

NGA Telephony; Architecture & Requirements

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Foreword

This NICC Document (ND) has been produced by NICC the NICC Architecture & Requirements (A&R) working group.

Introduction

This document captures the architecture and requirements for NGA telephony.

1 Scope

The present document specifies the architecture and requirements to enable a communications provider (CP) to offer a telephony service to customers served by an active line access (ALA). The present document describes the features and capabilities that may be supported by the CP, but does not define the telephony service. The architecture assumes an active line access as specified in ND1644 [2].

The present document specifies the architecture and requirements for management, including test and diagnostics, of the NGA telephony service.

2 References

For the particular version of a document applicable to this release see [ND1610](#) [1].

2.1 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] ND1610 Next Generation Networks, Release Definition
- [2] ND1644 Architecture for Ethernet Active Line Access (ALA)
- [3] ND1646 NGA Telephony Management
- [4] ND1643 Minimum Security Requirements for Interconnecting Communication Providers
- [5] ND1031 Active Line Access: ALA UNI Specification
- [6] RFC3261 SIP: Session Initiation Protocol.
- [7] ETSI TS 124 229, IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP)
- [8] ND1633 Next Generation Networks; Element Naming Framework
- [9] IETF STD0013 : Domain names - implementation and specification

2.2 Informative references

- [i.1] ND1017 Interworking between Session Initiation Protocol (SIP) and UK ISDN User Part (UK ISUP)
- [i.2] ND1007 ISDN User Part (ISUP)
- [i.3] ND1027 UK BICC for use between PLMNs
- [i.4] ND1006 Interconnect User Part (IUP)
- [i.5] ITU-T Recommendation E.164 (02/2005) The international public telecommunication numbering plan
- [i.6] BS 6312-2.1:1994 Connectors for analogue telecommunication interfaces
- [i.7] ETSI TS 183 043 Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS - based PSTN/ISDN Emulation; Stage 3 specification

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Next generation access telephony: the delivery of voice services over a fibre access using a packet based transport and session based protocols.

Next Generation Access Telephony (NGA-T) Service Provider : The Communications Provider that provides telephony service to the end-user, utilising the facilities of the Access Provider.

Next Generation Access Telephony (NGA-T) Access Provider : The provider of the access network utilised for the provision of Next Generation Access Telephony.

Analogue Telephony Adapter (ATA): A function that hosts one or more analogue ports and provides the interworking between the analogue signalling and the session/signalling flows. It also provides the analogue speech to packetised media conversion. An analogue port is only associated with a single ATA function.

Residential Voice over IP Gateway (R-VGW): as defined in [i.7].

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3WC	Three-way conference
ALA	Active line access (Ofcom)
AS	Application server
ATA	Analogue telephony adapter
BICC	Bearer independent call control
CC	Credit control
CLI	Calling line identifier
COT	Customer originated trace
CP	Communication provider
CPE	Customer premises equipment
CS	Call server
IACB	Indirect access call barring
IC	Incoming call
IP	Internet Protocol
ISDN	Integrated services digital network
ISUP	ISDN user part of C7 signalling
IUP	Interconnect user part
LC	Loosely-coupled
LEA	Law enforcement agency
MCI	Malicious call indication
MWI	Message waiting indication
NGA	Next generation access
NGA-T	Next generation access telephony

NTE	Network Termination Equipment
OCB	Outgoing call barring
OG	Outgoing (call)
OLT	Optical line termination
ONT	Optical network termination
PLMN	Public land mobile network
POTS	Plain old telephony system
PSTN	Public switched telephone network
RBWF	Ring back when free
R-VGW	Residential Voice-over-IP Gateway
SDP	Session description protocol
SIP-I	Session initiation protocol with encapsulated ISUP
SMS	Short message service
TC	Tightly-coupled
UA	User agent
UE	User Equipment
UK	United Kingdom of Great Britain and Northern Ireland
UNI	User-network interface
VLAN	Virtual local area network

4 Overview and Requirements

4.1 General

NGA telephony is envisaged as a replacement for analogue telephony services delivered over copper loops and the objective is to provide a broadly similar set of services via an adapter. There is no mandated minimum set of services and specification of interfaces and protocol should not prevent the innovation of new services or the provision of service directly to an intelligent user agent.

