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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Control load quantum for decomposed gateways

ITU-T H-series Recommendations – Supplement 6

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Supplement 6 to ITU-T H-series Recommendations

Control load quantum for decomposed gateways

Summary

This Supplement defines a baseline for control load metrics for H.248 systems with focus on performance engineering parameters relevant for control processing in H.248 network nodes, on correspondent performance design objectives relevant for H.248 network nodes, and on examples of traffic models.

Source

Supplement 6 to ITU-T H-series Recommendations was agreed on 13 April 2006 by ITU-T Study Group 16 (2005-2008).

Keywords

H.248, load control, NGN, performance, traffic model.

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Supplement 6 to ITU-T H-series Recommendations

Control load quantum for decomposed gateways

1 Paradigm shift – Motivation

The successful control load quantum in traditional circuit-switched networks (CSN): *Busy Hour Call Attempts* (BHCA), for a time unit 'hour', respectively denoted as *Call Attempts per Second* (CAPS), for a time unit 'second', as well as the corresponding control performance quantum *Busy Hour Call Completions* (BHCC), respectively denoted as *Call Completions per Second* (CCPS), are misleading in H.248 network nodes.

NOTE 1 – "Traditional" refers to the call definition and control load understanding according to ITU-T Rec. Q.543 [4], the control performance framework for digital switching systems. See also ITU-T Rec. Y.1530 [5].

An H.248-based packet-switched network (PSN) is (1) architecturally different in comparison to legacy CSNs, particularly in the following three principal aspects:

- *decomposed control structure* into H.248 MGC and H.248 MG, whereby the main vertical control processing portion is part of the 'controller';
- *server* approach, by centralizing the distributed control of many legacy switching systems into a few number of session control servers; and
- the typical *1:N relation* with regard to the MGC-to-MG ratio.

It is obvious that any reuse of legacy terminology requires a careful handling and common understanding.

NOTE 2 – The reuse of 'BHCA', 'CAPS', etc., is possible in H.248 environments, particularly in the scope of PSTN/N-ISDN service emulation. But it is not recommended, particularly due to potential misunderstandings and the PSTN/ISDN extending scope of H.248.

Additionally, the architectural motivation for the network is based on a technical incentive that requires a "BHCA mapping" on H.248 network nodes: implying that a knowledge of (2) load control and overload protection mechanisms is a prerequisite for understanding the underlying control load quantum. For example, the H.248.11 *Overload Control Package* defines a tight cooperation principle between a MGC and associated MGs; H.248.11 applies the same principles to load quantification.

(3) A third aspect concerns relating the pure Packet-to-Packet (Pa2Pa) MG application with session control protocols at a MGC level, i.e., without the presence of a direct *call* relationship (e.g., 3GPP IP Multimedia Subsystem – IMS).

1.1 Purpose

This Supplement introduces BHC_oA (Busy Hour Context Attempts) as a baseline control load metrics for H.248 systems, and defines a control load quantum based on a basic H.248 context. It includes the definition of performance engineering parameters relevant for control processing in H.248 network nodes and the definition of performance design objectives relevant for H.248 network nodes. This Supplement also provides examples of processing capacity calculations.

1.2 Scope and initial objectives

The objectives of the current edition are:

- identification of the need for an extended performance engineering framework in the context of decomposed control platforms;
- introduction of new terminology (such as BHC_oA, BHSA, effective multiplication factor);

- initial definition of a control processing model;
- initial definition of H.248 Context-based performance classes; and
- basic relations of load and performance parameters according to the defined performance framework.

The initial scope is to achieve consensus on a qualitative basis, the natural next step would be then to commence quantitative performance investigations.

1.3 Linearity assumption

Linearity is assumed. Also, first-order traffic engineering calculations frequently use linearization approximations, particularly in the context of control load estimations (like BHC_aA)¹.

