

Precedence and Preemption for the GIG Transport Services

Yong Xue, Robert G. Cole and Antonio DeSimone

31 July 2005

Objectives

- ⇒ **GIG Transport Service**
- ⇒ **Target Reference Architecture for Guidance**
 - ⇒ **Deployment Guidelines**
 - ⇒ **Implementation Considerations**
- ⇒ **Identify Issues for Future Investigations**
 - ⇒ **Issues for Standards Work**

Problem Statement (from CJCSI 6215.02A)

- Develop an GIG QoS architecture to support the following multilevel precedence and preemption capabilities:
 - **Precedence levels supporting C2 communications be supported: ROUTINE, PRIORITY, IMMEDIATE, FLASH, FLASH OVERRIDE, and FLASH OVERRIDE-OVERRIDE (ordered lowest to highest).**
 - **In the best case, sufficient resources exist to transmit data of different priorities with their required quality. Otherwise, higher priority data must be transmitted at the expense of lower precedence data, possibly degrading or even preempting the lower priority data.**
 - **GIG voice networks shall be designed with additional features which permit higher precedence calls to preempt lower precedence calls at the end-user voice telephony device on a per-call basis if required**
 - **During times of surge or crisis, Commanders' ability to direct traffic controls (selected blocking of flows, directionalization, and usage controls) to ensure usage for critical users.**

Problem Statement (from CJCSI 6215.02A)

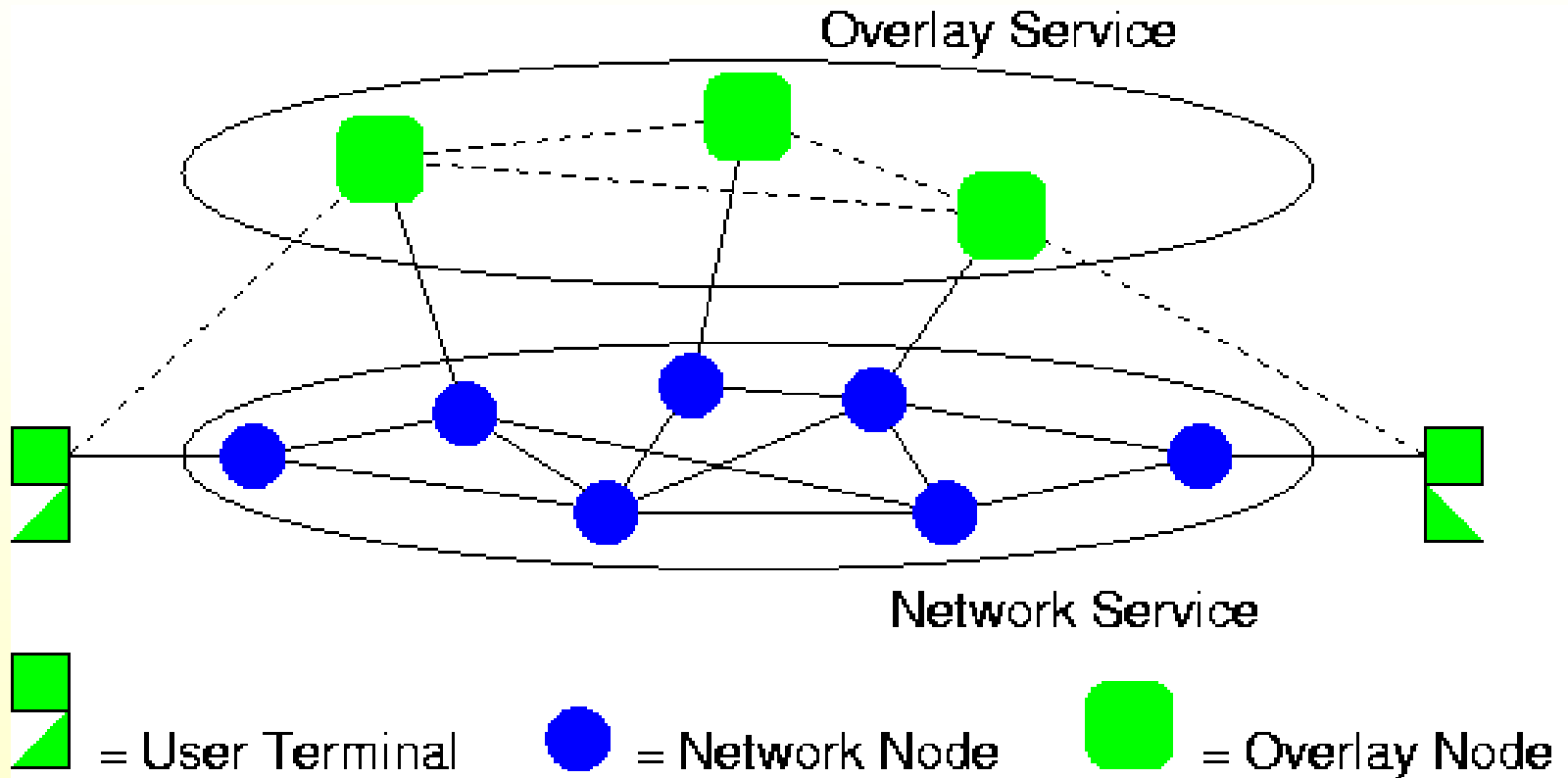
Precedence - In communications, a designation assigned to a message by the originator to indicate to communications personnel the relative order of handling and to the addressee the order in which the message is to be noted.

