" These users are internally identified as emscomm, emscommneteco, emscommcum and emscommts. The identification

and authentication procedure of these users are performed using a password based challenge-response protocol implemented at the application layer for OSS system login authentication. Each user is used for a specific OSS module: Emscomm is used for connection management, security management and performance management. Emscommts is used for call history log report. Emscommneteco is used for cross-system coordination management and Emscommcum is used for an alternative network configuration.

B. Access control (Management network)

34 The TOE implements role-based access control, limiting access to different management functionality to different roles as defined in administrator-defined access control associations. This feature is implemented only for the access through the integrated ports.

C. Communications security

35 The TOE offers SSL/TLS channels for FTP, ALARM , MML (man-machine language, which is a kind of Command Line Interface), and BIN (Huawei's private binary message protocol) access to the TOE.

36 The TOE establishes a **trusted** channel for the communications with the U2020 providing the following secure features:

- Integrity
- Confidentiality
- Authentication

37 For all other communication through the management network for local, domain user and FTPS communication the TOE provides the following secure features:

- Integrity
- Confidentiality

D. Uu-U Interface protection (radio network)

38 The TOE air interface supports AES, SNOW 3G and ZUC for service data encryption. it ensures the privacy of user plane (data) session.

Notes: gNodeB NSA only supports user plane (data) traffic for Uu-U interface.

E. Backhaul Interface protection (telecom network)

39 IPsec is used in the backhaul interfaces to protect the traffic between the TOE and other network elements such as master eNodeB (X2) or security gateway (S1-U, i.e., S1 user plane).

40 The TOE establishes a **secure** channel for the IPsec communications between itself and peer IPsec entity (security gateway or master eNodeB). providing the following secure features:

- Integrity
- Confidentiality
- Authentication

F. Resource management

41 VLANs (Virtual Local Area Networks) are implemented to separate the traffic from different flow planes, which reduce traffic storms and avoid resource overhead.

42 The TOE can limit the user access to the TOE device or application using the ACL (Access Control List) feature by matching information contained in the headers of connection-oriented or connectionless IP packets against ACL rules specified.

43 ACL (Access Control List) implements packet filtering features to restrict resource use via IP address, ports, etc. Those features protect the TOE against various unauthorized access from unauthorized NEs.

G. Security function management

44 The following means are provided by the TOE for management of security functionality:

- User and group management
- Trusted channels management
- Session establishment management
- Access control management (by means of defining command groups, and association of users with particular command groups)

H. Digital signature

45 Software package and patches integrity are protected by a digital signature scheme (message digest and signature) which is verified by the TOE before loading it.

I. Auditing

46 There are two kinds of audit files, the operation log and the security log.

1. Security log (SEC): Records user operations related to the system security, including user behaviour and configuration commands, for example, account locking due to consecutive login failure and updating the security policy.
2. Operation log (OPE): Records the operational commands run by users.

47 Audit records are created for security-relevant events related to the use of the TOE.

- The TOE provides the capability to read all the information from the audit records.

- The TOE protects the audit records from unauthorized deletion.

1.5.2. Physical Scope

48 The release packages are composed of software and documents. The 5G gNodeB core software package is in the form of compressed file.

49 The software is available on Huawei support website (support.huawei.com). The documents are sent to the customer via e-mail.

Software and documents	Description	Remark
BTS3900_5900 V100R015C00SPC108_gNodeB(Software).7z	Board software package (In the form of a compressed file)	The software packages which are the TOE will be digitally signed to ensure their legitimacy and integrity.
The install guide, commissioning and maintenance documents of gNodeB	Including the documents listed in the following table (*).	The guidance documents of 5G gNodeB Software

Table 1 *Physical Scope*

(*) List of documents considered as guidance:

Document	Format
CC HUAWEI 5G gNodeB V100R015C00SPC108 - Installation Guide v4.1 SHA1 **checksum**: 22bc255f2cdbcdc975d772d018975fc3e3bf5ba1	DOC
CC HUAWEI 5G gNodeB V100R015C00SPC108 - Security Management Guide v0.4 SHA1 **checksum**: a7698fe7416aa3204431efbd466dc3139f087b65	PDF
BTS3900&BTS5900 V100R015C00SPC108 MML Command Reference, v1.1 SHA1 **checksum**: 58867ce36821b8322ae5537d3e297374ff6e1248	CHM
BTS3900&BTS5900 V100R015C00SPC108 Error codes, v0.1 SHA1 **checksum**: 4044d8f63a541165d978cbfd422c8c70dd6ad95f	XLSX

2. Conformance claim

50 This ST is CC Part 2 conformant [CC] and CC Part 3 conformant [CC], no extended. The CC version of [CC] is Version 3.1 Revision 5.

51 This ST is EAL4 conformant as defined in [CC] Part 3, with the assurance level of EAL4 Augmented with ALC_FLR.1.

52 The methodology to be used for evaluation is CEM3.1 R5

53 No conformance to a Protection Profile is claimed.

3. Security Problem Definition

3.1. TOE Assets

54 The following table includes the assets that have been considered for the TOE:

Asset	Description
A1.Software and patches	The integrity and confidentiality of the system software and the patches when in transit across the management network should be protected from modification and disclosure.
A2.Stored configuration data	The integrity and confidentiality of the stored configuration data should be protected. Configuration data includes the security related parameters under the control of the TOE (such as user account information and passwords, audit records, etc).
A3. In transit configuration data	The integrity and confidentiality of the configuration data when travelling in the management network.
A4. User Traffic	The user traffic includes the user data packets transferred upon the S1-U/X2 interface (telecom network). Confidentiality and integrity of the user traffic in the telecom network are protected by security functions implemented by the TOE.
A5. Service	Recoverability in terms of the capacity of recovery in case of denial of service.

Table 2 *TOE assets*

3.2. Threats

55 This section of the security problem definition shows the threats to be countered by the TOE, its operational environment, or a combination of both. The threat agents can be categorized as either:

Agent	Description
Telecommunication network attacker	An attacker from the telecommunication network who can connect to the TOE through S1-U/X2 interface is able to intercept, and potentially modify or re-use the

	data that is being sent to the TOE.
Management network attacker	An unauthorized agent who is connected to the management network.
Restricted authorized user	An authorized user of the TOE who belongs to the management network and has been granted authority to access certain information and perform certain actions.

Table 3 *Threats agents*

3.2.1. Threats by Management Network Attacker

Threat: T1.InTransitConfiguration	
Attack	An attacker in the management network succeeds in accessing the content of the BS file while transferring, violating its confidentiality or integrity.
Asset	A3.In transit configuration data
Agent	Management Network Attacker

Threat: T2. InTransitSoftware	
Attack	An attacker in the management network succeeds in accessing the content of the BS software/patches while transferring, violating its confidentiality or integrity.
Asset	A1.Software and patches;
Agent	Management Network Attacker

Threat: T3.UnauthenticatedAccess	
Attack	An attacker in the management network gains access to the TOE disclosing or modifying the configuration data stored in the TOE in a way that is not detected.
Asset	A2.Stored configuration data
Agent	Management Network Attacker

Threat: T4.UnwantedNetworkTraffic_M	
Attack	Unwanted network traffic sent to the TOE from management network will cause the TOE's processing capacity for incoming network traffic to be consumed thus failing to process legitimate traffic. This may further causes the TOE fails to respond to system control

	and security management operations. The TOE will be able to recover from this kind of situations.
Asset	A5. Service
Agent	Management Network Attacker

3.2.2. Threats by Telecommunication Network Attacker

Threat: T5.UnwantedNetworkTraffic_T	
Attack	Unwanted network traffic sent to the TOE from telecommunication network (S1-U and X2 interfaces) also cause the TOE's processing capacity for incoming network traffic to be consumed thus failing to process legitimate traffic. This may further causes the TOE fails to respond to system control and security management operations. The TOE will be able to recover from this kind of situations.
Asset	A5. Service
Agent	Telecommunication Network Attacker

Threat: T6. UserTraffic	
Attack	An attacker who is able to modifying/reading external network traffic and thereby gain unauthorized knowledge about the user data transferring between TOE and S-GW (S1-U) and master eNodeB (X2).
Asset	A4.User Traffic;
Agent	Telecommunication Network Attacker

3.2.3. Threats by restricted authorized user

Threat: T7.UnauthorizedAccess	
Attack	A user of the TOE accessing through the management network who is authorized to perform certain actions and access certain information gains access to commands or information he is not authorized for.
Asset	A2.Stored configuration data
Agent	Restricted authorized user

3.3. Organizational Policies

3.3.1. P1.Audit

56 The TOE shall provide audit functionality:

- Generation of audit information.
- Storage of audit log.
- Review of audit records.

