X3S3.3/92-228
1 June, 1992

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To: X3S3.3

From: D. Marlow (NSWC)

Re: Tutorial Viewgraphs on the U.S. High Speed Protocols requirement study

NSWC has prepared this tutorial in support of the X3S3.3/92-174R report which is intended to describe to the ISO SC6 community the work effort that was undertaken by the U.S. in its project 753, Study on the Requirements for High Speed Protocols. This contribution is proposed as the basis for a presentation at the July SC6 meeting for discussion under project JTC1.06.36, Enhanced Communication Functions and Facilities for OSI Lower Layers (formerly Enhanced Transport Mechanism Guidelines).

U.S. discussion on this input is planned for the ANSI X3S3.3 committee's June 1992 meeting in Raleigh, N.C.

U.S. High Speed Protocols Requirement Identification and Analysis Effort

David T. Marlow

U.S. High Speed Protocols Requirement Identification and Analysis Effort

- ❏ *INTRODUCTION*
- ❏ OBSERVATIONS FROM U.S. DISCUSSIONS
- ❏ IDENTIFICATION OF REQUIREMENTS
- ❏ SIGNIFICANT REQUIREMENTS
- ❏ MODIFICATIONS OF OSI STANDARDS
- ❏ MAJOR NEW EFFORTS
- ❏ CONCLUSIONS

U.S. High Speed Protocols Requirement Identification and Analysis Effort

- The U.S. has been studying the requirements that pertain to the Enhanced Communication Functions and Facilities for OSI Lower Layers (project JTC1.06.36)
  - First phase completed on April 19,1991
    - identified the ***significant*** requirements which are expected to drive protocol and service definition development
    - OSI protocols were analyzed in light of these ***significant*** requirements
    - Conclusions were reached
  - Requirement discussions are on-going in the U.S.
- The contribution describes the first phase of the U.S. effort in relationship to the JTC1.06.36 program of work

JTC1.06.36 Program of Work

1 The identification of application requirements that have implications for OSI lower layer services and protocols.

2 The examination of existing OSI lower layer services and protocols to determine if the requirements identified in (1) can be met by existing or pending OSI standards.

3 In those cases in which requirements cannot be met by existing or pending OSI standards, the consideration of proposals for modification/extension of existing OSI services and/or protocols.

4 In those cases in which neither of the approaches outlined in (2) and (3) is sufficient to satisfy identified requirements, the consideration of proposals for new services and/or protocols.

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OBSERVATIONS FROM DISCUSSIONS

- Paradigm Shift
- Bandwidth
  - a solved problem
- Functional Capabilities
  - appears to be a primary justification for major new work
- Implementation Efficiency
  - appears to be a driver in achieving objectives of present day “high speed” networking efforts
  - need to maintain performance improvements as technology upgrades
- Use of “hard numbers”
  - not a meaningful way of expressing a requirement that is expected to change with time.

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REQUIREMENTS CONSIDERED

- Concentrated on Transport level requirements of four different application areas:
  - Technical Workstations
  - Process Control
  - Real-time Military Systems
  - Scientific Supercomputing
- Also brought in requirements identified in the U.S. discussions through an "additional" requirements caveat
- 30 requirements were identified

REQUIREMENT CATEGORIZATION

- An organized list of requirements was made where the thirty identified requirements were categorized into groups and combined wherever possible. Nineteen categorized requirements resulted. The groups were:
  - New functional capabilities
  - Efficient protocol implementations
  - Design features
  - Interoperability capabilities
  - Other requirements

REQUIREMENT EVALUATION

Class 1 Those requirements significant enough to drive new protocol and service definition development

Class 2 Those requirements which while important are not driving requirements for protocol or service definition development

Class 3 Those requirements needing further study

Class 4 Those requirements which are out of the scope of the study

- The ***significant*** requirements are those identified as being in Class1

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SIGNIFICANT REQUIREMENTS (1)

- Efficient transactions
  - Efficient support for Application layer RPCs, Transactions,...
    - Minimal exchanges by the user and the provider
    - Minimum number of PDUs exchanged by the providers
    - Minimal latency in carrying out the operation
    - Workstation application area needs TSDUs unrestricted in length
- Multicast transfer
  - requirements for both unacknowledged and acknowledged delivery
- Selectable error control
  - service user to select the amount of error control to apply to TSDUs passed via a specific TSAP
    - Very important for multicast transfer
    - Even with no error control applied “hole preservation” is needed (e.g. for video image transfer)

