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Technical Specification

Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS/NGN Performance Benchmark Part 3: Traffic Sets and Traffic Profiles



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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

The present document is part 3 of a multi-part deliverable covering the IMS/NGN Performance Benchmark, as identified below:

- Part 1: "Core Concepts";
- Part 2: "Subsystem Configurations and Benchmarks".
- Part 3: "Traffic Sets and Traffic Profiles".**

Introduction

TS 186 008-1 [1] provides a general introduction to the environment in which the benchmark exists.

TS 186 008-2 [2] documents the subsystem configurations, use-cases and design objectives corresponding to them.

The present document defines an initial benchmark tests through definitions of traffics sets and traffic profiles.

1 Scope

The present document is for an initial, revision 1.0, release of an IMS/TISPAN NGN performance benchmark. The metrics measured and reported are for performance of this subsystem under a communications application load.

The benchmark is defined for the IMS network as a whole, as well as for several subsystems of an IMS network. The benchmark is designed so that nodes composing a subsystem can also be benchmarked alone.

This multi-part deliverable consists of three parts. TS 186 008-1 [1] contains overall benchmark descriptions, architectures, processes, and information models that are common to all specific benchmarking scenarios. Part 1 of this document has no attachments. TS 186 008-2 [2] contains the IMS and ETSI TISPAN SUT subsystem configurations, the specific benchmarking use-cases and scenarios, along with scenario specific metrics and design objectives. It also defines the SUT configuration parameters. The present document defines an initial benchmark test through the specification of a traffic set, traffic-time profile, and benchmark test procedure.

The initial benchmark test data defined in the present document include:

- Traffic set.
- Traffic-time profile.
- Benchmark test procedure.

It is expected that the present document will be updated as service providers refine their use of the benchmark and their deployment of IMS and ETSI TISPAN networks.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
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NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present 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] ETSI TS 186 008-1: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS/NGN Performance Benchmark Part 1: Core Concepts".
- [2] ETSI TS 186 008-2: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS/NGN Performance Benchmark Part 2: Subsystem Configurations and Benchmarks".

3 Definitions and abbreviations

3.1 Definitions

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

arrival distribution: function describing the probability distribution of the interarrival time of events (e.g. messages)

Attempts Per Second (APS): rate at which scenarios are executed. Depending on the scenario, the actual implementation might be RAPS, Registration Attempts Per Second, or CAPS, Call Attempts Per Second

background load: workload applied to an SUT during a benchmark test, for the purpose of consuming SUT resources during a benchmark test and changing the traffic intensity at which the capacity of the SUT is reached

benchmark log: data file containing measurements of SUT performance collected during the execution of a test procedure

benchmark report: documented generated at the conclusion of a test procedure containing the metrics measured during the execution of the test and/or computed from the data collected in the benchmark log

benchmark test: apcedure by which a test system interacts with a System Under Test to measure its behavior and produce a benchmark report

configuration: specification of a subset of IMS architectural elements and metrics for which collection of benchmark tests can be defined

design objective: probabilistic model of delay and failure requirements for an SUT, associated with a use-case. It is specified by threshold values and probabilities for delay and scenario failure

Design Objective Capacity (DOC): largest load an SUT can sustain while not exceeding design objectives defined for a use-case

DOC overload: condition, or part of a load profile, in which the system load exceeds the DOC