2 References

- [1] ITU-T Q-series Suppl. 31 (2000), *Technical Report TRQ.2141.0: Signalling requirements for the support of narrow-band services over broadband transport technologies – Capability Set 2 (CS-2)*.
- [2] *ITU-T Vocabulary: SANCHO Database* (ITU-T Sector Abbreviations and Definitions for a Telecommunications Thesaurus Oriented database), <http://www.itu.int/sancho>.
- [3] ITU-T Recommendation E.600 (1993), *Terms and definitions of traffic engineering*.
- [4] ITU-T Recommendation Q.543 (1993), *Digital exchange performance design objectives*.
- [5] ITU-T Recommendation Y.1530 (2004), *Call processing performance for voice service in hybrid IP networks*.
- [6] VILLAR (J.E.): Traffic Calculations in SPC Systems, *8th ITC*, November 1976.
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- [8] ITU-T Recommendation E.500 (1998), *Traffic intensity measurement principles*.
- [9] ITU-T Recommendation E.501 (1997), *Estimation of traffic offered in the network*.
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- [13] ITU-T Recommendation E.529 (1997), *Network dimensioning using end-to-end GOS objectives*.
- [14] ITU-T Recommendation E.711 (1992), *User demand modelling*.
- [15] *Generic Requirements for Voice over Packet End-to-End Performance*. Telcordia GR-3059-CORE (March 2000).
- [16] *Switching System Overload Control Generic Requirements*. Telcordia TR-NWT-001358, (September 1993).
- [17] *LSSGR: Traffic Capacity and Environment*. Telcordia GR-517-CORE (December 1998).

¹ For example, [6]: The assumption of a *linear relationship* between processor *occupancy* and offered load (BHCA) holds well in *steady-state, fault-free* conditions with a *constant call-type distribution*, up to the designed occupancy level for overload capacity.

- [18] ETSI TR 182 015, *Architecture for control of processing overload in next generation networks*.

3 Terminology and definitions

3.1 Session versus Call

The telecommunication network specific term "call" is often translated to the term "session" for packet-switched connectionless networks (e.g., Internet). The notion of a *session* is also fundamental to IP-based NGN architectures. A **session** extends the traditional notion of a **call** in telecommunication networks. An "H.248 session/call" and the associated creation of an "H.248 Context" is typically triggered by a specific *Call Control Protocol* (e.g., SS7 TUP, SS7 ISUP, BICC, DSS1, H.225/H.245, etc.), or a *Session Control Protocol* (e.g., SIP, SIP-I, SIP-T, NGN-SCP) events. The differentiation between a "call" and a "session" is transparent and is actually not too relevant from an H.248 perspective. Both may be used interchangeably from the Gateway Control Protocol point of view. The key control association is fundamentally the H.248 Context.

NOTE 1 – ITU-T Rec. E.600 [3] defines the individual terms "call", "call attempt", and "busy hour", primarily in the context of BHC_aA (Busy Hour Call Attempts). See also the ITU-T terms and definitions database [2].

NOTE 2 – SIP uses the notions of "call", "session" and "dialog" in different aspects (see IETF documents).

In order to avoid confusion with the legacy BHCA definition, it is recommended that the terms "BHSA" and "BHC_oA" be used in the context of H.248 network nodes. That is the reason why the term 'Session' is continuously used in this Supplement.

3.2 General definitions

3.2.1 session/call: 'Session' or 'Call' is a generic term related to the creation, modification and deletion of an H.248 Context (in a MG). Normally, a qualifier is necessary to make clear the aspect being considered, e.g., session attempt. This definition is aligned with ITU-T Rec. E.600 [3].

3.2.2 session/call attempt: 'Session/Call Attempt' is an attempt to achieve the creation of one or more new H.248 Context(s) in the MG. This definition is aligned with ITU-T Rec. E.600 [3].

3.2.3 load: 'Load' means the total number of the various types of attempts presented to a MGC (e.g., a Call attempt from a PSTN terminal or a Session attempt from a SIP user agent) or a MG (e.g., a Context Attempt by the primary MGC) during a given interval of time (i.e., offered load). This definition is aligned with the performance objectives of ITU-T Rec. Q.543 [4].

3.2.4 session load: See Figure 1.

3.2.5 context load: MG Context Load; see Figure 1.

3.2.6 processor: 'Processor' denotes the logical entity responsible for all control processing work. The technical realization may be very different, from a single CPU to multi-processor systems, in any form of cluster organization (e.g., distributed, hierarchical, load and/or functional sharing modes, etc.).