3.3.2. P2. RoleManagement

57 Different People accessing the TSF needs to be divided according to different roles with different permissions, as possible, the user should have the minimum required permissions.

3.3.3. P3.Uu-U_Secure channel

58 The TOE shall encrypt/decrypt the data exchanged over the Uu-U interface.

3.4. Assumptions

3.4.1. Physical

A.PhysicalProtection

59 It is assumed that the TOE is protected against unauthorized physical access.

3.4.2. Personnel

A.TrustworthyUsers

60 It is assumed that the organization responsible for the TOE and its operational environment has measures in place to establish trust into and to train users of the TOE commensurate with the extent of authorization that these users are given on the TOE.

3.4.3. Connectivity

A.NetworkSegregation

61 It is assumed that the management network, the telecom network and the signal network are separated between each other.

62 **Note**:

- The **management network** is accessible through the integrated ports & FTP interfaces. SSL/TLS channels are implemented.

- The **telecom network** is accessible through the S1-U and X2 interfaces. IPSEC channels are implemented.

- The **radio network** is accessible through the Uu-U interface.

3.4.4. Support

A.Support

63 The operational environment must provide the following supporting mechanisms to the TOE: Reliable timestamps for the generation of audit records.

3.4.5. SecurePKI

A.SecurePKI

64 There is a well-managed & protected public key infrastructure. The certificates used by the TOE and its clients are managed by the PKI.

4. Security Objectives

4.1. Security Objectives for the TOE

65 The following objectives must be met by the TOE:

O.Authentication

66 The TOE must authenticate users and control the session establishment. The I&A mechanism shall be implemented in the following users: Local, EMSCOMM.

67 The TOE shall implement a session establishment mechanism restricting the local users to access the TOE based on time.

O.Authorization

68 The TOE shall implement different authorization levels that can be assigned to users in order to restrict the functionality available to them. This access control mechanism shall be implemented for the following users: Local, Domain and EMSCOMM.

O.SecureCommunication

The TOE shall provide a secure remote communication channels via SSL/TLS within the management network and IPSEC within the telecom network.

69 The TOE establishes a **trusted** channel for the communications with the U2020 through the management network providing the following secure features:

- Integrity
- Confidentiality
- Authentication

70 For all other communication through these networks for local, domain user and FTPS communication the TOE provides the following secure features:

- Integrity
- Confidentiality

O. SoftwareIntegrity

71 The TOE must provide functionality to verify the integrity of the received software patches.

O.Resources

72 The TOE shall implement a session establishment mechanism (SEP) controlled by IP, port, protocol and VLAN id for telecom (S1-U, X2) and management network (integrated ports & FTP) allowing VLAN separation and IP based ACLs to avoid resource overhead.

O.Audit

73 The TOE shall provide audit functionality:

- Generation of audit information.
- Storage of audit log.
- Review of audit records.

O.UserTrafficProtection

74 The TOE shall provide encryption protection for the data exchanged over the radio network (Uu-U interface).

4.2. Security Objectives for the Operational Environment

OE. PhysicalProtection

75 The TOE (i.e., the complete system including attached interfaces) shall be protected against unauthorized physical access.

OE.TrustworthyUsers

76 Those responsible for the operation of the TOE and its operational environment must be trustworthy, and trained such that they are capable of securely managing the TOE and following the provided guidance.

OE.NetworkSegregation

77 The TOE environment shall assure that the management network, the telecom network and the signal network are separated between each other.

OE.Support

78 Those responsible for the operation of the TOE and its operational environment must ensure that the operational environment provides the following supporting mechanisms to the TOE: Reliable timestamps for the generation of audit records.

OE. SecurePKI

79 A well-managed protected public key infrastructure is implemented in the operational environment. The certificates used by the TOE and its client are managed by the PKI.

4.3. Security Objectives rationale

4.3.1. Coverage

80 The following tables provide a mapping of security objectives to the environment defined by the threats, policies and assumptions, illustrating that each security objective covers at least one threat and that each threat is countered by at least one objective, assumption or policy.

	T1.InTransitConfiguration	T2.InTransitSoftware	T3.UnauthenticatedAccess	T4.UnwantedNetworkTraffic_M	T5.UnwantedNetworkTraffic_T	T6. UserTraffic	T7.UnauthorizedAccess	A.PhysicalProtection	A.TrustworthyUsers	A.NetworkSegregation	A.Support	A. SecurePKI	P1.Audit	P2.RoleManagement	P3.Uu-U_Secure channel
O.Authentication			X												
O.Authorization			X				X							X	
O.SecureCommunication	X	X	X			X									
O.SoftwareIntegrity		X													
O.Resources				X	X										
O.Audit													X		
O.UserTrafficProtection															X
OE.PhysicalProtection								X							
OE.TrustworthyUsers									X						
OE.NetworkSegregation										X					
OE.Support											X				
OE.SecurePKI	X	X	X			X						X			

Table 4 *Mapping of security objectives*

4.3.2. Sufficiency

81 The following rationale provides justification that the security objectives are suitable to counter each individual threat and that each security objective tracing back to a threat, when achieved, actually contributes to the removal, diminishing or mitigation of that threat:

Threat	Rationale for security objectives
T1.InTransitConfiguration	The threat T1.InTransitConfiguration is countered by requiring communications security via SSL/TLS for network communication between entities in the management network and the TOE (O.SecureCommunication). A secure PKI will be needed to assure the validity of the used certificates. (OE.SecurePKI)
T2. InTransitSoftware	The threat T2.InTransitSoftware is countered by O.SoftwareIntegrity: when a software package is loaded, its message digest and signature are verified. O.SecureCommunication contributes also as a secure communication channel between the TOE and external entities in the management network is established. A secure PKI will be needed to assure the validity of the used certificates. (OE.SecurePKI)
T3.UnauthenticatedAccess	The threat T3.UnauthenticatedAccess is countered by the security objective for the TOE O.Authentication which requires the TOE to implement an authentication mechanism for the local users together with O.Authorization which requires the TOE to implement an access control mechanism for the users in the management network. It is also countered by requiring communications security via SSL/TLS for network communication between entities in the management network and the TOE (O.SecureCommunication). A secure PKI will be needed to assure the validity of the used certificates. (OE.SecurePKI)

T4.UnwantedNetworkTraffic_M	The threat T4.UnwantedNetworkTraffic_M is directly counteracted by the security objective for the TOE O.Resources.
T5.UnwantedNetworkTraffic_T	The threat T5.UnwantedNetworkTraffic_T is also directly counteracted by the security objective for the TOE O.Resources.
T6.UserTraffic	The Threat T6.UserTraffic is countered by the security objective for the TOE (O.SecureCommunication). This provides secure channels for X2 interface traffic between gNodeB and master eNodeB, and S1-U interface traffic between gNodeB and security gateway by implement IPsec. A secure PKI will be needed to assure the validity of the used certificates. (OE.SecurePKI)
T7.UnauthorizedAccess	The threat T7.UnauthorizedAccess is countered by the security objective for the TOE O.Authorization which requires the TOE to implement an access control mechanism for the users in the management network.

