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Next Generation Protocols (NGP); Next Generation Protocol Requirements

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Reference

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Contents

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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Next Generation Protocols (NGP).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The scope of the present document is to specify the minimum set of key requirements for the Next Generation Protocols (NGP), Industry Specific Group (ISG).

The present document addresses requirements in the following areas:

- Business Case and Techno-Economics
- Migration
- General Technical Requirements
- Addressing
- Security
- Mobility
- Multi-Access Support (including FMC)
- Context Awareness
- Performance (including Content Enablement)
- Network Virtualisation
- IoT Support
- Energy Efficiency
- e-Commerce
- MEC
- Mission Critical Services
- Drones and Autonomous Vehicles and Connected Vehicles
- Ultra Reliable Low Latency Communications

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI GS NGP 001: "Next Generation Protocol (NGP); Scenario Definitions".

NOTE: ETSI NGP references are available at http://www.etsi.org/deliver/etsi_gs/NGP/.

[2] ETSI TS 122 280: "Technical Specification Group Services and System Aspects; Mission Critical Services Common Requirements (MCCoRe); Stage 1".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] 3GPP TR 23.799: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on Architecture for Next Generation System".

[i.2] ETSI TR 121 905: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Vocabulary for 3GPP Specifications (3GPP TR 21.905)".

[i.3] 3GPP TR 22.862: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Feasibility Study on New Services and Markets Technology Enablers for Critical Communications; Stage 1".

NOTE: ETSI standards are available at http://www.etsi.org/standards.

[i.4] Recommendation ITU-R M.2083-0: "Framework and overall objectives of the future development of IMT for 2020 and beyond".

[i.5] ETSI GS NFV 001: "Network Functions Virtualisation (NFV); Use Cases".

[i.6] 3GPP TR 37.868: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on RAN Improvements for Machine-type Communications".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions applying to scenarios that include mobile network architectures given in ETSI GS NGP 001 [1], ETSI TR 121 905 [i.2] and 3GPP TR 23.799 [i.1] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GS NGP 001 [1], ETSI TR 121 905 [i.2] and the following apply.

AN Access Network
FPGA Field Programmable Gate Array
GGC General Group Communications
IC Integrated Circuit
IOC Information Object Class
LTE Long Term Evolution

NOTE: Cellular standard.

MCS Mission Critical Services

MEC Mobile Edge Computing

NOTE: ETSI, ISG specified.

MPS Multimedia Priority Service
NFV Network Function Virtualisation
NGP Next Generation Protocol
NG-UE Next Generation User Equipment

NOTE: Beyond LTE.

NIC Network Interface Card
PGW PDN Gateway

NOTE: In LTE system.

SDN Software Defined Networking
SGSDS Smart Grid System with Distributed Sensors
SGW Serving Gateway

NOTE: In LTE system.

SPC Substation Protection and Control
TFT Traffic Flow Template

NOTE: E.g. as defined for 3GPP LTE.

UE User Equipment for LTE
URLLC Ultra Reliable Low Latency Communications
VM Virtual Machine

4 Overview

The Next Generation Protocols (NGP), ISG aims to review the future landscape of Internet Protocols, identify and document future requirements and trigger follow up activities to drive a vision of a considerably more efficient Internet that is far more attentive to user demand and more responsive whether towards humans, machines or things.

ETSI GS NGP 001 [1], Scenarios Descriptions specification, lists the key agreed networking and internetworking issues for multi-access communications at present and provides examples of current scenarios where these issues are exemplified. ETSI GS NGP 001 [1] further provides recommendations, on a per issue basis, targeted at applicable next generation SDOs: ITU-T, IEEE, IETF and 3GPP in their consideration of future networking and internetworking protocol architecture definitions.

The present document progresses the requirements decomposition process one further stage to define key requirements for NGP.

The present document provides key general NGP requirements, in clause 5 and NGP issue specific requirements, in clause 6.

5 General Requirements

5.1 Business Case

[**Gen-BC-01**] The NGP architecture shall be 25 % more energy efficient across end-user devices, servers, fixed transmission and access technologies and wireless and/or cellular access technologies as compared to existing IPv4/v6 protocol based architectures.