Preemption - The seizure—usually automatic—of military system facilities that are being used to serve a lower precedence call in order to serve immediately a higher precedence call.

Note:

- Not dealing with voice only-applications.
- The procedures associated with P&P must operate independent of the state of the network to the fullest extent possible.
- They should apply to all types of messages
- Requirements written in terms of messages (not packets)

Network Transport Service versus Overlay (RTS)



Fundamental Requirements

- ➔ GIG MA-ICD (Mission Area – Initial Capabilities Document) 22 November 2003
- ➔ CJCSI 6215.02A (Chairman Joint Chief of Staff Instructions) 31 July 2004
 - ➔ GETS: IAW NCS Directive 3-10 (10 February 2001)
 - ➔ TSP NS/EP: IAW NCS Directive 3-1 (10 August 2000)
- ➔ GSCR (Generic Switching Center Requirements), 08 September 2003
- ➔ Others may be added or requirements modified

Fundamental Requirements

Req#	P&P Requirement (Note: need to put direct quote in this column, will update)	Reference
1*	Precedence levels supporting C2 communications are defined in Enclosure H as ROUTINE, PRIORITY, IMMEDIATE, FLASH, FLASH OVERRIDE, and FLASH OVERRIDE-OVERRIDE (ordered lowest to highest).	CJCSI-B 5.a(1)
2*	This instruction extends the application of these precedence levels to all modes of C2 communications, not just voice as stated in the JD definition.	CJCSI-B 5.a(1)
3*	Responsiveness: For all application services end-to-end, all C2 traffic shall receive, upon authorized request, both Class of Service and distinguishable Quality of Service (including prioritization and preemption as applicable to the specific application service), so that it is distinguished from, and may receive favored treatment over network traffic not requiring comparable service.	CJCSI-B 5.a(2)(c)
4*	GIG networks shall be designed and configured to be robust, adaptive and reliable by employing network and configuration management, diverse routing, and automatic rerouting features as applicable.	CJCSI-B 5.a(2)(i) p B-5
5*	Other Users. These are users who have a requirement to use GIG networks but who do not meet the criteria for the classes of “special C2 users” or “C2 users.” These users, when using voice or any other C2 application or service, are granted only ROUTINE access.	CJCSI-B 5.b(2)(c) p B-7