These definitions are illustrated in Figure 1.

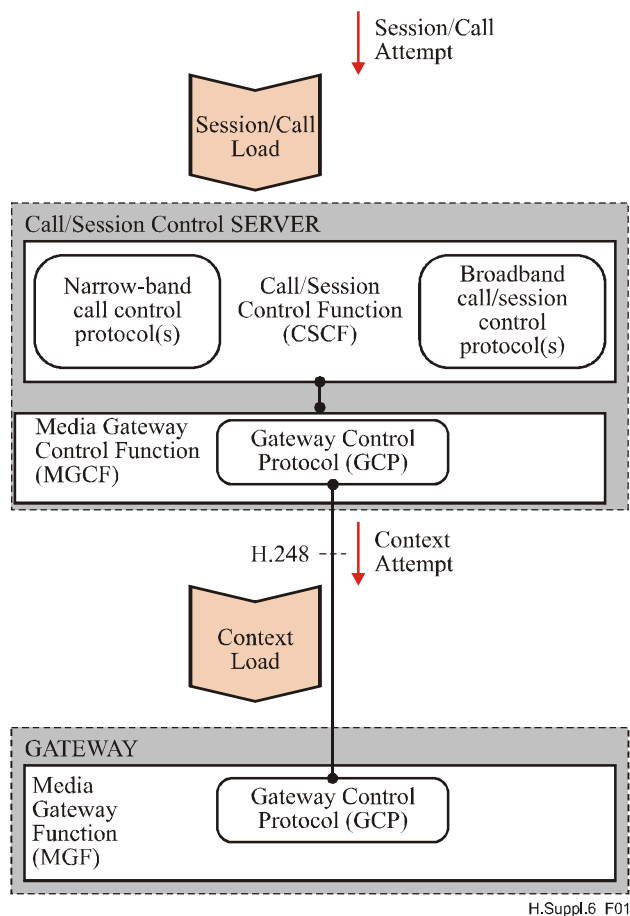


Figure 1 – "Context Attempts" and generated "Context Load"

3.3 BHxA-related definitions

The following table provides a list of generic, BHxA-related load parameters, and corresponding technology-specific example parameters.

BHC _a A BHC _{Q.543} A (shorthand: BHCA)	Busy Hour Call Attempts NOTE – 'call' = PSTN or N-ISDN call according to ITU-T Rec. Q.543.
BHC _b A BHC _{Q.19XX} A	Busy Hour Bearer Connection Attempts NOTE – 'bearer connection' = connection controlled by ITU-T Rec. Q.19XX BICC CS1, CS2, CS3 Bearer Control Function (BCF).
BHC _o A BHC _{H.248} A	Busy Hour Context Attempts NOTE – 'context' = ITU-T Rec. H.248 Context.