Table 5 *Sufficiency analysis for threats*

Assumption	**Rationale for security objectives**
A.PhysicalProtection	This assumption is directly implemented by the security objective for the environment OE.PhysicalProtection.
A.TrustworthyUsers	This assumption is directly implemented by the security objective for the environment OE.TrustworthyUsers.
A.NetworkSegregation	This assumption is directly implemented by the security objective for the environment OE.NetworkSegregation.
A.Support	This assumption is directly implemented by the security objective for the environment OE.Support.
A. SecurePKI	This assumption is directly implemented by the security objective for the environment. OE. SecurePKI

Table 6 *Sufficiency analysis for assumptions*

Policy	**Rationale for security objectives**
P1.Audit	This policy is directly implemented by the security objective for the TOE O.Audit
P2.RoleManagement	This policy is directly implemented by the security objective

	for the TOE O.Authorization
P3.Uu-U_Secure channel	This policy is directly implemented by the security objective for the TOE O.UserTrafficProtection

Table 7 *Sufficiency analysis for organizational security policy*

5. Security Requirements for the TOE

5.1. Security Requirements

5.1.1. Security Audit (FAU)

5.1.1.1. FAU_GEN.1 Audit data generation

FAU_GEN.1.1 The TSF shall be able to generate an audit record of the following auditable events:

a) Start-up and shutdown of the audit functions;

b) All auditable events for the [selection: ***not specified*****] level of audit; and**

c) [assignment: ***The following auditable events:***

i. user activity

1. login, logout (SEC)

2. operation requests that triggered by manual operation. (OPE)

ii. user management

1. add, delete, modify (SEC & OPE)

2. password change through GUI (SEC)

3. password change through MML (MOD OP) (SEC & OPE)

4. authorization modification (SEC & OPE)

iii. Locking, unlocking (manual or automatic) (SEC)

1. Locking (automatic) (SEC)

2. Locking (manual: through SET OPLOCK) (SEC & OPE)

3. unlocking (automatic) (SEC)

4. unlocking (manual: through ULK USR) (SEC & OPE)

iv. Command group management

1. Add/ delete commands into/from command group (SEC & OPE)

2. Modify name of command group name (SEC &OPE)

]

Application note: Domain users are managed by U2020, so changing password of domain user through GUI will not be logged in SECLOG.

FAU_GEN.1.2 The TSF shall record within each audit record at least the following information:

a) **Date and time of the event, type of event, subject identity (if applicable), and the outcome (success or failure) of the event; and**

b) **For each audit event type, based on the auditable event definitions of the functional components included in the PP/ST. [assignment: *workstation IP (if applicable), user (if applicable), and command name (if applicable).*]**

5.1.1.2. FAU_GEN.2 User identity association

FAU_GEN.2.1 For audit events resulting from actions of identified users, the TSF shall be able to associate each auditable event with the identity of the user that caused the event.

5.1.1.3. FAU_SAR.1 Audit review

FAU_SAR.1.1 The TSF shall provide [assignment: *users with audit review rights*] with the capability to read [assignment: *all information*] from the audit records.

FAU_SAR.1.2 The TSF shall provide the audit records in a manner suitable for the user to interpret the information.

5.1.1.4. FAU_SAR.3 Selectable Audit review

FAU_SAR.3.1 The TSF shall provide the ability to apply [assignment: *selection*] of audit data based on [assignment: *date and time range, user name, terminal type, and/or result*.]

5.1.1.5. FAU_STG.1 Protected audit trail storage

FAU_STG.1.1 The TSF shall protect the stored audit records in the audit trail from unauthorized deletion.

FAU_STG.1.2 The TSF shall be able to [selection: *prevent*] unauthorized modifications to the stored audit records in the audit trail.

5.1.1.6. FAU_STG.3 Action in case of possible audit data loss

FAU_STG.3.1 The TSF shall [assignment: *delete the oldest files*] if the audit trail exceeds [assignment: *the pre-defined storage capacity limitation*].

Application note: For security log storage, the capacity limitation is 2M bytes. For operation log storage, the capacity limitation is 11M bytes. Each log file has the size of about 1M bytes. When the capacity is used up, the oldest log file will be deleted.

5.1.2. Cryptographic Support (FCS)

5.1.2.1. FCS_COP.1/Sign Cryptographic operation

FCS_COP.1.1 The TSF shall perform [assignment: *digital signature verification*] in accordance with a specified cryptographic algorithm [assignment: *RSA with underlying SHA-256*] and cryptographic key sizes [assignment: *1024bits*] that meet the following: [assignment: *none*]

5.1.2.2. FCS_COP.1/SSL/TLS Cryptographic operation

FCS_COP.1.1 The TSF shall perform [assignment: *encryption, decryption, cryptographic checksum generation for integrity and verification of checksum on TOE access channels*] in accordance with a specified cryptographic algorithm [assignment: *algorithms supported by SSL/TLS*] and cryptographic key sizes [assignment: *key sizes supported by SSL/TLS*] that meet the following: [assignment: *none*]

5.1.2.3. FCS_COP.1/Uu-U Cryptographic operation

FCS_COP.1.1 The TSF shall perform [assignment: *ciphering protection of TOE communication with the UE*] in accordance with a specified cryptographic algorithm [assignment: *NEA1– based on SNOW 3G or NEA2– based on AES-128 or NEA3– based on ZUC*] and cryptographic key sizes [assignment: *128 bits*] that meet the following: [assignment: *none*]

5.1.2.4. FCS_COP.1/IPsec Cryptographic operation

FCS_COP.1.1 The TSF shall perform [assignment: *encryption, decryption, cryptographic checksum generation for integrity, verification of checksum and cryptographic key agreement of TOE communication with the ike peer*] in accordance with a specified cryptographic algorithm [assignment: *algorithms supported by IPSec/IKE*] and cryptographic key sizes [assignment: *key sizes supported by IPSec/IKE*] that meet the following: [assignment: *none*]

5.1.2.5. FCS_CKM.1/SSL/TLS Cryptographic key generation

FCS_CKM.1.1 The TSF shall generate cryptographic keys in accordance with a specified cryptographic key generation algorithm [assignment: *cryptographic key generation methods supported by SSL/TLS*] and cryptographic key sizes [assignment: *key sizes supported by SSL/TLS*] that meet the following: [assignment: *none*]

5.1.2.6. FCS_CKM.1/Uu-U Cryptographic key generation

FCS_CKM.1.1 The TSF shall generate cryptographic keys in accordance with a specified cryptographic key generation algorithm [assignment: *AKA protocol*] and cryptographic key sizes [assignment: *128 bits*] that meet the following: [assignment: *none*]

5.1.2.7. FCS_CKM.1/IPsec Cryptographic key generation

FCS_CKM.1.1 The TSF shall generate cryptographic keys in accordance with a specified cryptographic key generation algorithm [assignment: *cryptographic key generation methods supported by IPSec/IKE*] and cryptographic key sizes [assignment: *key sizes supported by IPSec/IKE*] that meet the following: [assignment: *none*]

5.1.3. User Data Protection (FDP)

5.1.3.1. FDP_ACC.1/Local Subset access control

FDP_ACC.1.1 The TSF shall enforce the [assignment: *Local access control policy*] on [assignment: *local users as subjects, commands as objects, and execution of commands by local users*].