NOTE 1: This performance measure should be based on network wide measurements and devices connecting with reference access technologies current at the time of specification as follows: LTE-A, Rel-12, Wi-Fi™ 802.11ac and Ethernet 100 Mbit/s FE.

[**Gen-BC-02**] The NGP architecture shall be 30 % more spectrally efficient when transporting NGP across the access technology as compared to transporting existing IPv4/v6 protocol based architectures and considering all over-air impacting facets.

[**Gen-BC-03**] The NGP architecture shall be at least 25 % more header efficient than existing IPv4/v6 protocol based architectures.

[**Gen-BC-04**] The NGP architecture shall be at least 10 % more bitwise efficient per packet than existing IPv4/v6 protocol based architectures for the same application transport.

NOTE 2: The scope of Gen-BC-02x requirements is from the UE or NG-UE to the edge of Operator Domain connecting to the Internet or other external PDN.

NOTE 3: Gen-BC-02(x) performance measures should be based on reference radio-based access technologies current at the time of specification as follows: LTE-A, Rel-12, Wi-Fi™ 802.11ac.

[**Gen-BC-05**] The NGP architecture shall be able to be cost effectively implemented into existing user device operating systems with no additional processor or memory requirements, as compared to IPv4/6 implementations.

NOTE 4: Current key user device, operating systems should include Android™, iOS® and Windows®.

[**Gen-BC-06**] The NGP architecture shall be able to be cost effectively implemented into existing user server operating systems with no additional processor or memory requirements, as compared to IPv4/6 implementations.

NOTE 5: Current key server operating systems should include Linux® variants and Windows®.

[**Gen-BC-07**] The NGP architecture shall be able to be cost effectively implemented into network interface software and hardware, with no additional processor or memory requirements. as compared to IPV4/6 implementations.

NOTE 6: Current implementations should include: Custom Integrated Circuits (IC), Field Programmable Gate Array (FPGA) technology solutions and software defined, Network Interface Cards (NIC).

5.2 Migration

[**Gen-Mig-01**] The NGP architecture shall be able to provide peer to peer communications between a next generation access communications device and the edge of that access network or networks with no increase in setup delay as compared to existing IPv4/v6 protocol based architectures, for the issues described in ETSI ETSI ETSI GS NFV 001 [i.5] and when operating over LTE-A, Rel-12 access technology.

NOTE 1: An access communications device may include an evolved 3GPP UE, server or IoT device and the access network may include millimetric radio, cellular, wireless and/or fixed connectivity.

NOTE 2: Access efficiency in this context may be: spectrum efficiency, bitwise efficiency, or byte efficiency of the protocol.

[**Gen-Mig-02**] The NGP architecture shall be able to interwork to the existing IPv4 and IPv6 protocol.

[**Gen-Mig-03**] The NGP architecture shall be able to support transmission of the 3GPP TR 23.799 [i.1] defined interfaces: NG1, NG2, NG3 NG4 and NG6, interfaces at layer 3.

5.3 Technical

[**Gen-Tech-01**] NGP shall support multi-level mutual authentication between peers.

NOTE 1: Authentication is operated between peer entities.

NOTE 2. Authentication among applications only involves the applications, not NGP.

NOTE 3: Authentication within NGP is among the entities supporting NGP itself.

NOTE 4: NGP should require the authentication of all members of a given layer.

[**Gen-Tech-02**] NGP shall not allow third parties (other than those authorized by law, such as national security agencies) to discover the identity of entities that are communicating with each other.

[**Gen-Tech-03**] NGP shall provide stakeholder based confidentiality for user data.

[**Gen-Tech-04**] NGP shall provide stakeholder based confidentiality for protocol control.

NOTE 5: For Gen-Tech-03x: A stakeholder would typically include N x communicating peers.

NOTE 6: For Gen-Tech-03x: A stakeholder agreement could optionally include an N+1 party as well as the peers (e.g. Operator and/or Lawful Intercept party.

6 Issue Specific Requirements

6.1 Addressing

[**Iss-Addr-01**] In a multi-access and multi-layer, context aware NGP environment future protocols should address ID and Addressing aspects separately.