BHC _o A _{MG}	<p>Busy Hour Context Attempts on Media Gateway level</p> <p>NOTE – 'context' = Media Gateway Context for either one of the following H.248-based MG types:</p> <ul style="list-style-type: none"> – IETF RFC 3525/ITU-T Rec. H.248.1 Media Gateway (MG); – ITU-T Rec. Q.1950 Bearer Interworking Function (BIWF) or Media Gateway Unit (MGU)^{a)}; – 3GPP 29.232 Circuit-Switched Media Gateway Function (CS-MGW); – 3GPP 29.332 IP Multimedia Media Gateway Function (IM-MGW); – ITU-T "SG 11" Packet Gateway Function (PGF); – ITU-T Rec. J.171.2 Media Gateway (MG)^{b)}.
BHC _o A _{MGC}	<p>Busy Hour Context Attempts on Media Gateway Controller level</p> <p>NOTE – 'context' = Media Gateway Controller Context for either one of following H.248-based MGC types:</p> <ul style="list-style-type: none"> – IETF RFC 3525/ITU-T Rec. H.248.1 Media Gateway Controller (MGC); – ITU-T Rec. Q.1950 Call Service Function (CSF); – 3GPP 29.232 Mobile Switching Centre Server (MSC Server)^{c)}; – 3GPP 29.332 Media Gateway Control Function (MGCF); – ITU-T "SG 11" Packet Gateway Control Function (PGCF); – ITU-T Rec. J.171.2 Media Gateway Controller (MGC).
BHSA	Busy Hour Session Attempts
BHS _{SIP} A BHSA _{RFC3261,SIP}	<p>Busy Hour Session Attempts</p> <p>NOTE – 'session' = according to IETF RFC 3261 Session Initiation Protocol.</p>
BHS _{SCP} A BHSA _{NGN-SCP}	<p>Busy Hour Session Attempts</p> <p>NOTE – 'session' = according to Draft ITU-T TRQ.ncapx <i>NGN Session Control Protocol requirements</i>.</p>
BHS _{SIP} A BHSA _{3GPP,SIP}	<p>Busy Hour Session Attempts</p> <p>NOTE – 'session' = according to 3GPP 24.229 IP Multimedia Call Control Protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP).</p>
<p>a) See TRQ.2141.0 Annex C.</p> <p>b) Reference: ITU-T Rec. J.171.2, <i>IPcablecom Trunking Gateway Control Protocol (TGCP)</i>; <i>TGCP Profile 2</i>, November 2005. The "TGCP Profile 2" is based on ITU-T Rec. H.248, and entitled "TGCP_H248".</p> <p>c) E.g., Serving MSC Server, Gateway MSC Server.</p> <p>NOTE – The difference between Busy Hour Context Attempts on MG level BHC_oA_{MG} and MGC level BHC_oA_{MGC} is illustrated in Figure 10.</p>	

The corresponding performance, BHxC-related definitions are appropriate.

Finally, a technical BHxA-related load parameter is provided which is useful for performance considerations on the MG level:

BHC _{h,DSP} A	<p>Busy Hour Channel Attempts</p> <p>NOTE – 'channel' = general resource component type "media conversion unit" (MCU) within a MG; a technical realization for a MCU is a "DSP channel"^{a)}. Note that a "DSP Channel" is the intra-system segment of a user plane connection (e.g., bearer channel) related with a DSP component.</p>
<p>^{a)} Channel in this sense is the basic "capacity unit" for a digital signal processor in H.248 MG systems. NOTE – The term "mean value" is understood to be the expected value in the probabilistic sense.</p>	

4 Abbreviations

This supplement uses the following abbreviations:

ALN	Analog Line (H.248 Termination physical type)
BHC _a A	Busy Hour Call Attempts
BHC _b A	Busy Hour Bearer Connection Attempts
BHC _h A	Busy Hour Channel Attempts (NOTE – e.g., DSP Channel)
BHC _o A	Busy Hour Context Attempts
BHC _o A _{MG}	Busy Hour Context Attempts (H.248 Context on MG level)
BHC _o A _{MGC}	Busy Hour Context Attempts (H.248 Context on MGC level)
BHSA	Busy Hour Session Attempts
BHSC	Busy Hour Session Completions
BICC	Bearer Independent Call Control
C	H.248 Context
C2C	Circuit-to-circuit (see 5.2.4)
C2P	Circuit-to-packet (see 5.2.2)
C2X	C2X denotes either a C2C or a C2P Session variant
C _a APS	Call Attempts per Second
C _a CPS, CCPS	Call Completions per Second
C _a HT, CHT	Call Holding Time
C _o APS	Context Attempts per Second
C _o CPS	Context Completions per Second
C _o HT	Context Holding Time
CP	Context Processor (H.248)
	Control Path (System)
CSCF	Call/Session Control Function
CSN	Circuit-Switched Network (ITU-T Recs H.246, H.332, Y.1001)
DSP	Digital Signal Processor (general)
e	Extension Factor (see 10.1)