DOC underload: condition, or part of a load profile, in which the system load does not exceed the DOC

duration distribution: function (e.g. Poisson) describing the probability distribution of the duration of an event (e.g. a call)

inadequately handled scenario attempt: scenario attempt which either fails or which exceeds the threshold values defined for the use case of which the scenario attempt is an instantiation

maximum capacity: smallest scenario arrival rate at which the successful scenario rate cannot be increased

metric: performance measurement of an SUT reported in a benchmark report

parameter: attribute of an SUT, test system, system load, or traffic set whose value is set externally and prior to a benchmark test, and whose value affects the behavior of the benchmark test

percent registered subscribers: parameter specifying the percent of subscribers with records in the HSS/UPSF that are active during the benchmark test

percent roaming subscribers: parameter specifying the percent of active subscribers who are roaming

preamble: phase at the beginning of a test procedure during which initialization of the test system and System Under Test is performed

protocol diagram: diagram depicting a collection of architectural elements as vertical lines, and protocol interactions between the elements as directed lines between architectural elements, where the vertical order in which the directed lines appear indicate time sequence

recovery capacity: when a traffic-time profile describes a scenario arrival rate starting at a value greater than maximum capacity and monotonically decreasing, the maximum value at which design objectives for the use-case in effect are no longer exceeded

SAPS increase amount: increment by which the average SAPS changes between steps of a profile. Equivalent to system load increase amount

scenario: specific path through a use-case, including the sequence of messages exchanged by all agents, and (when meaningful) a scenario duration distribution (e.g. the duration of a call)

EXAMPLE: An example of a scenario is "simple call - succeeded".

scenario attempt: event of a scenario being initiated by the test system and handled by the SUT

scenario attempts per second: average number of scenarios that are instantiated by the test system per second

scenario arrival distribution: probability distribution that governs the arrival times of scenarios during a test phase

scenario duration distribution: probability distribution that governs the duration of an individual scenario

scenario percent of system load: relative frequency of an individual scenario within a system load

simultaneous scenarios: number of scenarios that the test system may allow a single UE to perform simultaneously

step number: for a profile consisting of a sequence of steps, the number of steps

step time: length of time, in a profile consisting of a sequence of steps, at which the average scenario arrival rate remains at the same value

step transient time: parameter representing the time interval, measured from the beginning of a step, for which counts of scenario attempts and inadequately handled scenario attempts are not kept

stir time: parameter representing a period of time in the preamble of a benchmark test in which a system load is run in order to allow initial transient conditions attenuate to an insignificant level

subscriber base: information elements that describe simulated users

system load: stream of protocol interactions presented to the SUT by the test system

system load increase amount: increment by which the average SAPS changes between steps of a profile. Equivalent to SAPS increase amount

System Under Test (SUT): collection of hardware and software whose performance is measured by the benchmark test

test parameters: parameters whose values determine the behavior of a benchmark test

test procedure: specification of the steps to be performed by a benchmark test

test scenario: specific path through a use-case, whose implementation by a test system creates a system load

test system: collection of hardware and software which presents a system load to a System Under Test and collects data on the System Under Test's performance, from which metrics can be computed

total provisioned subscribers: number of simulated subscribers with records in the HSS/UPSF

traffic-time profile: evolution of the average scenario arrival rate over time. It is specified by a scenario arrival distribution and a function of average scenario arrival rate as a function of time

traffic set: mixture of scenarios whose proportional contributions to traffic are fixed

use-case: specification of a type of interaction between a test system and a system under test, corresponding to a mode of end-user behavior

NOTE: A use-case is a collection of scenarios.

EXAMPLE: An example of a use-case is "simple call", which may contain scenarios "simple call - succeeded", "simple call - no answer", and others.

user behavioral model: model that defines the number and rate at which an individual user of an IMS system makes scenario attempts