NOTE 1: For example Network Communications Protocol Address, Usage IDs, Session/Service-IDs and Application Naming are distinctly operated.

[**Iss-Addr-02**] Application-ID shall not change during mobility and multi-homing link state changes.

NOTE 2: This requirement is essential in order to maintain application instances during mobility.

NOTE 3: See NGP definition of 'Application Process' and 'Identity' in ETSI GS NGP 001[1].

[**Iss-Addr-03**] NGP should minimize addressing updates in future protocols for mobility and multi-homing. During mobility events, addressing may change but should be minimized.

[**Iss-Addr-04**] NGP addressing should support at least the following communication models: client-client, client-server (push and/or pull) and server-server models and multi-protocol versions thereof.

[**Iss-Addr-05**] NGP should be designed to minimize multi-address mappings.

NOTE 4: For example the inefficiencies associated with extensive use of NAT today including: NFV implementations, Device-to-Device capabilities (D2D), etc.

[**Iss-Addr-06**] NGP shall minimize the use of "well-known" ports.

[**Iss-Addr-07**] NGP shall include an addressing strategy that scales.

NOTE 5: This means that an addressing scheme that includes every entity on the planet does not need to include the full address length in the packet header all of the time for local communication, but has to accommodate the case for an entity to address another entity on the other side of the world when required.

Table 1 captures a set of KPIs that can be used to compare the merits of different addressing schemes.

Table 1: KPIs for Assessment of Addressing Requirements

KPI Name	Description	Related to requirements	Measured feature	Units	Example Values for IPv4 (CIDR)
Scalability of address space	Measures how many different entities can be uniquely addressed	[**Iss-Addr-07**]	Address space size	Integer value	2^32
Address encoding efficiency	Measures how many bits on the wire are required to encode the address information	[**Iss-Addr-07**]	Header overhead due to addressing	Integer value	Always 32
Aggregation capabilities	Measures how well address assignment follows the underlying "network topology" in order to facilitate aggregation	[**Iss-Addr-07**]	Size of forwarding tables in routers as a function of addressed entities in the network	Order of magnitude O(f(x)), where x is # of addressed entities	Up to 32 levels of addressing hierarchy. Forwarding efficiency depends on allocation policy
Identity decoupled from addressing	Checks if applications can be assigned independent identifiers which are loosely coupled to network addresses (via directories/mapping systems).	[**Iss-Addr-01**] [**Iss-Addr-02**]	Application identity separated from network addressing	Binary value	False
Cost of mobility	Measures the overhead of supporting mobility as the extra state required in the network due to mobility events	[**Iss-Addr-03**]	Extra entries in forwarding tables per mobility event	Order of magnitude O(f(x)), where x is # of mobility events	Depends on mobility management protocol in use, usually requires setup of tunnels per mobility event

6.2 Security

[**Iss-Sec-01**] NGP should decouple data transfer and layer management (also known as control plane) protocols from security functions (authentication, key agreement, access control, integrity verification, encryption) except where this would defeat other NGP security requirements. NGP should provide clear integration points for each type of security function.

NOTE 1: It is anticipated that the decoupling described in Iss-Sec-01 will facilitate rather than defeat most other security requirements.

[**Iss-Sec-02**] NGP shall adopt data transfer protocols that decouple port-id from connection-endpoint-id.

[**Iss-Sec-03**] NGP shall not use well-known ports.

[**Iss-Sec-04**] Applications should protect the confidentiality and integrity of their communication.

NOTE 2: Most security experts agree that the best encryption architecture should operate between peer applications.

NOTE 3: Operating peer application encryption greatly reduces the security problem for the network to primarily authenticating members of some layers, and protecting against traffic analysis at higher communication layers.

[**Iss-Sec-05**] Each protocol layer should offer an API that allows the layer above to request the properties of the network service it wants (bound on packet loss and delay, in-order delivery of data, etc.).

NOTE 4: NGP assumes that each layer and/ or the protocols in each layer should take the necessary security measures to protect their data without relying on the lower layer.

NOTE 5: This is to avoid making network service requirements implicit (as today) and having the network layers have to do DPI or similar to infer application requirements (which becomes very hard or infeasible if the application uses end-to-end encryption).