FAS	Facility Associated Signalling
GCP	Gateway Control Protocol
IUA	ISDN Q.921 User Adaptation Layer (ITU-T Rec. Q.921, RFC 4233)
MCU	Media Conversion Unit
MEGACOP	Media Gateway Control Protocol (= H.248)
MG	Media Gateway
MGC	Media Gateway Controller
MGCG	Media Gateway Control Function
MGF	Media Gateway Function
MSC	Mobile Switching Centre
NGN	Next-Generation Network
Pa2Pa	Packet-to-Packet
Pe2Pe	Peer-to-Peer
	NOTE – The abbreviation "P2P" could cause confusion as to whether meaning "peer-to-peer" or "packet-to-packet" and will therefore be avoided in this Supplement.
PSN	Packet-Switched Network
r	Reduction Factor (see 10.2)
SAPS	Session Attempts per Second
SCN	Switched-Circuit Network (ITU-T Rec. H.247) Switched Communication Network (ITU-T Rec. G.177) Signalling Communication Network (ITU-T Rec. G.7712/Y.1703) NOTE – "SCN" and "CSN" denote the same thing in the context of H.248 network nodes. In this Supplement, only the abbreviation "CSN" shall be used, due to the ambiguousness of the abbreviation "SCN".
SCP	Session Control Protocol
SCPS	Session Completions per Second
SG	Signalling Gateway
SHT	Session Holding Time
SIP	Session Initiation Protocol
SP	Session Processor
STM	Synchronous Transfer Mode
TDM	Time Division Multiplexing NOTE – H.248 Termination for <i>Synchronous Transfer Mode</i> (STM) interfaces, i.e., TDM is used to abbreviated <i>Synchronous Time Division Multiplexing</i> (STDM) [but not <i>Asynchronous TDM</i> (ATDM)].

4.1 Mathematical symbols

λ	Arrival rate	$[s^{-1}]$	Mean arrival rate of service requests ^{a)}
λ_{CoAPS}	MGC "Context Attempt" rate	$[s^{-1}]$	Mean "Context Attempt" rate generated by a MGC for a MG
μ	Service rate	$[s^{-1}]$	Mean service rate of the processing entity ^{b)}
$\mu_{Context}$	Context Service rate	$[s^{-1}]$	Mean service rate per H.248 Context
ρ	Utilization		Mean occupancy of a processing entity
ρ_{CcC}	Utilization factor		Mean occupancy of a processing entity by completing H.248 Contexts
ρ_{CcR}	Utilization factor		Mean occupancy of a processing entity by rejecting H.248 Contexts
ϕ	Throughput rate	$[s^{-1}]$	Mean throughput rate of served requests
$\phi_{Context}$	Throughput rate	$[s^{-1}]$	Mean effective H.248 Context throughput rate
ϕ_{CoBPS}, ϕ_{CoB}	Context Blocking rate	$[s^{-1}]$	Mean rate of blocked H.248 Contexts
ϕ_{CoCPS}, ϕ_{CoC}	Context Completion rate	$[s^{-1}]$	Mean rate of completed H.248 Contexts
ϕ_{CoRPS}, ϕ_{CoR}	Context Rejection rate	$[s^{-1}]$	Mean rate of rejected H.248 Contexts
$h_{Co}, h_{Context}$	Service time	$[s]$	Mean service time per H.248 Context
h_{CoC}	Service time	$[s]$	Mean service time per completed H.248 Context
h_{CoR}	Service time	$[s]$	Mean service time per rejected H.248 Context
A	Offered load	$[Erl]$	
A_{CP}	Offered load	$[Erl]$	Mean offered load per Context Processor
B	Blocking probability		
Y	Carried traffic	$[Erl]$	
Y_{CP}	Carried traffic	$[Erl]$	Mean carried traffic per Context Processor
Ω	Queue occupancy		Message buffers, etc.
τ	Delay	$[s]$	Mean delay of a message
<p>a) E.g., Control plane events: for instance, session initiation messages, call Setup messages, H.248 ADD requests, etc.; User plane events: any type of packet arrivals (e.g., IP packet, MAC frame, ATM cell, AAL2 CPS-Packet, FR frame).</p> <p>b) Technical realizations: e.g., CPUs, DSPs, IP Forwarding Engine, ATM SAR device, Ethernet switch, etc.</p>			

4.1.1 Indices

...Co ...Context	Context	H.248 Context
...CP ...ContextProcessor	Context Processor	MGC or MG embedded Context Processor
...CoA	Context Attempts	Load
...CoC	Completed Contexts	Performance: "Goodput"
...CoR	Rejected Contexts	Performance: "Badput" (e.g., rejected, blocked, discarded Contexts)

