Inter-Office Memorandum

To	Communication Protocols	Date	June 30, 1978
From	Ed Taft and Bob Metcalfe	Location	Palo Alto
Subject	Pup Specifications	Organization	PARC/CSL

XEROX

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The purpose of this memo is to specify a standard with which to interconnect Parc's vari
switching networks.

This memo updates *Pup Specifications* of October 20, 1975. A number of corrections and editori
changes have been incorporated. The primary motivation for this update has been to prod
version of the specifications in Bravo and Press format.

We have designed a protocol, based on Pups (*Parc Universal Packets*), to allow processes on any
our interconnected computers to exchange packets through any of our interconnected netwo
course, not all communications need use Pups. However, nearly all resources presently a
the Xerox research network communicate using Pups and Pup-based protocols, and, in parti
the Gateway hosts that interconnect our networks will forward Pups only.

At the most basic level, this standard introduces three fundamental principles.

1. All Pup-based communication makes use of a standard inter-network packet for
(the *Pup*), specified in this document. All transporting networks are assume
able to carry Pups transparently.

2. Pup communication is end-to-end at the packet level. The inter-network is r
only to be able to transport independently-addressed Pups from source to
destination. Use of higher levels of protocol is entirely the responsibilit
communicating end processes.

3. When Pups are handed to the packet transport mechanism, they may be expected
arrive only with high probability and not necessarily in the order they were
transmitted. It is the responsibility of the communicating end processes to
upon higher-level protocols that provide reliable communication of the quali
themselves require.

Also included in this memo are:

how a Pup should be encapsulated for transport through various existing networks;

a Pup Echo Protocol for test and diagnosis;

a Rendezvous/Termination Protocol for connection establishment and synchronization

a Pup Byte Stream Protocol for carrying error- and flow-controlled byte streams be

cooperating processes.

It should be noted that all of these protocols have remained essentially unchanged since Experience has demonstrated the strengths and weaknesses of these protocols, and a numbe other higher-level Pup-based protocols have been designed and implemented. However, thi all traffic is still carried by the protocols described in this document, and these prot to undergo any further change.

A word of caution is in order to anyone contemplating a new implementation of the Pup pr While these specifications are reasonably complete in describing the syntax and semantic protocols, they contain very little discussion of strategies for implementing them. Car strategies turn out to be crucial to good performance. Unfortunately, very little docum implementation strategies presently exists.

All numbers are decimal unless followed by 'B'.

The Pup

The standard Pup format is illustrated in Figure 1.

The *Pup Length* is the number of 8-bit bytes in the Pup, including header, contents, and ch There may be from 0 to 532 content bytes in a Pup so that the length will range between 554 bytes. The Pup specification does not expressly prohibit Pups longer than 554 bytes, but by convention hosts are not expected to be able to transport Pups larger than this. A Pup is always carried in an integral number of 16-bit words. The number of 16-bit words is calculated by adding 1 to the length and di The number of content bytes is calculated by subtracting 22 from the length. When there odd number of content bytes in a Pup, the extra garbage byte required to fill the Pup ou integral number of 16-bit words precedes the checksum word.

The *Transport Control* byte is for use by Gateways; it should normally be zeroed at the Pup's source. Setting bit 0, the most significant bit, indicates that the Pup should be trace Tracing might involve a Gateway's recording a packet's passage or perhaps even a trace m to some monitoring process, perhaps the originating process itself. To date, no such tracing mechanisms have been implemented. Bits 0-3 are used to count the number of Gateways encountered during the Pup's transport. A Pup which reaches its 16th Gateway will be discarded. Bits 4-7 curr no use and should be zero.

The *Pup Type* is assigned by the source process for interpretation by the destination proce carried in the header for possible use by Gateways. A type of 0 is illegal. Types 1 th registered types, such as the ones defined in this document. They may receive optional handling by intermediate agents such as Gateways. Registered types are assigned a singl interpretation that is either used in only one protocol or that is applicable in all pro not have different interpretations in different protocols.

Types of 128 through 255 are unregistered and their interpretation is strictly a matter between the source and destination processes. A given type may be assigned independent in different protocols so long as such protocols need not be *compatible* (in the sense of be simultaneously between a given pair of ports).

In practice, the distinction between registered and unregistered Pup Types has not turned out to be particularly useful, except in one case. Pups of type *Error* may be generated by the packet transport mechanisms without knowledge of the higher-level protocols being used by the end processes.