5.1.3.2. FDP_ACF.1/Local Security attribute based access control

FDP_ACF.1.1 The TSF shall enforce the [assignment: *Local access control policy*] to objects based on the following:

[assignment:

a) local users and their following security attributes:

i. user name

ii. user group (role)

b) commands and their following security attributes:

i. command name

*ii. command groups.***]**

FDP_ACF.1.2 The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:

[assignment:

if the user belongs to a user group that is assigned to a command group that includes the controlled command, then access is granted.

*If the user belongs to the custom user group, and he is associated to the command group that includes the controlled command, then access is granted***]**

FDP_ACF.1.3 The TSF shall explicitly authorise access of subjects to objects based on the following additional rules: [assignment: *If the user name is admin, access is always granted*]

FDP_ACF.1.4 The TSF shall explicitly deny access of subjects to objects based on the following additional rules: [assignment: *None*]

5.1.3.3. FDP_ACC.1/Domain Subset access control

FDP_ACC.1.1 The TSF shall enforce the [assignment: *Domain access control policy*] on [assignment: *domain users as subjects, commands as objects, and execution of commands by domain users*].

5.1.3.4. FDP_ACF.1/Domain Security attribute based access control

FDP_ACF.1.1 The TSF shall enforce the [assignment: *Domain access control policy*] to objects based on the following:

[assignment:

a) *domain users and their following security attributes:*
   i. *user name*

b) *commands and their following security attributes:*
   ii. *command name*]

FDP_ACF.1.2 The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:

[assignment: *if the user is assigned to the requested commands, then access is granted.*]

FDP_ACF.1.3 The TSF shall explicitly authorise access of subjects to objects based on the following additional rules: [assignment: *If the user group assigned to the user in the U2020 is Administrators, access is always granted*]

FDP_ACF.1.4 The TSF shall explicitly deny access of subjects to objects based on the following additional rules: [assignment: *None*]

5.1.3.5. FDP_ACC.1/EMSCOMM Subset access control

FDP_ACC.1.1 The TSF shall enforce the [assignment: *EMSCOMM access control policy*] on [assignment: *EMSCOMM user as subject, commands as objects, and execution of commands by the EMSCOMM user*].

5.1.3.6. FDP_ACF.1/EMSCOMM Security attribute based access control

FDP_ACF.1.1 The TSF shall enforce the [assignment: *EMSCOMM access control policy*] to objects based on the following:

[assignment:

a) EMSCOMM user and its following security attributes:

i. user name

b) commands and their following security attributes:

*ii. command name***]**

FDP_ACF.1.2 The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:

[assignment:

a) emscomm will always have execution permission of the targeted command.

emscommts will always have execution permission of the base command(G_0).

emscommneteco will always have execution permission of the base command(G_0) and energy management commands.

emscommcum will always have execution permission of the command group G_0~G_14 and G_16~G_21 **]**

FDP_ACF.1.3 The TSF shall explicitly authorise access of subjects to objects based on the following additional rules: [assignment: *None***]**

FDP_ACF.1.4 The TSF shall explicitly deny access of subjects to objects based on the following additional rules: [assignment: *None***]**

5.1.4. Identification and Authentication (FIA)

5.1.4.1. FIA_AFL.1 Authentication failure handling

FIA_AFL.1.1 The TSF shall detect when [selection: *an administrator configurable positive integer within [assignment: 1 and 255]* **] unsuccessful authentication attempts occur related to [assignment:** *authentication of local users since the last successful authentication of the user and before the counter for these attempts is reset after an administrator configurable time frame either between 1 and 60 minutes***].**

FIA_AFL.1.2 When the defined number of unsuccessful authentication attempts has been [selection: *surpassed***], the TSF shall [assignment:** *lockout the account for an administrator configurable duration either between 1 and 65535 minutes***]**

5.1.4.2. FIA_ATD.1 User attribute definition

FIA_ATD.1.1 The TSF shall maintain the following list of security attributes belonging to individual users:

[assignment:

a) User name
b) User group
c) Password
d) Number of unsuccessful authentication attempts since last successful authentication attempt
e) Login allowed start time
f) Login allowed end time
*g) Lock status***]**

5.1.4.3. FIA_SOS.1 Verification of secrets

FIA_SOS.1.1 The TSF shall provide a mechanism to verify that secrets meet:

[assignment:

a) an administrator configurable minimum length between 6 and 32 characters,
b) an administrator configurable combination of the following:

i. at least one lower-case alphanumerical character,

ii. at least one upper-case alphanumerical character,

iii. at least one numerical character,

iv. at least one special character.

c) that they are different from an administrator configurable number between 1 to 10 previous used passwords **]**

5.1.4.4. FIA_UAU.1/Local Timing of authentication

FIA_UAU.1.1 the TSF shall allow [assignment:

a) Handshake command
b) Parameter negotiation
c) Login request
d) Confirm user type
e) Logout

On behalf of the user to be performed before the user is authenticated.

FIA_UAU.1.2 the TSF shall require each user to be successfully authenticated before allowing any other TSF-mediated actions on behalf of that user.

5.1.4.5. FIA_UAU.2/EMSCOMM User authentication before any action

FIA_UAU.2.1 the TSF shall require each user to be successfully authenticated before allowing any other TSF-mediated actions on behalf of that user.

5.1.4.6. FIA_UAU.5 Multiple authentication mechanisms

FIA_UAU.5.1 The TSF shall provide [assignment:

a) *Authentication for Local Users*

b) *Authentication for EMSCOMM user*

] to support user authentication.

FIA_UAU.5.2 The TSF shall authenticate any user's claimed identity according to the [assignment:

a) *Local users are authenticated in the TOE by username and password stored in the TOE.*

b) *EMSCOMM user is authenticated in the TOE by a password based challenge-response protocol.*

]

5.1.4.7. FIA_UID.1/Local Timing of identification

FIA_UID.1.1 The TSF shall allow [assignment:

a) *Handshake command*

b) *Parameter negotiation*

c) *Confirm user type*

d) *Logout*

on behalf of the user to be performed before the user is identified.

FIA_UID.1.2 the TSF shall require each user to be successfully identified before allowing any other TSF-mediated actions on behalf of that user.

5.1.4.8. FIA_UID2/ EMSCOMM User identification before any action

The TSF shall require each user to be successfully identified before allowing any other TSF-mediated actions on behalf of that user.

5.1.5. Security Management (FMT)

5.1.5.1. FMT_MSA.1 Management of security attributes

FMT_MSA.1.1 The TSF shall enforce the [assignment: *Local access control policy*] to restrict the ability to [selection: *query and modify*] the security attributes [assignment:

a) Command groups
b) User groups]

to [assignment: *users with the appropriate rights*].

5.1.5.2. FMT_MSA.3 Static attribute initialization

FMT_MSA.3.1 The TSF shall enforce the [assignment: *Local access control policy*] to provide [selection: *permissive*] default values for security attributes that are used to enforce the SFP.

FMT_MSA.3.2 The TSF shall allow the [assignment: *administrator defined roles with the appropriate rights*] to specify alternative initial values to override the default values when an object or information is created.

5.1.5.3. FMT_SMF.1 Specification of Management Functions

FMT_SMF.1.1 The TSF shall be capable of performing the following management functions: [assignment:

a) Local User management
b) Command group management (creation, deletion, modification, commands membership)
c) Local users authorization management (User group authorization on Command groups)
d) Configuration of SSL/TLS (Certificates and auth mode)
e) Configuration of IPSec
f) Configuration of ACL
g) Configuration of VLAN
h) Configuration of Uu-U interface
i) FIA_SOS.1.1 configurable values (Password policy)
j) FIA_AFL.1.1 configurable values (Authentication failure handling)]

Application note: The TOE includes default users whose associated parameters (but the password) cannot be modified. These users are *admin* and *guest*.