...BL	Basic Load	Basic (or background) server load, i.e., the none-H.248 related load
...HL	High Load	
...NL	Nominal Load	Engineered capacity, recommended operating point for a considered resource
...OL	Overload	

NOTE – The attribute 'mean' in system/performance parameter notations characterizes the "time mean" (of the underlying stochastic process). However, the purpose of this Supplement is also to provide worst-case estimations for system/performance parameters. These specific requirements will be denoted by an additional index, as follows:

...min	Minimum	Minimum requirement with regard to worst-case assumptions
...max	Maximum	Maximum requirement with regard to worst-case assumptions

5 Basic model for 2-party communication services

The control load quantum shall be based on a basic teleservice, a conversational communication between two session parties.

NOTE – The same principle was applied in PSTN/N-ISDN by using speech telephony service between two calling parties (caller & callee) for "basic call" definitions.

5.1 Network model

The 2-Party property leads to H.248 Contexts types with two H.248 Terminations. H.248 Context processing is done on an MGC and MG level. The scope of this Supplement is beyond the H.248 Context level, and shall comprise session processing as well. The two technical network elements shall be denoted as *session control server*, and *gateway*. Figure 2 shows that simplified architectural network model.

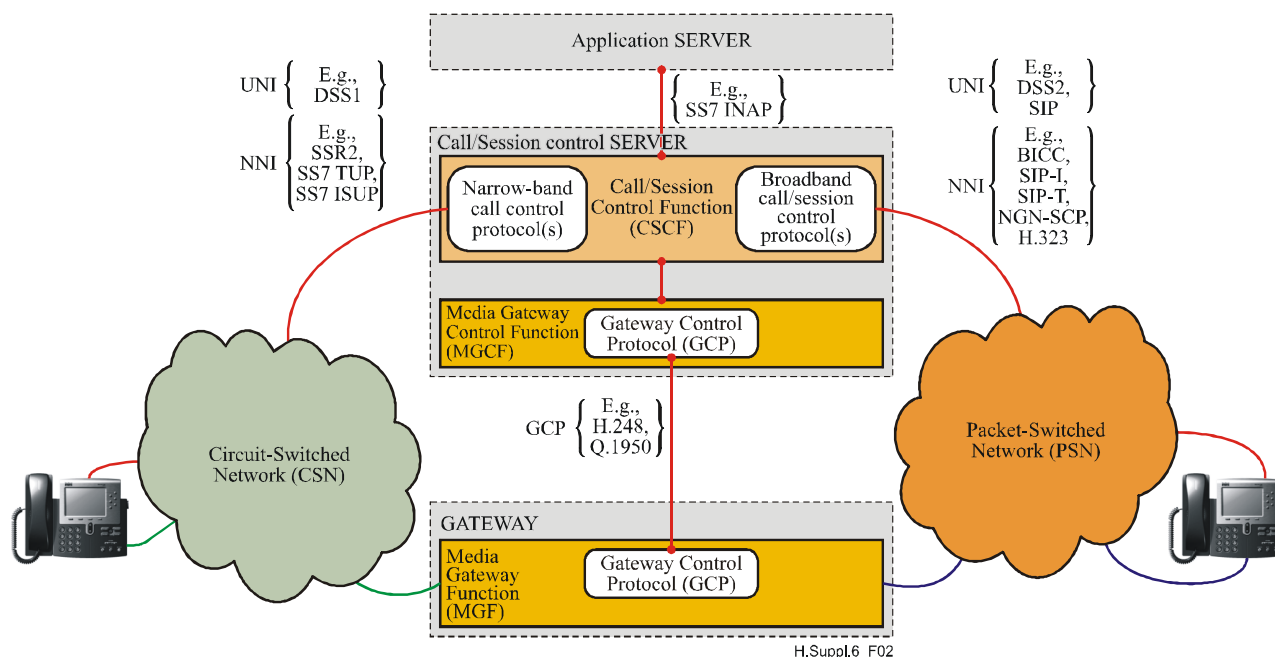


Figure 2 – NGN domains transport, control and application