3.2 Abbreviations

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

%IHS	Percent Inadequately Handled Scenarios
3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project-2
APS	Attempts Per Second
AS	Application Server
ATCA	Advanced Telecom Computing Architecture
BGCF	Border Gateway Control Function
CDMA	Code Division Multiple Access
CSCF	Call Session Control Function
DO	Design Objective
DOC	Design Objective Capacity
GSM	Global System for Mobile communication
HSS	Home Subscriber Server
IBCF	Interconnection Border Control Function
I-BGF	Interconnect-Border Gateway Function
I-CSCF	Interrogating-CSCF
IHSA	Inadequately Handled Scenario Attempt
IMS	IP Multimedia Subsystem
ISDN	Integrated Services Digital Network
IWF:	Inter-Working Function
JAIN	Java API for Integrated Networks
LAN	Local Area Network
MEM	MEMory usage
MRFC	Media Resource Function Controller
MRFP	Media Resource Function Processor
NGN	Next Generation Networks
OMG	Object Management Group
PCI	Peripheral Component Interconnect
P-CSCF	Proxy-CSCF
PSTN	Public Switched Telecommunications Network
QoS	Quality of Service
SBC	Session Border Control
S-CSCF	Serving CSCF
SGF	Serving Gateway Function
SIMS	SIMultaneous Sessions (per user)
SLF	Subscriber Location Function
SUT	System Under Test
TEM	Telecommunications Equipment Manufacturer
TISPAN	Telecommunications and Internet convergence Services for Advanced Networking
T-MGF	Trunk Media Gateway Function
TRT	Total Round-trip Time
UE	User Equipment

SIPP Simple Internet Protocol Plus
UPSF User Profile Server Function

4 Benchmark tests

TS 186 008-1 [1] and TS 186 008-2 [2] have defined the framework for defining and executing an IMS/NGN performance benchmark. The present document specifies a benchmark test, which may be implemented and performed as-is, or which may serve as an example for future benchmark tests developed by a service provider or SUT implementor. As experience with deployed IMS/NGN systems and with this benchmark is developed, additional benchmark tests will be added to future releases of this multi-part deliverable.

4.1 Benchmark test goals

A benchmark test may be used either for comparison (e.g. comparing the performance of two products), or for prediction (e.g. the configuration specified for a benchmark test is similar enough to a service provider's requirements that the result of the test can be used as an estimate of the performance of their deployed system).

In order to accomplish these goals, a suite of benchmark tests must cover a range of scenarios that are representative of the real world. Given the early nature of the IMS/NGN deployments, the data required to construct these scenarios is still in the process of being collected. For that reason, the benchmark test described here is more useful for prediction than for comparison.

It is expected that the benchmark test specified in this part of the standard will have to be supplemented by additional benchmark tests that follow the framework of the standard, but which are parameterized differently.

Additionally, while the primary metric collected by this benchmark test is the Design Objective Capacity (DOC) of the SUT, as experience is gained both with IMS/NGN deployments and with this benchmark, additional metrics will be defined.

4.2 Initial benchmark traffic set and traffic-time profile

As described in detail in TS 186 008-1 [1], a benchmark test measures the behavior of an SUT for a specified traffic set and traffic-time profile. A traffic set is composed of a mixture of test scenarios, whose relative frequency of occurrence is specified by traffic set parameters; the traffic-time profile is a specification of how the average arrival rate of test scenarios evolves over the execution of the benchmark test.

Tables 1 and 2 represent an educated assessment on the part of the release 1 benchmark authors of a generic IMS/NGN traffic set and profile covering the three major use-cases defined in TS 186 008-2 [2], clause 3.

In the execution of the test, test scenario types are randomly selected according to the frequencies listed in the table. Thereafter, users are randomly selected from the database of subscribed users, and the information associated with them is used to fill the fields of the messages generated by the test system.

In future releases of this multi-part deliverable, a user behavioral model may be specified, and the procedure for selecting a user and a test scenario type may be changed. This topic is discussed in TS 186 008-1 [1].