5.1.5.4. FMT_SMR.1 Security roles

FMT_SMR.1.1 The TSF shall maintain the roles: [assignment: *Administrator, User, Operator, Guest and Custom*]

FMT_SMR.1.2 The TSF shall be able to associate users with roles.

5.1.6. TOE access (FTA)

5.1.6.1. FTA_TSE.1/SEP TOE session establishment

FTA_TSE.1.1 The TSF shall be able to deny session establishment based on [assignment:

a) Protocol type (IP, ICMP, TCP, UDP or SCTP)
b) Source IP address and mask
c) Source port range
d) Destination IP address and mask
e) Destination port range
f) DSCP value
***g) VLAN id*]**

5.1.6.2. FTA_TSE.1/Local TOE session establishment

FTA_TSE.1.1 The TSF shall be able to deny session establishment based on [assignment:

a) Login allowed start time
b) Login allowed end time
***c) Account status.*]**

5.1.7. Trusted Path/Channels (FTP)

5.1.7.1. FTP_ITC.1/IntegratedPort Inter-TSF trusted channel

FTP_ITC.1.1 The TSF shall provide a communication channel between itself and another trusted IT product that is logically distinct from other communication channels and provides assured identification of its end points and protection of the channel data from modification or disclosure.

FTP_ITC.1.2 The TSF shall permit [selection: *U2020*] to initiate communication via the trusted channel.

FTP_ITC.1.3 The TSF shall initiate communication via the trusted channel for [assignment: *execution of MML/BIN commands*].

5.2. Security Functional Requirements Rationale

5.2.1. Coverage

82 The following table provides a mapping of SFR to the security objectives, showing that each security functional requirement addresses at least one security objective.

	O.Audit	O.Authentication	O.Authorization	O.SecureCommunication	O.Resources	O.SoftwareIntegrity	O.UserTrafficProtection
FAU_GEN.1	×						
FAU_GEN.2	×						
FAU_SAR.1	×						
FAU_SAR.3	×						
FAU_STG.1	×						
FAU_STG.3	×						
FDP_ACC.1/Local			×				
FDP_ACF.1/Local			×				
FDP_ACC.1/Domain			×				
FDP_ACF.1/Domain			×				
FDP_ACC.1/EMSCOMM			×				
FDP_ACF.1/EMSCOMM			×				
FIA_AFL.1		×					
FIA_ATD.1		×					
FIA_UAU.1/Local		×	×				
FIA_UAU.2/EMSCOMM		×	×				

FIA_UAU.5		×	×				
FIA_UID.1/Local	×	×	×				
FIA_UID.2/EMSCOMM	×	×	×				
FIA_SOS.1		×					
FMT_MSA.1			×				
FMT_MSA.3			×				
FMT_SMF.1		×	×	×	×		×
FMT_SMR.1			×				
FTA_TSE.1/SEP					×		
FTA_TSE.1/Local		×					
FCS_COP.1/SSL/TLS				×			
FCS_CKM.1/SSL/TLS				×			
FCS_COP.1/Uu-U							×
FCS_CKM.1/Uu-U							×
FCS_COP.1/IPsec							×
FCS_CKM.1/IPsec							×
FCS_COP.1/Sign						×	
FTP_ITC.1/IntegratedPort				x			

Table 8 Mapping SFRs to objectives

5.2.2. Sufficiency

83 The following rationale provides justification for each security objective for the TOE, showing that the security functional requirements are suitable.

Security objectives	Rationale
O.Audit	The generation of audit records is implemented by FAU_GEN.1. Audit records are supposed to include user identities (FAU_GEN.2) where applicable, which are supplied by the identification mechanism (FIA_UID.1/Local and FIA_UID.2/EMSCOMM). Functionality is provisioned to read these records (FAU_SAR.1, FAU_SAR.3). The protection of the stored audit records is implemented in FAU_STG.1. Functionality to prevent audit data loss (of the data that is going to be generated by removing the oldest files) is provided by FAU_STG.3.

O.Authentication	Local user authentication is implemented by FIA_UAU.1/Local, EMSCOMM user authentication is implemented by FIA_UAU.2/EMSCOMM. FIA_UAU.5 is implemented for multi-user authentication. Individual user identification is implemented in FIA_UID.1/Local and FIA_UID.2/EMSCOMM. The necessary user attributes are spelled out in FIA_ATD.1. The authentication mechanism supports authentication failure handling (FIA_AFL.1), and a password policy (FIA_SOS.1), restrictions as to the validity of accounts for logon (FTA_TSE.1/Local). Management functionality is provided in FMT_SMF.1.
O.Authorization	Local user authentication is implemented by FIA_UAU.1/Local, EMSCOMM user authentication is implemented by FIA_UAU.2/EMSCOMM. FIA_UAU.5 is implemented for multi-user authentication. Individual user identification is implemented in FIA_UID.1/Local and FIA_UID.2/EMSCOMM. The requirements for the local users' access control policy are modelled in FDP_ACC.1/Local, FDP_ACF.1/Local, FMT_MSA.1 and FMT_MSA.3. This access control is based on the definition of roles (FMT_SMR.1). Management functionality for this access control policy is provided in FMT_SMF.1. The domain users' access control policy is modelled in FDP_ACC.1/Domain and FDP_ACF.1/Domain. The EMSCOMM access control policy is modelled in FDP_ACC.1/EMSCOMM and FDP_ACF.1/EMSCOMM.
O.SecureCommunication	Communications security is implemented using encryption for the communication with the U2020 through the integration port interface and in the communication with the FTP servers. The keys used for the channels are generated as part of the SSL/TLS connection establishment process. (FCS_COP.1/SSL/TLS, FCS_CKM.1/SSL/TLS) A trusted channel is provided for the use of the TOE through the Integrated Ports interface (FTP_ITC.1/IntegratedPort) Management functionality to enable these mechanisms

	is provided in FMT_SMF.1.
O.UserTrafficProtection	Ciphering and integrity protection is implemented to protect the data transferred between the TOE and the UE. The keys used for ciphering and integrity protection are generated using AKA (FCS_COP.1/Uu-U, FCS_CKM.1/Uu-U) Management functionality to configure the channel is provided in FMT_SMF.1. Encryption over the S1-U/X2 interface is addressed ciphering the channel between the TOE and peer NE (security gateway or master eNodeB). The keys used for the channels are generated as part of the IPSec connection establishment process using Diffie-Hellman. (FCS_COP.1/IPsec, FCS_CKM.1/IPsec) Management functionality to configure the channel is provided in FMT_SMF.1.
O.Resource	FTA_TSE.1/SEP implements the separation of traffic based on VLANs and the IP based ACL to avoid resource overhead. Management functionality to configure the ACL and the VLANs is provided in FMT_SMF.1.
O.SoftwareIntegrity	The software integrity objective is directly implemented with FCS_COP.1/Sign so the TOE performs digital signature verification over the software patches.

Table 9 *SFR sufficiency analysis*

5.2.3. Security Requirements Dependency Rationale

84 The security functional requirements in this Security Target do not introduce dependencies on any security assurance requirement; neither do the security assurance requirements in this Security Target introduce dependencies on any security functional requirement.