This document provides the architecture and requirements for a User-Network Interface providing session-based telephony services.

The general requirements are:

- To provide PSTN-like services to a single user through session-based equipment;
- To support PSTN-like services to an analogue telephone connected to a session-based adaptation device;
- To support UK regulatory requirements by supporting extension of the User-Network Interface into another NGA-T Service Provider's network;
- To provide a high level of service interoperability with existing ISUP based networks (PSTN and PLMN based on UK ISUP, BICC and SIP-I);

The PSTN-like services are described by their features and capabilities in clause 4.2. A full and formal specification is not provided, the existing PSTN shall be used as the reference point. Identical service implementation (i.e. the same "look and feel" from the user perspective) is not required, only similar features/capabilities.

The functional requirements, based on a generalised architecture, are provided in clause 5.

4.2 Service Requirements

Support of the service features listed in table 1 and capability features listed in table 2 shall not be precluded.

NOTE: these service and capability features enable PSTN-like services. The services supported in any deployment are determined by the NGA-T Service Provider

Table 1 : Service Features

Title	Description
Anonymous Call Rejection	Enables subscribers to block calls from callers who have withheld their number. Bars incoming calls "withheld" CLI, but not "unavailable" CLI.
Call Diversion (Customer Controlled)	Ability to divert calls - Immediate diversion All Calls, Divert on No Answer, Divert on Busy
Call Diversion (Admin Controlled)	Ability to divert calls
Distinctive Ringing	Multiple telephone numbers, minimum of 2 & preferably 5, against each ATA port which when dialled result in distinctive cadence of ring current to be applied to the port and hence CPE associated with it
Call Waiting	Whilst already on a call customer notified of incoming call and can switch between
Caller Display	Present CLI to CPE connected to port on incoming call to telephone number associated with port
Caller Redirect	Where customer ceases service to take service elsewhere or has line renumbered then this feature can be used to refer callers to the new number
Calling Line Identity Withheld By Default	Withhold customer CLI from being presented by default on all calls that they make
Calling Line Identity Withheld By Default Override (Release Number On Per Call Basis)	Prefix to override permanent number withheld for this call only
Calling Line Identity Withheld Per Call (Withhold Number On Per Call Basis)	Prefix to withheld CLI for this call only
Linking of Feature, Facility & Stand Alone Codes	Codes can appear at the beginning of a telephone number, e.g. 1470 to restrict CLI on a per call basis.
Fixed Line Text	Send and Receive SMS from and to SMS enabled fixed phones
{IC} Call Barring (Admin Controlled)	Admin controlled barring of all incoming calls
Indirect Access Call Barring (IACB)	IACB is a network-based feature which rejects any outgoing call attempts by End Users keying indirect access codes
Route To Credit Control	Route to CC when customer attempts to make chargeable call and have exceeded their credit limit.
Last Caller Barring	Enables a customer to bar subsequent calls from the last incoming calling number. Users may also enter numbers into their personal store. Up to 10 barred numbers may be stored. Barred callers receive an announcement.
Last Caller Erasure	Enables a customer to erase the number of the last caller. This is a data protection requirement.
Last Caller Identity (Call Return)	Plays back time/date and number (if available) of last missed or answered call received (not busy calls). Honours CLI restriction and presentation number in the same way as CLI Display.
{OG} Call Barring (Admin Controlled)	Admin controlled barring of the customer's ability to originate outgoing calls, i.e. Bar All Calls, Bar International Calls, Bar Premium Calls, Bar Mobile Calls
{OG} Call Barring (Admin Controlled) (OCB Debt Management)	Admin controlled barring of the customer's ability to originate outgoing calls, i.e. Bar All Calls, Bar International Calls, Bar Premium Calls, Bar Mobile Calls
{OG} Call Barring (Customer Controlled)	Customer controlled barring of their ability to originate outgoing calls, i.e. Bar All Calls, Bar International Calls, Bar Premium Calls, Bar Mobile Calls
Reminder Call	Subscriber can arrange to receive a single reminder call
Ring Back (When Free)	Automatically calls back a previously dialled busy number when the called party becomes free, without the need for the calling party to redial.
Route to 15X	Route calls to 15X number to appropriate NGA-T Service Provider contact centre agents
Temporary Out of Service	Normal service removed, but retain the ability to make emergency calls
Three Way Calling	Allows for 3 parties to converse at the same time (conferencing) or swapping between parties. Options to independently terminate 2nd or 3rd party's call legs.
Standard Voice Mail	Divert to voicemail platform on no reply (pre-determined number of rings) and/or when busy is encountered. Provision of notification (e.g. stuttered dial tone) that a voice message is available to retrieve. Certain implementations may restrict the entity that can provide the notification
Voice Mail Plus	An end-user customised version of standard voicemail, includes the capability for the user to set the "no reply time" (e.g. number of rings). Certain implementations may restrict the entity that can provide the notification.
Hotline	When the subscriber goes off hook, a call will immediately be placed to a pre-configured destination.
Line Reversal on Answer	Reverses the polarity of the calling line (ATA port) when the called party answers.