Fundamental Requirements

Req#	P&P Requirement (Note: need to put direct quote in this column, will update)	Reference
6*	Network Convergence. With the projection for circuit-switched networks to converge into packet-switched data networks and to ensure their ability to support effective military C2 functions, converged data networks shall adhere to the equivalent functional capability objectives required of current circuit-switched networks to the largest extent possible.	CJCSI-B 5.b p B-5
7*	All GIG networks shall be designed with the ability to support end-to-end treatment of five distinct Class of Service (CoS) prioritization levels. These prioritization levels require that higher precedence data flows will be transmitted through the networks with their required Quality of Service with greater assurance than lower precedence data flows. The five applicable Class of Service (see Precedence Levels in paragraph 4.a(2) above) levels are: FLASH OVERRIDE, FLASH, IMMEDIATE, PRIORITY, and ROUTINE. Prioritization must enforce transmission of higher precedence data in the network at best concurrently with or at worst to the detriment of lower precedence data flows.	CJCSI 5.b.3.a
8*	GIG voice and video networks shall be designed with additional features which permit higher precedence calls to preempt lower precedence calls at the end-user voice telephony device on a per-call basis if required.	CJCSI 5.b.3.b
9*	Agencies responsible for the operations of the GIG shall ensure that PRIORITY and IMMEDIATE traffic will encounter, at a minimum, no more than two percent (2%) degradation in the transfer of information from end-to-end, and one percent (1%) degradation during 100% surge usage.	CJCSI 5.b.4.a

Fundamental Requirements

Req#	P&P Requirement (Note: need to put direct quote in this column, will update)	Reference
10*	During times of surge or crisis, the Chairman of the Joint Chiefs of Staff, Joint Task Force Commanders, Theater Commanders, and Mission Commanders can direct implementation of certain traffic controls, such as selected blocking of flows, directionalization, and usage or availability control (e.g., MINIMIZE) to ensure usage for critical users	CJCSI 5.b.4.b
11*	When VoIP is fully implemented on DoD GIG networks, it shall comply with the requirements, priorities, and procedures established by the NCS regarding NS/EP and government emergency telecommunications service (GETS), IAW NCS Directive 3-10, 10 February 2001, “Telecommunications Operations Government Emergency Telecommunications Service (GETS)”, and NCS Directive 3-1, 10 August 2000, “Telecommunications Service Priority (TSP) System for National Security and Emergency Preparedness (NS/EP)”.	CJCSI 5.b.7

Derived Goals

Goal#	P&P Goal Description	Source
1	The network should function as expected, i.e., it should not suffer a dramatic collapse under minor damage, if resources exist they should be allocated as expected, and performance degradation (for those applications whose data are permitted access) is gradual under levels of increasing damage.	
2	The GIG will provide capability to apply precedence and preemption across service classes. This capability will be invoked when doing so will allow meeting QoS requirements of higher precedence traffic which may otherwise not be met.	
3	The P&P services should function as expected and meet the above requirements independent of the loads offered across the P-Levels.	
4	Simple architectures are to be preferred over more complex architectures offering comparable services.	
5	Distributed architectures are preferred over centralized architectures.	
6	Within an affected P&P class, i.e., the load on a resource is such that some of the data related to the affected class is being preempted, the preemption should be handled in such a way to mitigate the impact to as few flows as possible, e.g., some form of selective preemption should be implemented.	
7	Security mechanisms should be incorporated to prevent denial of service, and other types of attacks against the P&P services.	
8	Under conditions where preemption is not necessary, standard QoS mechanisms should behave as expected.	

Issues for Investigation

- ⇒ P&P sub-team
- ⇒ GIG Routing Working Group
 - ⇒ GIG IA Working Group
 - ⇒ Standards – IETF, others

Some Issues:

- ***Are requirements incomplete (probably yes and also inconsistent)?***
- ***When to Preempt (related to QoS requirements)?***
- **Does Preemption Imply Starvation?**
 - Does the existence of DOS attacks argue against strict priority queuing for Precedence-levels?
 - Other communities may not want strict priorities
 - Some applications may not like strict priorities
- ***Is Integrity Checking and Correction Required (or how to protect against really bad DOS attacks)?***
- ***When to place a requirement in Overlay versus Network Service?***
- ***What is critical control traffic (Do we need higher than FOO for critical network control traffic)?***
- ***What are the requirements, algorithms, policies around Selective Discarding within a Precedence-level?***
- ***What types of management policies related to P&P are required to be supported within the transport service?***
- ***What are the Quality of Protection Routing requirements?***
- ***What do we need wrt Application Developer's Guidelines for P&P services (and what does this imply regarding DNS and TCP and ...)?***

Thanks !

Any questions?

Yong Xue, Robert G. Cole and Antonio DeSimone

Yong.Xue@disa.mil, Robert.Cole@jhuapl.edu, Antonio.Desimone@jhuapl.edu