Table 1: Initial benchmark traffic set

Use Case Section	Test Scenario	Scenario ID	Type	Scenario % of System Load	Scenario Arrival Distribution	Scenario Duration Distribution (calls), message size (text messaging)
TS 186 008-2 [2], clause 5.1: Registration/ De-registration Use-Case	TS 186 008-2 [2], clause 5.1.2.1: Scenario 1 - Successful Initial Registration without Synchronization	PX_S1_1	float	1 %	Poisson, mean selected by traffic-time profile	
	TS 186 008-2 [2], clause 5.1.2.2: Scenario 2 - Successful Initial Registration with Synchronization	PX_S1_2	float	0 %		
	TS 186 008-2 [2], clause 5.1.2.3: Scenario 3 - Re-Registration - User Currently Registered	PX_S1_3	float	1 %	Poisson, mean selected by traffic-time profile	
	TS 186 008-2 [2], clause 5.1.2.4: Scenario 4 - Re-Subscription - User Currently Registered	PX_S1_4	float	0 %		
	TS 186 008-2 [2], clause 5.1.2.5: Scenario 5 - Re-Registration - User Roaming	PX_S1_5	float	0 %		
	TS 186 008-2 [2], clause 5.1.2.6: Scenario 6 - UE Initiated De-Registration	PX_S1_6	float	1 %		
	TS 186 008-2 [2], clause 5.1.2.7: Scenario 7 - Network Initiated De-Registration	PX_S1_7	float	0 %		
	TS 186 008-2 [2], clause 5.1.2.8: Scenario 8 - Network initiated de-registration upon roaming or expiration	PX_S1_8	float	0 %		
	TS 186 008-2 [2], clause 5.1.2.9: Scenario 9 - Network initiated re-authentication	PX_S1_9	float	0 %		

Use Case Section	Test Scenario	Scenario ID	Type	Scenario % of System Load	Scenario Arrival Distribution	Scenario Duration Distribution (calls), message size (text messaging)
TS 186 008-2 [2], clause 5.2: Session Set-Up/ Tear-Down Use-Case PX_	TS 186 008-2 [2], clause 5.2.2.1: Scenario 1 - Successful Call - Resource reservation on both sides	PX_S2_1	float	12 %	Poisson, mean selected by traffic-time profile	Exponential, mean 120 s
	TS 186 008-2 [2], clause 5.2.2.2: Scenario 2 - Successful Call - No resource reservation on originating side	PX_S2_2	float	12 %	Poisson, mean selected by traffic-time profile	Exponential, mean 120 s
	TS 186 008-2 [2], clause 5.2.2.3: Scenario 3 - Successful Call - No resource reservation on the terminating side	PX_S2_3	float	12 %	Poisson, mean selected by traffic-time profile	Exponential, mean 120 s
	TS 186 008-2 [2], clause 5.2.2.4: Scenario 4 - Successful Call - No resource reservation on either side	PX_S2_4	float	12 %	Poisson, mean selected by traffic-time profile	Exponential, mean 120 s
	TS 186 008-2 [2], clause 5.2.2.5: Scenario 5 - Successful Call - Resource reservation on originating side and non-IMS terminating side	PX_S2_5	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.6: Scenario 6 - Successful Call - No resource reservation on originating side and non-IMS terminating side	PX_S2_6	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.7: Scenario 7 - Successful Call - Originating side non-IMS and resource reservation on terminating side	PX_S2_7	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.8: Scenario 8 - Successful Call - Originating side non-IMS and no resource reservation on terminating side	PX_S2_8	float	0 %		

Use Case Section	Test Scenario	Scenario ID	Type	Scenario % of System Load	Scenario Arrival Distribution	Scenario Duration Distribution (calls), message size (text messaging)
	TS 186 008-2 [2], clause 5.2.2.9: Scenario 9 - Abandoned Call - Resource reservation on both sides	PX_S2_9	float	3 %	Poisson, mean selected by traffic-time profile	Exponential, mean 15 s
	TS 186 008-2 [2], clause 5.2.2.10: Scenario 10 - Abandoned Call - No resource reservation on originating side	PX_S2_10	float	3 %	Poisson, mean selected by traffic-time profile	Exponential, mean 15 s
	TS 186 008-2 [2], clause 5.2.2.11: Scenario 11 - Abandoned Call - No resource reservation on terminating side	PX_S2_11	float	3 %	Poisson, mean selected by traffic-time profile	Exponential, mean 15 s
	TS 186 008-2 [2], clause 5.2.2.12: Scenario 12 - Abandoned Call - No resource reservation on either side	PX_S2_12	float	3 %	Poisson, mean selected by traffic-time profile	Exponential, mean 15 s
	TS 186 008-2 [2], clause 5.2.2.13: Scenario 13 - Abandoned Call - Resource reservation on originating side and non-IMS terminating side	PX_S2_13	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.14: Scenario 14 - Abandoned Call - No resource reservation on originating side and non-IMS terminating side	PX_S2_14	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.15: Scenario 15 - Abandoned Call - Originating side non-IMS and resource reservation on terminating side	PX_S2_15	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.16: Scenario 16 - Abandoned Call - Originating side non-IMS and no resource reservation on terminating side	PX_S2_16	float	0 %		