Table 2 – Service Capabilities

Title	Description
Call Forward of Call Waited Calls	Calls are forwarded to Voice Mail if the call is not answered within a configurable number of seconds. This includes the called party not responding to the Call Waiting tones within the configurable number of seconds
Call Hold	Ability to place a POTS call on hold. Inherent to 3WC. By means of Flash Hook.
Customer Originated Trace (COT)	Customer receiving malicious calls has COT enabled on their line. After malicious call then dial short code which results in the details of the last call being logged at the AS for periodic retrieval and making available to the LEA Team. The malicious caller will not be aware their abuse call has been logged. Note that this approach does not necessitate the disabling of any supplementary service features provisioned against a line.
Malicious Caller Identify (MCI)	Customer receiving malicious calls has MCI enabled on their line. During malicious call they Flash Hook by pressing Recall and this results in the details of the call being logged at the AS for periodic retrieval and making available to the LEA Team. The malicious caller may or may not perceive the momentary click, resulting from the timed break. Note that this approach does necessitate the disabling of any supplementary service features provisioned against a line. These supplementary services would need to be restored following termination of MCI.
Emergency Services calls priority treatment	Trunk reservation. Priority routing applies to emergency traffic. Continuous retries on congestion, priority marking of calls desirable. Emergency calls are identified by digits dialed.
Howler	On receiver Off Hook for prescribed period without activity then apply graduated howler tone
Lawful Interception	Require capability under legal obligation
Message Waiting Indication	Signal voicemail waiting in customer's mailbox by applying Stutter Dial Tone to their line
Number Portability	Includes: 1) Port-out an owned number to another operator by adding a porting prefix for incoming calls and 2) Port-in a number from non-owned block and receive incoming calls containing a porting prefix.
Flash Processing	Required to facilitate other services which require mid call trigger, e.g. three party calling & call waiting, mid call trace, etc
Action in event of loss of important messages	Behaviour to restore SIP state machines to known state in the event of the loss of important messages. The loss of the BYE message and RE-ANSWER message is considered very serious.
Multiple Ringing Cadences	Multiple ringing cadences per ATA applicable to ring current. Minimum of 2 cadences, preferably at least 5.

4.3 Voice Quality Reporting

To monitor the quality and assist in fault location and detection, the telephony termination functional entity (see clause 5) may provide voice quality metrics on a per session basis. An NGA-T service provider is permitted to ignore or discard this information.

5. Functional requirements

5.1 Functional model

The functional model is shown in Figure 1.