The 32 bits of the *Pup Identifier* are assigned by the source process for interpretation, rela Pup type, by the destination process. Pup IDs identify Pups and their contents to disti from others, for purposes such as duplicate suppression and ordering. The specific inte the Pup ID is not defined at the Pup level but is rather a matter of convention establis levels of protocol (e.g., the Byte Stream Protocol presented later in this document).

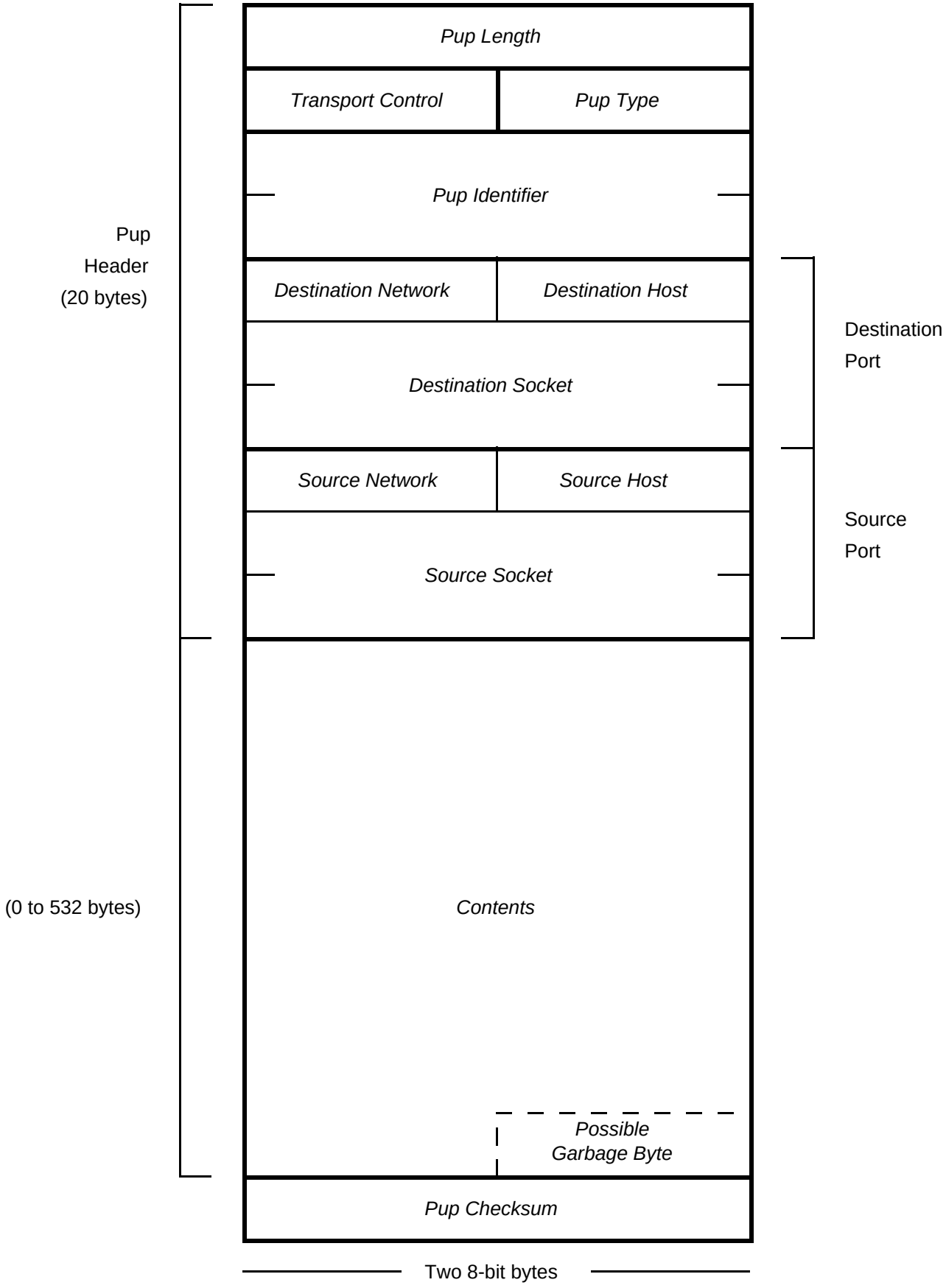


Figure 1. The Format of a Pup

All Pups originate at a *Source Port* and are routed to a *Destination Port*. Pup ports extend the addressing normally found in networks both for communication with distinct processes in host and for communication with hosts on networks other than the local one. A Port iden of 255 possible networks, one of 255 hosts in that network, and one of 2^{32}-1 sockets in t

The *Destination Port* is specified by the source process. The *Source Port* is verified enroute. source socket is provided and/or verified by the source host's process interface. The s source network bytes are specified and/or verified by the first authority. Careful enro and verification of Pup source ports is the basis for (inter)network access control.