85 The following table demonstrates the dependencies of SFRs modelled in CC Part 2 and how the SFRs for the TOE resolve those dependencies:

Security Functional Requirement	Dependencies	Resolution
FAU_GEN.1	FPT_STM.1	OE.Support : the operational environment provides Reliable time stamps for the generation of audit records.
FAU_GEN.2	FAU_GEN.1	FAU_GEN.1

	FIA_UID.1	FIA_UID.1
FAU_SAR.1	FAU_GEN.1	FAU_GEN.1
FAU_SAR.3	FAU_SAR.1	FAU_SAR.1
FAU_STG.1	FAU_GEN.1	FAU_GEN.1
FAU_STG.3	FAU_STG.1	FAU_STG.1
FCS_COP.1/Sign	[FDP_ITC.1 | FDP_ITC.2 | FCS_CKM.1]	Not resolved. The digital certificate used for signature verification is loaded as part of the manufacture process.
	FCS_CKM.4	Not resolved. The digital certificate used for signature verification is loaded as part of the manufacture process and are never destructed.
FDP_ACC.1/Local	FDP_ACF.1	FDP_ACF.1/Local
FDP_ACF.1/Local	FDP_ACC.1 FMT_MSA.3	FDP_ACC.1/Local FMT_MSA.3
FDP_ACC.1/Domain	FDP_ACF.1	FDP_ACF.1/Domain
FDP_ACF.1/Domain	FDP_ACC.1	FDP_ACC.1/Domain
	FMT_MSA.3	Not resolved. The dependency with FMT_MSA.3 is not resolved because the attributes of the access control policy are not under the control of the TOE.
FDP_ACC.1/EMSCOMM	FDP_ACF.1	FDP_ACF.1/ EMSCOMM
FDP_ACF.1/EMSCOMM	FDP_ACC.1	FDP_ACC.1/ EMSCOMM
	FMT_MSA.3	Not resolved. The dependency with FMT_MSA.3 is not resolved because the attributes of the access control policy are not under the control of the TOE.
FIA_AFL.1	FIA_UAU.1	FIA_UAU.1
FIA_ATD.1	None	
FIA_UAU.1/Local	FIA_UID.1/Local	FIA_UID.1/Local
FIA_UAU.2/EMSCOMM	FIA_UID.2/EMSCOM	FIA_UID.2/EMSCOMM

	M	
FIA_UAU.5	None	
FIA_UID.1/Local	None	
FIA_UID.2/EMSCOMM	None	
FIA_SOS.1	None	
FMT_MSA.1	[FDP_ACC.1 | FDP_IFC.1]	FDP_ACC.1
	FMT_SMR.1	FMT_SMR.1
	FMT_SMF.1	FMT_SMF.1
FMT_MSA.3	FMT_MSA.1	FMT_MSA.1
	FMT_SMR.1	FMT_SMR.1
FMT_SMF.1	None	
FMT_SMR.1	FIA_UID.1	FIA_UID.1
FTA_TSE.1/SEP	None	
FTA_TSE.1/Local	None	
FCS_COP.1/SSL	[FDP_ITC.1 | FDP_ITC.2 | FCS_CKM.1]	FCS_CKM.1/SSL
	FCS_CKM.4	Due to the security problem the memory where the keys are stored is not physically accessible. Furthermore, the memory cannot be downloaded through the available logical paths. Therefore, the keys cannot be obtained and, according to the CEM, it is considered that the dependency with FCS_CKM.4 is not necessary or useful.
FCS_CKM.1/SSL	[FCS_CKM.2 | FCS_COP.1]	FCS_COP.1/SSL
	FCS_CKM.4	Due to the security problem the memory where the keys are stored is not physically accessible. Furthermore, the memory cannot be downloaded through the available logical paths. Therefore, the keys cannot be

		obtained and, according to the CEM, it is considered that the dependency with FCS_CKM.4 is not necessary or useful.
FCS_COP.1/UU-U	[FDP_ITC.1 | FDP_ITC.2 | FCS_CKM.1]	FCS_CKM.1/UU-U
	FCS_CKM.4	Due to the security problem the memory where the keys are stored is not physically accessible. Furthermore, the memory cannot be downloaded through the available logical paths. Therefore, the keys cannot be obtained and, according to the CEM, it is considered that the dependency with FCS_CKM.4 is not necessary or useful.
FCS_CKM.1/UU-U	[FCS_CKM.2 | FCS_COP.1]	FCS_COP.1/UU-U
	FCS_CKM.4	Due to the security problem the memory where the keys are stored is not physically accessible. Furthermore, the memory cannot be downloaded through the available logical paths. Therefore, the keys cannot be obtained and, according to the CEM, it is considered that the dependency with FCS_CKM.4 is not necessary or useful.
FCS_COP.1/IPsec	[FDP_ITC.1 | FDP_ITC.2 | FCS_CKM.1]	FCS_CKM.1/IPsec
	FCS_CKM.4	Due to the security problem the memory where the keys are stored is not physically accessible. Furthermore, the memory cannot be downloaded through the available logical paths. Therefore, the keys cannot be obtained and, according to the CEM, it is considered that the

		dependency with FCS_CKM.4 is not necessary or useful.
FCS_CKM.1/IPsec	[FCS_CKM.2 | FCS_COP.1]	FCS_COP.1/IPsec

Table 10 *Dependencies between TOE Security Functional Requirements*

5.3. Security Assurance Requirements

86 The security assurance requirements for the TOE are the Evaluation Assurance Level 4 components as specified in [CC] Part 3, augmented with ALC_FLR.1. No operations are applied to the assurance components.

Assurance class	Assurance Family	Assurance Components by Evaluation Assurance Level
Development	ADV_ARC	1
	ADV_FSP	4
	ADV_IMP	1
	ADV_TDS	3
Guidance documents	AGD_OPE	1
	AGD_PRE	1
Life-cycle support	ALC_CMC	4
	ALC_CMS	4
	ALC_DEL	1
	ALC_DVS	1
	ALC_FLR	1
	ALC_LCD	1
	ALC_TAT	1
Security Target evaluation	ASE_CCL	1
	ASE_ECD	1
	ASE_INT	1
	ASE_OBJ	2
	ASE_REQ	2
	ASE_SPD	1
	ASE_TSS	1
Tests	ATE_COV	2

	ATE_DPT	1
	ATE_FUN	1
	ATE_IND	2
Vulnerability assessment	AVA_VAN	3

Table 11 Security Assurance Requirements

5.4. Security Assurance Requirements Rationale

87 The evaluation assurance level has been chosen commensurate with the threat environment that is experienced by typical consumers of the TOE.

6. TOE Summary Specification

6.1. TOE Security Functionality

6.1.1. Authentication

88 The TOE offers the enforcement of timer-based account lockouts: administrators can specify after how many consecutive failed authentication attempts an account will be temporarily locked, and whether the counter for failed attempts will be reset automatically after a certain amount of minutes. (FIA_AFL.1) This functionality only applies to the local users. The EMSCOMM user is not considered in this requirement. The EMSCOMM user is authenticated in the TOE by a password based challenge-response method. Domain users are authenticated in the U2020 element of the TOE environment, so they are also not considered in this requirement neither by the TOE authentication functionality.

89 The TOE authenticates the local users based on individual user IDs and passwords. User IDs are unique within the TOE and stored together with associated passwords and other security attributes in the TOE's configuration database. Those attributes can be configured by users with the appropriate rights. (FIA_ATD.1, FMT_SMF.1). FIA_ATD.1 only applies to the local users. The EMSCOMM user is not considered in this requirement. The EMSCOMM user is authenticated in the TOE by a password based challenge-response method. Domain users are authenticated in the U2020 element of the TOE environment, so they are also not considered in this requirement neither by the TOE authentication functionality.

90 Verification of the password policy is performed when creating or modifying users (FIA_SOS.1). This functionality only applies to the local users.