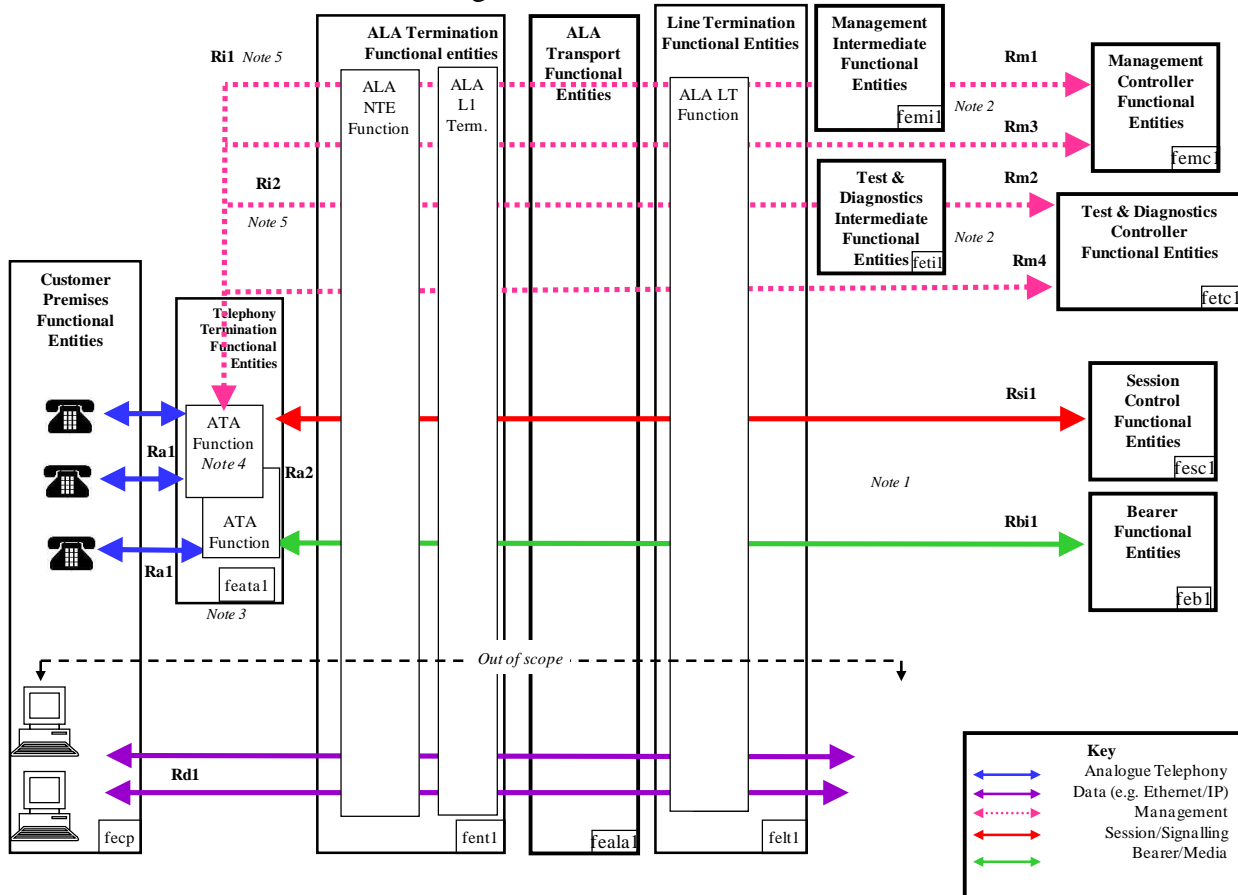


Figure 1 – NGA Telephony Overall Functional Model

Note 1: Reference Points Rsi1,Rbi1, Rm3 and Rm4 are provided over the ALA described in ND1644 [2].

Note 2: Supports Options A and B for ATA Management.

Note 3: Reference point Ra2 need not coincide with a physical interface (e.g. where feata1 and fent1 are realised as a single equipment) see Section 5.2.2.

Note 4: feata1 may contain one or more ATA functions. and in the example of this diagram has two, one having a single analogue port, the other having two.

Note 5: Ri1 and Ri2 are internal to the NGA-T Access Provider system and therefore out of scope of this document. They are included in Figure 1 for completeness only.

The functional model reflects both physical and logical functionality within an access system supporting an ALA with ONT and ATA functionality. The functional entities and some functions are described in the following clauses. Functional entities and functions significant to NGA telephony and the interconnect to a NGA-T Service Provider to provide a telephony service are described in more detail. Those functions and functional entities that are not significant, in that they do not affect the ability of a NGA-T Service Provider to provide a service to customers utilising an ATA, are merely summarised.