Use Case Section	Test Scenario	Scenario ID	Type	Scenario % of System Load	Scenario Arrival Distribution	Scenario Duration Distribution (calls), message size (text messaging)
	TS 186 008-2 [2], clause 5.2.2.17: Scenario 17 - Rejected Call - Resource reservation on both sides	PX_S2_17	float	3 %		
	TS 186 008-2 [2], clause 5.2.2.18: Scenario 18 - Rejected Call - No resource reservation on originating side	PX_S2_18	float	3 %		
	TS 186 008-2 [2], clause 5.2.2.19: Scenario 19 - Rejected Call - No resource reservation on terminating side	PX_S2_19	float	3 %		
	TS 186 008-2 [2], clause 5.2.2.20: Scenario 20 - Rejected Call - No resource reservation on either side	PX_S2_20	float	3 %		
	TS 186 008-2 [2], clause 5.2.2.21: Scenario 21 - Rejected Call - Resource reservation on originating side and non-IMS terminating user	PX_S2_21	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.22: Scenario 22 - Rejected Call - No resource reservation on originating side and non-IMS terminating side	PX_S2_22	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.23: Scenario 23 - Rejected Call - Originating side non-IMS and resource reservation on terminating side	PX_S2_23	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.24: Scenario 24 - Rejected Call - Originating side non-IMS and no resource reservation on terminating side	PX_S2_24	float	0 %		
	TS 186 008-2 [2], clause 5.2.2.25: Scenario 25 - Failed Call	PX_S2_25	float	1 %	Poisson, mean selected by traffic-time profile	

Use Case Section	Test Scenario	Scenario ID	Type	Scenario % of System Load	Scenario Arrival Distribution	Scenario Duration Distribution (calls), message size (text messaging)
TS 186 008-2 [2], clause 5.3: Page-mode Messaging Use-Case	TS 186 008-2 [2], clause 5.3.2.1: Scenario 1 - Successful Message Exchange	PX_S3_1	float	19 %	Poisson, mean selected by traffic-time profile	message size uniform [0 to 140] characters
	TS 186 008-2 [2], clause 5.3.2.2: Scenario 2 - Unsuccessful Message Exchange - Called User Not Found	PX_S3_2	float	5 %	Poisson, mean selected by traffic-time profile	message size uniform [0 to 140] characters

Table 2: Initial benchmark traffic-time profile

Traffic-time profile Parameter	Traffic-time profile Value	Notes
PX_SimultaneousScenarios (SIMS)	2	Maximum per UE
PX_TotalProvisionedSubscribers	100,000 Subs	Data in Part 2
PX_PercentRegisteredSubscribers	40 %	At test start. The percent of registered subscribers will fluctuate during the test
PX_PercentRoamingSubscribers	None	No roaming in Release 1
PX_StepNumber	3 steps	DOC underload, DOC, and DOC overload
PX_StepTransientTime	120 seconds	Maximum
PX_StepTime	30 minutes	Minimum
PX_BackgroundLoad	None	
PX_SApSIncreaseAmount	10 SApS	Maximum Report three results, step before, DOC and step after
PX_SystemLoad	DOC	Reported result in Scenario Attempts Per Second
PX_IHS % InAdequately Handle Scenario Attempts Maximum (IHS)	0,1 %	Average over a test step