91 The TOE can identify local users in the management network by a unique ID and enforces their authentication before granting them access to the TSF management interfaces. Warning of "error username or password" will be prompted when the user fails to provide a correct username or password. Some not security related actions can be performed before identification and authentication. These are the MML commands corresponding to these actions:

a) Handshake command (SHK HAND)
b) Parameter negotiation (NEG OPT)
c) Login request (LGI REQUEST)
d) Confirm user type (CFM IDENTITY)
e) Logout (LGO)

92 The only applicable command for the interface BIN is the corresponding to the Handshake command and Logout. (FIA_UID.1/Local,FIA_UAU.1/Local)

93 The TOE can identify EMSCOMM users in the management network by their unique ID and enforces authentication before granting it access to the TSF management interfaces. (FIA_UID.2/EMSCOMM, FIA_UAU.2/EMSCOMM)

94 Several authentication mechanisms are provided for the different available users:

1. Local users
2. EMSCOMM

95 This functionality implements FIA_UAU.5.

6.1.2. Access control

96 The Local access control policy is enforced in the following way:

1. The system sorts users with the same operation rights into a group to facilitate authorization and user management of the administrator. The TOE supports five predefined user groups (Administrator, Operator, User, Guest and Custom). The TOE grants default command group rights to Administrator, Operator, User and Guest which can’t be modified. (FMT_SMR.1). These roles are only applicable to the local users. The domain users are not maintained in the TOE, no role neither user group is assigned to a domain user. Also, the EMSCOMM user can not be assigned to any role. The custom user group means that the command groups are directly assigned to the user. The domain users are not maintained by the TOE, no role neither user group is assigned to a domain user.

2. The TOE divides the system commands to different groups which is called command groups according to different functions. 5G gNodeB creates 22 default command groups in which the commands are preconfigured and can’t be modified by user. And it provides 10 non-default command groups to which user adds or removes commands. (FDP_ACF.1/Local)

3. User groups are allowed to access one or more command groups. (FDP_ACF.1/Local)

4. The users that have a custom user group are directly related to the command groups accessible by them.

5. Therefore, a user has access to a command if its user group is associated with a command group that contains the command the user wants to access. (FDP_ACC.1/Local)

6. This access control policy is used to restrict the ability to modify the users and commands relationship. (FMT_MSA.1, FMT_MSA.3)

7. If the user is the admin special user, access is always granted regardless the command group.

97 To allow the customization of the product, ten configurable commands groups and one configurable user group exist. (FMT_SMF.1).

98 The domain access control policy allows users managed by the U2020 to execute commands in the TOE. The management of the security attributes of this access control policy is out of the scope of the TOE. Each time a domain user logs in the TOE, the TOE send the used user and password to the U2020 which performs user authentication and return to the user the commands that the user can execute. If the user belongs to the role Administrator group of the U2020, access to all functionality is always granted. (FDP_ACC.1/Domain, FDP_ACF.1/Domain).

99 The EMSCOMM users are built-in users that are used by the U2020 to operate the TOE. This user has permission to execute all the commands of the TOE and cannot be modified neither deleted. This user can only be implicitly accessed through the management interface. (FDP_ACC.1/EMSCOMM, FDP_ACF.1/EMSCOMM).

6.1.3. Auditing

100 Removing the logs is always forbidden (FAU_STG.1)

101 There are two kinds of audit files, the operation log and the security log.

1. Security log: Records user operations related to the system security, including user behaviour and configuration commands, for example, account locking due to consecutive login failure and updating the security policy

2. Operation log: Records several MML and BIN commands run by users.

102 For each of these two kinds of log files, the storage capacity is limited respectively. If the storage exceeds the limitation, the oldest file will be deleted. (FAU_STG.3)

103 The auditing functionality of the TOE cannot be started or stopped independently from the operational TOE. The TOE generates audit

records for the start and shutdown of base station, and for several auditable events, storing the audit data in the appropriate file (FAU_GEN.1)

104 Where available, the data recorded with each audit record includes the unique user ID associated with a subject during authentication. (FAU_GEN.2)

105 Users with the appropriate rights can review the audit records available in the database. The TOE offers search functionality based on time intervals, user IDs, interface, and/or result. (FAU_SAR.1, FAU_SAR.3)

6.1.4. Communications security

106 The TOE provides communication security for management and FTP networks connections:

- OMCH connections to the integrated ports (MML/BIN/ALARM) using SSL/TLS.
    - The SSL/TLS connection with the U2020 must include confidentiality, integrity and client authentication, this way, a trusted channel is established (FTP_ITC.1/IntegratedPort)
    - The SSL/TLS connection with the Local and Domain users must include integrity and confidentiality, this way, a secure channel is established (FCS_COP.1/SSL/TLS).
- The TOE includes a FTPS client which can establish secure connection with a FTP server. The connection parameters include the username and password and the IP address of the FTP server, which can be configured. SSL/TLS is used in this connection. (FCS_COP.1/SSL/TLS)

107 The following table shows the TLS cipher suites supported by the TOE:

Cipher suite	**TLS/1.2**
TLS_RSA_WITH_AES_256_CBC_SHA	**X**
TLS_RSA_WITH_AES_256_CBC_SHA256	**X**
TLS_DHE_RSA_WITH_AES_128_GCM_SHA256	**X**
TLS_DHE_RSA_WITH_AES_256_CBC_SHA	**X**
TLS_DHE_RSA_WITH_AES_256_CBC_SHA256	**X**
TLS_DHE_RSA_WITH_AES_256_GCM_SHA384	**X**
TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	**X**

TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384	X
TLS_RSA_WITH_AES_128_GCM_SHA256	X
TLS_RSA_WITH_AES_256_GCM_SHA384	X

Table 12 Supported SSL/TLS cipher suites

108 This functionality is implemented through FCS_COP.1/SSL/TLS and FCS_CKM.1/SSL/TLS.

109 This functionality is configurable. (FMT_SMF.1)

6.1.5. Uu-U interface Protection

110 5G gNodeB air interface channel refers to wireless channel between the gNodeB and UE. It uses NEA1 – based on SNOW 3G or NEA2– based on AES-128 or NEA3– based on ZUC cipher protection to prevent unauthorized access to communications content. (FCS_COP.1/Uu-U)

111 Keys are generated using the AKA protocol (FCS_CKM.1/Uu-U)

112 The cipher mode is configurable in the TOE by a set of management commands. (FMT_SMF.1)

6.1.6. Backhaul Interface Protection

113 The TOE provides secure communication protocols for the S1-U interface (only the segment between gNodeB and security gateway) and X2 interface, using IPSec/IKE. (FCS_COP.1/IPSEC)

114 The keys are generated according to the IPSec/IKEv2 protocol (FCS_CKM.1/IPSEC)

	IKEv2
RFC Document	RFC 4306
Protocol messages	4 messages for initial exchanges
Authentication type	Pre-shared key
SA negotiation	Responder's selection for initiator's proposal
Identity Hiding	Always
Perfect Forward Secrecy	Yes (optional)
Anti-Dos	Yes (optional)
Input of HASH	All messages
Reliability	Reliable
Backward compatibility	Yes
Remote address acquisition	CP payload

Encryption algorithm	AES-CBC-256
Authentication algorithm	HMAC-SHA1
Key Derivation function	PRF_HMAC_SHA1
Diffie-Hellman Group	Diffie-Hellman (DH) group 14

115 The TOE supports the following IPsec protocol functions

	IPsec
Protocol	ESP
Encapsulation mode	Tunnel mode
Encryption algorithm	AES-CBC-256
Integrity algorithm	HMAC-SHA1
Anti-replay	Yes

116 This functionality is configurable. (FMT_SMF.1)

6.1.7. Resource management

117 The TOE provides VLAN to separate the traffic from different flow planes, which reduce traffic storms and avoid resource overhead.