5.2 Functional entities

5.2.1 General

The network termination points for use by customers fall into two classes:

- a) Ra1 provides Telephony using BS6312-2 connectors [i.6]
- b) Ra2 provides Ethernet using connectors as prescribed by IEEE 802.3, i.e. IEC 60603-7 eight pin modular connectors. The range of electrical interfaces supported is described in ND1031[5]. In some implementations/deployments, Ra2 may not be made available as a physical interface (see Section 5.2.2).

5.2.2 Telephony Termination Functional Entities (feata1)

The Telephony Termination functional entities (feata1) terminate the session/signalling flow and provide bearer conversion between analogue telephony and digital media. These functional entities may either be combined with the same apparatus as the ALA termination functional entity grouping (fent1) or be provided by an externally connected device.

Where the Telephony Termination functional entities (feata1) are combined with fent1 into one physical equipment, the reference point Ra2 does not map to a physical interface (since it is an internal interface).

Where the Telephony Termination functional entities (feata1) are independent from the ALA termination, the telephony VLAN, see clause 5.2.4, will be presented as an ALA UNI (as specified in the ALA architecture [2]) at reference point Ra2, i.e. the ethernet connector described above

Note : a deployment could

- combine Feata1 with Fent1 into one physical box, or
- could have separate physical boxes implementing Feata1 and Fent1, or
- could have multiple instances of Feata1 with one or more Feata1 combined with Fent1, the remainder as separate physical boxes.

Annex 1 illustrates potential configurations.

An ATA function provides session and bearer control associated with one or more interfaces to analogue telephones.

- A UE behaves as described in [7] in so far as is necessary to provide NGA Telephony,
- Each UE controls a single analogue telephone interface
- Each UE is capable of independent registration,
- Each ATA function embodies one or more UEs
- References to UA, UAC or UAS [6] are to the relevant roles played by a UE.

The degree of independence of ATA function instances, other than SIP behaviour, may be restricted by an implementation (e.g. shared management interface).

The NGA-T access provider may also support the management and Test & Diagnostics extended to an external feata1 (via Rm1 and Rm2 or Rm3 and Rm4).

For the purposes of this document, the interactions with an independent feata1 shall be assumed to be the same as the interactions when feata1 is combined with a fent1. Feata1 functional entity may be realised as a R-VGW (as defined in [i.7]).

5.2.3 Customer premises functional entities (fecp)

For the purposes of this document, the customer premises functional entities (fecp) are considered to provide the same functionality as existing equipment that can be connected to the existing UK PSTN using an analogue telephony connector (BS6312-2).

5.2.4 ALA Functional Entities Grouping

The ALA functional entities provide the transport and terminating functionality for line and network.

Within the group of entities, the Network Termination functional entities (fent1) terminate the ALA. The Telephony VLAN shall carry the session and media flows and, depending upon the implementation, the management flows. The Telephony VLAN shall be provided by an ALA AUC supporting class A as specified in ND1644 [2]. A single AUC shall carry NGA-T flows for all voice ports supported by the ATA function.

The requirements for the ALA portion of fent1 shall be as defined in ND1644 [2].

5.2.5 Session control and bearer functional entities (fecp)

Fesc1 and Feb1 terminate the session control and the bearer in the NGA-T service provider's network. There are no requirements on these functional entities, which may be realised using any or all of session controllers, border gateways, call servers, media gateways. The requirements in the present document are concerned with enabling these functional entities to interact with the telephony termination functional entities (feata1) to provide a telephony service.

6 Interworking requirements

The service features and service capabilities described in clause 4.2 shall be interoperable with the same feature/capability provided in the existing PSTN, PLMN and PSTN/PLMN-like networks. This is expected to require protocol interworking.

Note: To simplify the UK standards, it is expected that any interworking should be defined once, and may be achieved implicitly using concatenation of existing interworking specifications. Thus, if UK standards for interworking describe SIP to SIP-I and SIP-I to BICC, then interworking SIP to BICC should be considered as covered, and a separate interworking specification may not be required.

NGA Telephony shall interwork to at least:

- SIP-I [i.1];
- UK ISUP [i.2];
- BICC [i.3].

Additionally, regulated service features and capabilities shall interwork to IUP [i.4].

7 Naming and addressing requirements

IP addresses for conveyance of information across reference points R_{m3} , R_{m4} , R_{si1} and R_{bi1} shall be assigned by the NGA-T Service Provider. The ATA Function shall support both dynamic and static provisioning of IP addresses.