SIGNIFICANT REQUIREMENTS (2)

- Latency control facilities
  - The selection by the provider to support the transfer of data associated with one TSAP at the expense of data associated with other TSAPs
    - Consistent implementation and usage is needed
  - Time critical applications need capabilities to pass short high priority messages in the middle of large file transfers
- Efficient implementation
  - Protocol design discipline
    - Considerations include: minimizing options in the critical path, use of fixed PDU fields, placement of fields within the PDUs
  - Only the environment that an application runs in will determine what factors need to be optimized for efficiency (e.g. bandwidth, latency, local resources required)
- Support for time synchronization
  - Hooks at the lower layers are needed to support interconnected systems to precisely determine the "time-of-day" via network data transfers
  - Can be treated separately from the other significant requirements

Significant Requirements by Application Area

Significant Requirement	Workstation	Process Control	Military	Super-computing
Efficient Transaction	X		X	X
Multicast Transfer		X	X	
Selectable Error Control		X	X	
Latency Control Facilities		X	X	
Efficient Implementation	X	X	X	X
Time Synchronization		X	X	

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MODIFICATIONS TO OSI STANDARDS

- Transport layer
  - Only item that has been identified by the U.S. is to provide additions to the Connectionless Transport Protocol (ISO 8602) to support multicast transfer
    - Satisfies, in part, the need for multicast transfer capabilities
    - Very useful for a class of data transfer applications
- Network layer
  - Multicast additions can be brought in by additions to the current standards
    - Addressing work has begun (JTC1.06.32.01.05)
    - U.S. has initiated NWI proposals for CLNP, ES-IS and IS-IS Intra-Domain protocols
    - CCITT X.6 multicast service description is anticipated to lead to multicast extensions for CONS networks.
- Data Link layer
  - No conclusions have been made at this time

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MAJOR NEW EFFORTS - TRANSPORT LAYER(1)

- In particular, multicast transmissions and selective error control are two fundamentally new services which will necessitate either a new class of protocol or a new protocol entirely.
- To adequately address the design of a new Transport Protocol, a service definition must be created outlining the service provided. The service definition should incorporate new features such as user error control, QOS management, multicast transmission, group management, and other issues that are not currently present. Without a new service definition, it is very difficult to measure the degree of success in defining the new protocol.
- The addition of multicast will require a major redefinition of the Transport Protocols. The first step would be to define the multicast service required at the Transport Layer (reliable or unreliable). Second, the appropriate multicast management procedures would need to be introduced. Finally, the new protocol or features would be integrated into the existing Transport Layer standards or new Transport Layer standard. Two possible choices are seen: new class or new version.

MAJOR NEW EFFORTS - TRANSPORT LAYER(1)

- It is in the area of selectable error control that major conceptual changes are required in the Transport Service and Protocol. The selection provided should span the range of no action on errors to complete recovery schemes.
- A major design constraint would be the development of a coordinated approach to user selectable error control, latency control, QOS management, and the existing functions.
- The Transport Protocols are not designed at this time to provide any control over latency. They are designed with completely different parameter aimed at providing maximum bandwidth over connections. Also, the Transport Protocols are concerned with being general purpose solutions; not tailored for specific environments. To achieve latency control the Transport Protocols need to be redesigned considering this requirement. Finally, it needs the addition of QOS management facilities that permit the user to control the aspects of QOS that are important on a particular connection.

MAJOR NEW EFFORTS

- Network Layer
  - The U.S. has not made any conclusions on new efforts to be undertaken at the Network layer. One significant requirement cannot be met by “minor changes” to the OSI standards and that relates to providing Latency Control Facilities
    - Neither X.25 nor ISO 8473 provides any means of controlling latency dispersion or low latency dispersion operation modes.
- Data Link layer
  - No conclusions have been made at this time

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CONCLUSIONS

Significant Requirements Exist

- Transport Layer
  - Combination of new functional requirements along with the requirement for efficient implementation provides a strong justification for further Transport standard development
    - First step is Transport service definition development
    - At the conclusion of the work make final determination of calling out a new protocol or a new Transport protocol class
- Network Layer
  - Most of the needed capabilities can be achieved via modifications to the current standards
- Data Link layer
  - No conclusions have been made at this time