118 The TOE support VLAN division based on flows such as signalling flows, data flows, or management flows. In other words, different VLAN tags are marked on the three types of flows passing the BS and they are separate from each other.

119 The TOE supports IP-based and VLAN-based Access Control List (ACL) to filter traffic destined to TOE which might cause system overload and service interruption.

120 The ACL provides a simple security policy that controls the incoming and outgoing data of unauthorized users. The ACL determines what data is allowed to enter the transmission port and what data is not allowed to enter the transmission port. In this way, the ACL filters the illegitimate data.

121 The ACL controls the network access, preventing the network attacks. In addition, the ACL filters out illegitimate data flows, improving the network performance.

122 The ACL consists of multiple rules. Each VLAN-based rule contains 2 conditions: VLAN range and ACL Action. Each IP-based rule contains the following filtering conditions:

1. Protocol type (IP, ICMP, TCP, UDP, and SCTP)
2. Source IP address and mask

3. Source port range

4. Destination IP address and mask

5. Destination port range

6. Differentiated Services Code Point (DSCP) value

7. ACL Action (Deny, Permit)

123 The ACL rules can be pre-set in the S1-U/X2 network interfaces, and the ACL Action can be designated in advance. In this way, the communication flows can be permitted or denied, and the illegitimate data can be filtered. This method effectively prevents illegitimate intrusions and malicious packet attacks, ensuring the security of network devices. (FMT_SMF.1, FTA_TSE.1/SEP). The requirement FTA_TSE.1/SEP addresses the VLAN separation and VLAN/IP based ACLs to avoid resource overhead in the S1-U/X2 interface and in the management network.

124 If applicable, i.e., if an administrator has specified values for these parameters for a specific user, the TOE will deny authentication of the user if the user tries to authenticate in a timeframe that lies outside of the “login start time” and “login end time” specified for the user. (FMT_SMF.1, FTA_TSE.1/Local)

125 The TOE also provide login time control mechanism: Each account can be configured with the login time segment, including the valid date range, time segment, and week restriction. Any login is prohibited beyond the configured time segment. (FMT_SMF.1, FTA_TSE.1/Local). Only local users are taken into account in this requirement. The EMSCOMM user is not considered in this requirement. The EMSCOMM user is authenticated in the TOE by a password based challenge-response method. Domain users are authenticated in the U2020 element of the TOE environment, so they are not considered in this requirement neither by the TOE authentication functionality.

6.1.8. Security function management

126 The TOE offers management functionality for its security functions, where appropriate. This is partially already addressed in more detail in the previous sections of the TSS, but includes:

1. User management, including User Group memberships, passwords, account lockout, validity periods for an account and/or password, etc. For authentication failure handling values are configurable.

2. Access control management, including the definition of Command Groups, and the association of users and User Groups with Command Groups.

3. Configuration of SSL/TLS for the communication between U2020 and the TOE.

4. Configuration of IPSec for the communication between gNodeB and IKE Peer.

5. Configuration of VLAN for the different plane between the TOE environment and the TOE.

6. Configuration of ACL for the communication between the TOE environment and the TOE.

7. Configuration of the Air interface.

8. Authorized administrators are able to configure a system-wide password policy that is then enforced by the TOE. Besides the minimum length of the password, which can be set to be between 6 and 32 characters, administrator has the option to enforce the use of specific characters (numeric, alphanumeric low or capital, and special characters).

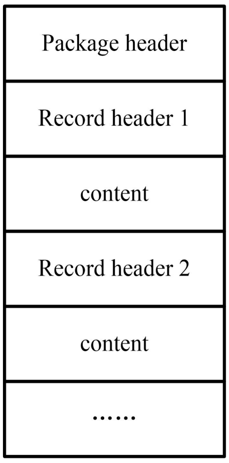
127 All these management options are available. (FMT_SMF.1)

6.1.9. Digital Signature

128 To address security issues, digital signature mechanism to ensure the legitimacy and integrity of the software packages are provided.

129 The TOE automatically checks the digital signature of the software when the user runs the ACT SOFTWARE command to active the software. This way exercise the digital signature mechanism implemented in the TOE (FCS_COP.1/Sign).

130 In the following image the CSP structure is depicted:



131 This way, a directory structure is stored in the CSP file. This structure is expected to contain some important files:

132 VERDES.SGN contains the signature of the VERDES.XML file. This way, the TOE will verify the signature stored in VERDES.SGN to ensure that the file VERDES.XML has not been tampered. And then hash and CRC value of each of the files will be verified by the TOE using the VERDES.XML file.

133 This way, the integrity chain is guaranteed.

7. Abbreviations, Terminology and References

7.1. Abbreviations

Abbreviations	Full Spelling
ACL	Access Control List
AKA	Authentication and Key Agreement
ASPF	Application Specific Packet Fi5GrFilter
BS	Base Station
BIN	Huawei's binary interface
CC	Common Criteria
CPBSP	Common Platform Board Support Package
CPRI	Common Public Radio Interface
DSCP	Differentiated Services Code Point
EMS/U2020	Element Management System(U2020)
ETH	Ethernet
FE	Fast Ethernet
FTP	File Transfer Protocol
FTPS	FTP-over-SSL/TLS
S1-U	User plane for S1 interface. In NSA mode, gNodeB only supports S1-U, not have S1 control plane link(S1-C) which is provided by the eNodeB
SCTP	Stream Control Transport Protocol
GE	Gigabit Ethernet
GSM	Global System for Mobile Communications
ICMP	Internet Control Message Protocol
IKE	Internet Key Exchange
IP	Internet Protocol
HERT	Huawei Enhanced Radio Technology
HERT -BBU	Huawei Enhanced Radio Technology-Base Band Unit

IPSec	IP Security Protocol
5G	Long term evolution
NE	Network Element
NMS	Network Management System
NSA	Non-Standalone,5G only support data related service, use 4G for non-data duties
NTP	The Network Time Protocol
MAC	Medium Access Control
MML	Man-Machine Language
MPT	Main Processing&Transmission unit
BBI	Base-Band Interface board
OAM (OM)	Operation Administration and Maintenance
OSS	Operations Support System
RRM	Radio Resource Management
SEC	Operator Security management
SFP	Small form-factor pluggable
SFR	Security Functional Requirement
SSL/TLS	Security Socket Layer
ST	Security Target
SWM	Software management
TCP	Transfer Control Protocol
TLS	Transport Layer Security
TOE	Target of Evaluation
TSF	TOE Security Functions
TR	Transfers Management
TRAN	Transport of Radio Access Network
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial BUS

Uu-U	User plane for 5G air interface
VISP	Versatile IP and Security Platform
VLAN	Virtual Local Area Network
VPP	Voice Protocol Platform

7.2. Terminology

134 This section contains definitions of technical terms that are used with a meaning specific to this document. Terms defined in the [CC] are not reiterated here, unless stated otherwise.

135 **Administrator or Admin**: A user of the TOE who may have been assigned specific administrative privileges within the TOE. This ST may use the term admin or administrator occasionally in an informal context for both cases the meaning is the same, and not in order to refer to a specific role definition – from the TOE's point of view, an administrator/admin is simply a user who is authorized to perform certain administrative actions on the TOE and the objects managed by the TOE.

136 **Operator:** See User.

137 **User:** A user is a human or a product/application using the TOE.

7.3. References

138 [CC] Common Criteria for Information Technology Security Evaluation. Part 1-3. April 2017. Version 3.1 Revision 5.

139 [CEM] Common Methodology for Information Technology Security Evaluation. April 2017. Version 3.1 Revision 5.