4.3 Initial benchmark test implementation

The specification does not dictate the specific implementation of a test scenario. The test scenarios are defined in TS 186 008-2 [2] as protocol diagrams. These scenarios are implemented by either a commercial test system provider or as part of a benchmark test run. Example implementations include using the ETSI TTCN3 notation, using an XML notation (e.g. based on the open source SIPP), or specifically coding the test in a general programming language. For comparison (and ultimately certification) purposes, a specification of the test system used to implement the traffic-time profile, and documentation of the test scenario implementation in the test system with sufficient detail to be independently replicated, shall be included as part of the report.

4.3.1 SUT Configuration

The initial benchmark supports a Session Control Subsystem SUT configuration as defined in TS 186 008-2 [2] clause 4. Release 1 does not specify reliability or availability requirements. The availability architecture and design objective target of the SUT should be described in the test report.

4.3.2 Preamble

The preamble defines the steps necessary to configure the SUT for a benchmark run. The following steps must be completed before the initial benchmark test run.

- 1) The SUT must be started from a cold boot.
- 2) "Total Provisioned Subscribers" must be provisioned in the database.
- 3) The initial "Percent Registered Subscribers" must be setup.

4.3.3 Test Execution

The initial benchmark test must contain *StepNumber* stair steps in the profile.

The test execution is valid if the profile has steps in the DOC underload range and at least one step in the DOC overload range.

4.3.4 Graphs

The following graphs shall be plotted in the benchmark report:

- Scenario success rate:
 - X-Axis: time (s).
 - Y-Axis 1: Scenario Attempts Per Second for the traffic set.
 - Y-Axis 2: Percentage of Inadequately Handled Scenario Attempts.
- Scenario average transaction response time {for each identified scenario in the traffic set}:
 - X-Axis: time (s).
 - Y-Axis 1: Scenario Attempts Per Second for the individual scenario.
 - Y-Axis 2: For each TRT design objective in the identified scenario, SUM of the TRT for a second divided by the SApS for the second.
- Scenario Retransmissions {for each identified scenario in the traffic set that has retransmissions}:
 - X-Axis: time (s).
 - Y-Axis 1: Scenario Attempts Per Second.
 - Y-Axis 2: Number of retransmissions in a second for that scenario.
- CPU {on each of SUT node}:
 - X-Axis: time (s).
 - Y-Axis 1: Scenario Attempts Per Second.
 - Y-Axis 2: CPU.
- MEM {on each of SUT node}:
 - X-Axis: time (s).
 - Y-Axis 1: Scenario Attempts Per Second.
 - Y-Axis 2: MEM.

Annex A (informative): Bibliography

ETSI ES 282 007 (V1.1.1): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS); Functional architecture".

IETF RFC 3310 (September 2002): "Hypertext Transfer Protocol (HTTP) Digest Authentication Using Authentication and Key Agreement (AKA)".

IETF RFC 3840 (August 2004): "Indicating User Agent Capabilities in the Session Initialization Protocol (SIP)".

ETSI TR 121 905: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Vocabulary for 3GPP Specifications (3GPP TR 21.905 version 7.0.0 Release 7)".

ETSI TS 183 041 (V1.1.1): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Messaging service using the IP Multimedia (IM) Core Network (CN) subsystem; Stage 3: Protocol specifications [Endorsement of 3GPP TS 24.247 Release 6]".

ETSI TS 123 228: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); IP Multimedia Subsystem (IMS); Stage 2 (3GPP TS 23.228 Release 6)".

ETSI TS 124 247: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Messaging service using the IP Multimedia (IM) Core Network (CN) subsystem; Stage 3 (3GPP TS 24.247)".

History

Document history		
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