The SIP URI naming scheme should conform to ND1633 [8], using the format:

<network internal part>.<local application ID>.<provider>.<NGN root domain>

The NICC specified *<local application ID>* shall be “nga-t”.

The *<network element identifier>* comprises *<network internal part>.<local application ID>*. The *<network element identifier>* shall identify the particular Session Control Functional Entity within the NGA-T Service Provider’s network and is allocated by the NGA-T Service Provider. The *<network element identifier>* may contain a series of labels, separated by dots.

Where a naming scheme other than that specified in ND1633 [8] is used, it shall be compliant with STD0013 [9] and shall comply with the permissible characters described in Section 4.2.1 and overall length described in Section 4.2.2 of ND1633 [8].

8 Management requirements

Two options are envisaged for managing the ATA function.

- Option A: the NGA-T service provider manages their ATA function(s) using the management intermediate function entities (femi1);
- Option B: the NGA-T service provider manages their ATA function(s) without using the management intermediate function entities (femi1).

An independent feata1 may be managed, in principle, using either of the options above. Use of shared or direct management of an independent feata1 is implementation dependent, where supported at all.

Further requirements for NGA telephony management shall be as specified in [3].

9 Test & diagnostics requirements

The requirements for NGA telephony test and diagnostics shall be as specified in [3].

10 Security requirements

- 1) The NGA-T service provider and the access provider must assume that the fent1/feata1 may have been compromised (e.g. running code chosen by the customer or other attacker) and

thereby attackers can gain access to any security credentials and other features / services embedded in the device.

- 2) The access provider must maintain the link between the physical location and the customer's identity (telephone number). If the optical network constrains this identity to one tail, then the maximum number of tails must be less than 129.
- 3) The NGA-T service provider must use DHCP option 82 to issue IP addresses based on the OLT port or equivalent. This IP address information must be used by the session control functional entity to tie physical location with device identity. The NGA-T service provider must prevent a user configuring an IP address manually.
- 4) The access provider must ensure that each ATA function delivers traffic over an individual vLAN to the NGA-T service provider so that they can identify the physical location of the ATA/ONT device and the telephone within the constraints described in para 2 above.
- 5) The access provider must prevent code running on the `featl`/`feata1` from sending traffic to unauthorised destinations¹. The network must, therefore, prevent packets from being forwarded anywhere except the call server and the management servers of the NGA-T service provider and access provider respectively. **Note:** Given that the `featl` and `feata1` may be a single device, and more protocols may need to be supported, this list of destinations may be dynamic.
- 6) The access and NGA-T service providers must prevent the `featl` and `feata1` from sending traffic to any device except through a network core.
- 7) The access and NGA-T service providers must prevent the R-VGW from sending traffic to another R-VGW's management interfaces.
- 8) The NGA-T service provider must monitor the network to detect illegal, irregular or damaged SIP messages being transmitted from an ONT / ATA device(s). The NGA-T service provider must make provision for shutting down / disconnecting such devices in an appropriate and timely manner.
- 9) The NGA-T service provider must authenticate any management protocol including SSH, TFTP, SNMP (and any local logon). The service provider must use both:
 - (i) a unique (per device) password and
 - (ii) the IP address of the management server to prevent unauthorised access.
 The password must make use of the maximum length available on each type of device and must be randomly generated using at least [A-Z, a-z and 0-9] and created using a well designed algorithm [see: <http://csrc.nist.gov/groups/ST/toolkit/rng/index.html> and Annex C of FIPS140-2]. This must be shared with the access provider for the initial configuration of the R-VGW. The access provider must not use this for any other purpose.
- 10) The NGA-T service provider must have the ability to change the password in the event that it has been compromised.
- 11) The manufacturers of the ONT/ATA devices covered by his standard must include access management software capable of processing a minimum of a 13 character password and meet the provisions of paras 9 and 10 above.
- 12) The NGA-T service provider must implement monitoring to authenticate ATA functions from a single vLAN. In the event of a monitoring alert the NGA-T service provider must log it and take appropriate and timely action.
- 13) The NGA-T service provider must prevent simultaneous or sequential attempts to authenticate from subsequent locations (within the constraints described in para 2). The NGA-T service provider must log these attempts and process in accordance with para 12.
- 14) The access provider must ensure that the NGA-T service provider has the ability to check the integrity of the code and configuration running on the R-VGW.

¹ An unauthorised destination is a destination not explicitly and mutually authorised by the NGA-T service and access providers

- 15) The NGA-T service provider must make provision for unique access and rights to upgrade the code on the ONT / ATA devices easily and in a timely manner to respond to security vulnerabilities. Adequate network infrastructure (architecture / servers etc.) for performing code upgrade functionality (for security and other purposes) on all connected ONT / ATA devices must be included in the implementation by the access provider (e.g. as shown in Fig.1).
- 16) The NGA-T service provider must design and implement the network to ensure that only their server(s) are permitted to send traffic to the ONT / ATA for management purposes (as shown in Fig. 1).
- 17) Access and NGA-T service providers must ensure that the use of encryption, TLS and SRTP shall not be precluded in future releases.
- 18) The NGA-T service provider must protect their management systems to prevent another service provider modifying their services either deliberately or accidentally.
- 19) Access and NGA-T service providers must ensure that the management protocols on the ATA (e.g. the SNMP server) are not accessible on any non-management interfaces of the ATA (e.g. internet interfaces, data interfaces etc.). The access provider must prevent anyone from sending packets to the IP stack of the ATA / ONT from anywhere other than the CP / NGA access provider's servers.

Annex A (Informative)

NGA Telephony AUC configurations

The figure below shows possible configurations of ALA User Connections (AUCs) for NGA-T.

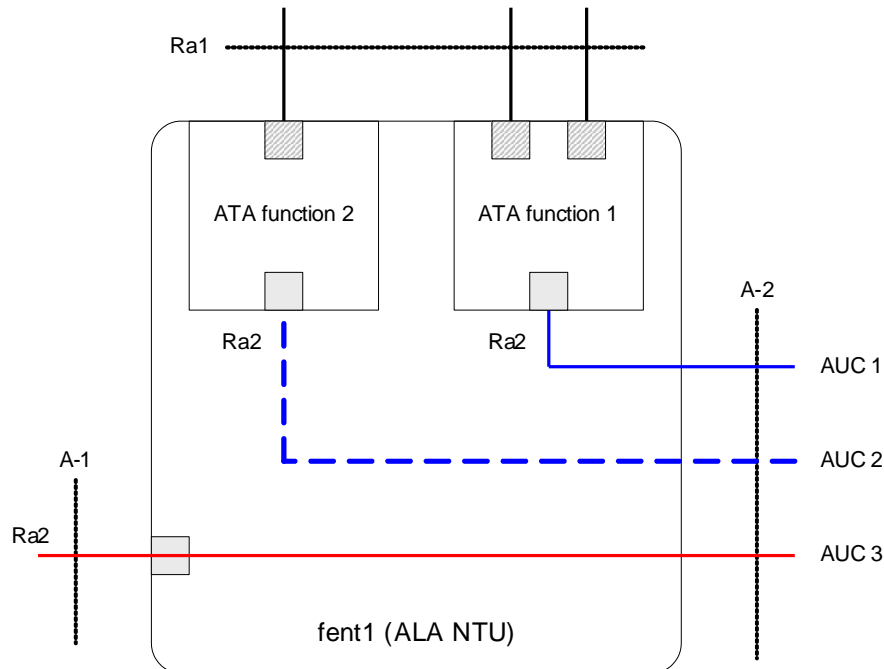


Figure 2 – NGA Telephony AUC configurations

AUC 1 and AUC 2 show the case where the AUC terminates at an internal ATA function.

AUC 3 terminates at an ALA UNI, to which an feata1 must be directly connected.

Support of NGA-T requires only one of AUC 1, AUC 2 or AUC 3 to be present, but concurrent support of the configurations is not precluded.

History

Document history		
<Version>	<Date>	<Milestone>
1.1.1	April 2011	Initial publication
1.1.2	June 2011	Correction of error in pdf process that caused diagram in Annex A to be corrupted
1.1.3	August 2023	Republished to correct OLT and ONT in the Abbreviations section