A source network of zero indicates that the source process does not know the identity of network to which its host is connected. A destination network of zero indicates that th addressed to a host in the current network, i.e., the one over which the Pup is physical by the source process. This convention is for use by processes which know that they wan communicate with a known host on their own network, but can't find out which network the We wish to avoid the situation in which processes on the same network can't communicate another because there is not an operating Gateway at the moment.

If the destination host is zero, the process intends the Pup to be *broadcast* in the destina (if such a broadcast capability is implemented in that network). The Pup is received by at the given destination socket in all hosts on the specified network. By convention, we do not preser permit a Pup source to broadcast to any except a directly connected network; that is, broadcasts never propagate through Gateways.

These conventions permit convenient communication among machines known to be on the same unidentified network and provide a mechanism for finding Gateways. Processes will not b to send Pups outside of their local network unless they know its identity. A process mu find out the identity of its local network from its local network control program which find out from a directly connected Gateway. See the memo *Naming and Addressing Conventions for Pup* for an elaboration on these topics.

There may be from 0 to 532 *Content Bytes* in a Pup. Content bytes are carried in an integral number of 16-bit words. If the number of content bytes is odd, the last word is filled garbage byte, not counted in the Pup's length.

The *Pup Checksum* is an optional 16-bit, one's complement, add-and-cycle checksum computed the 16-bit words in the Pup's header and contents. It is intended as an end-to-end reas correct transport by intermediate hardware and software components, and is not associate replacement for any network's existing error checking mechanisms (which are usually spec detect the specific sorts of errors commonly encountered on that network).

The checksum is initialized to 0 and computed by repeated one's complement addition and cycle, starting with the Pup's Length word and ending with the last content word. Note checksum includes the garbage data byte if there is one. If the result is the ones-comp "minus zero" (177777B), it should be converted to "plus zero". 177777B is specifically mean that the Pup carries no checksum.

The Pup's checksum is carried with it from source to destination. If and when a Pup is enroute, say when the hop count in the transport control field is incremented, its check recomputed. Our choice of the 1's complement add-and-cycle is intended to permit increm checksum updating. The algorithm for updating the checksum after changing a single word Pup is as follows (one's complement arithmetic used throughout):

1. If the Pup Checksum is 177777B, do nothing.

2. Subtract the old contents of the changed word from the new.

3. Left-cycle this difference (n mod 16) bits, where n is the distance (in words the changed word to the Pup Checksum word.

4. Add the result to the existing Pup Checksum.

The foregoing procedure produces a correct Pup Checksum if and only if the original Pup Checksum was correct.

It may be assumed that the packet transport system will give its best efforts to the del It *must* be assumed, however, that *Pups will sometimes be lost* (even when they are "known" to traverse only networks that are believed to be "perfect"). If a Pup's checksum is check and found to be in error, the Pup may be thrown away without even so much as a trouble r Pups may also be discarded in the event of a buffer shortage or other resource limitatio the places through which it may pass. An optional Pup Error Protocol exists by means of which a Pup's source may be notified of the packet's demise, but no process should depend on receiving such negative acknowledgments for all (or indeed any) lost packets. Many precautions will be taken to improve the chances of a Pup in getti to its destination, but no amount of machinery can assure trouble-free transport.

Pup Encapsulation

Pups are to be *encapsulated* to conform to the conventions and formats of a transporting net is unlikely but in the spirit of Pup encapsulation to rearrange various portions of a Pu convenient handling; however, Pups must be seen by user processes and Gateways as define previously.

Pup encapsulation consists of two steps (sometimes accomplished in a single operation). Pup is transformed in whatever fashion is necessary to permit the entire Pup (including Checksum) to pass through the transporting network as "data". This generally involves s adding network-dependent headers and/or trailers, but could also include encoding of dat various ways (for transmission over phone lines, for example). Second, an *immediate destinati* is derived from the Pup Destination Port. This will be either the *final* destination host is directly connected to the network over which the Pup is about to be transported) or a host through which it is believed (by some sort of routing function) the final destinati reached.

When a Pup is received at its final destination port, it is *decapsulated* (by applying the i encapsulation transformation for that network) before being passed to the destination pr When a Pup is received by a Gateway, it is (1) decapsulated, (2) routed to another netwo re-encapsulated according to the conventions of this new network.

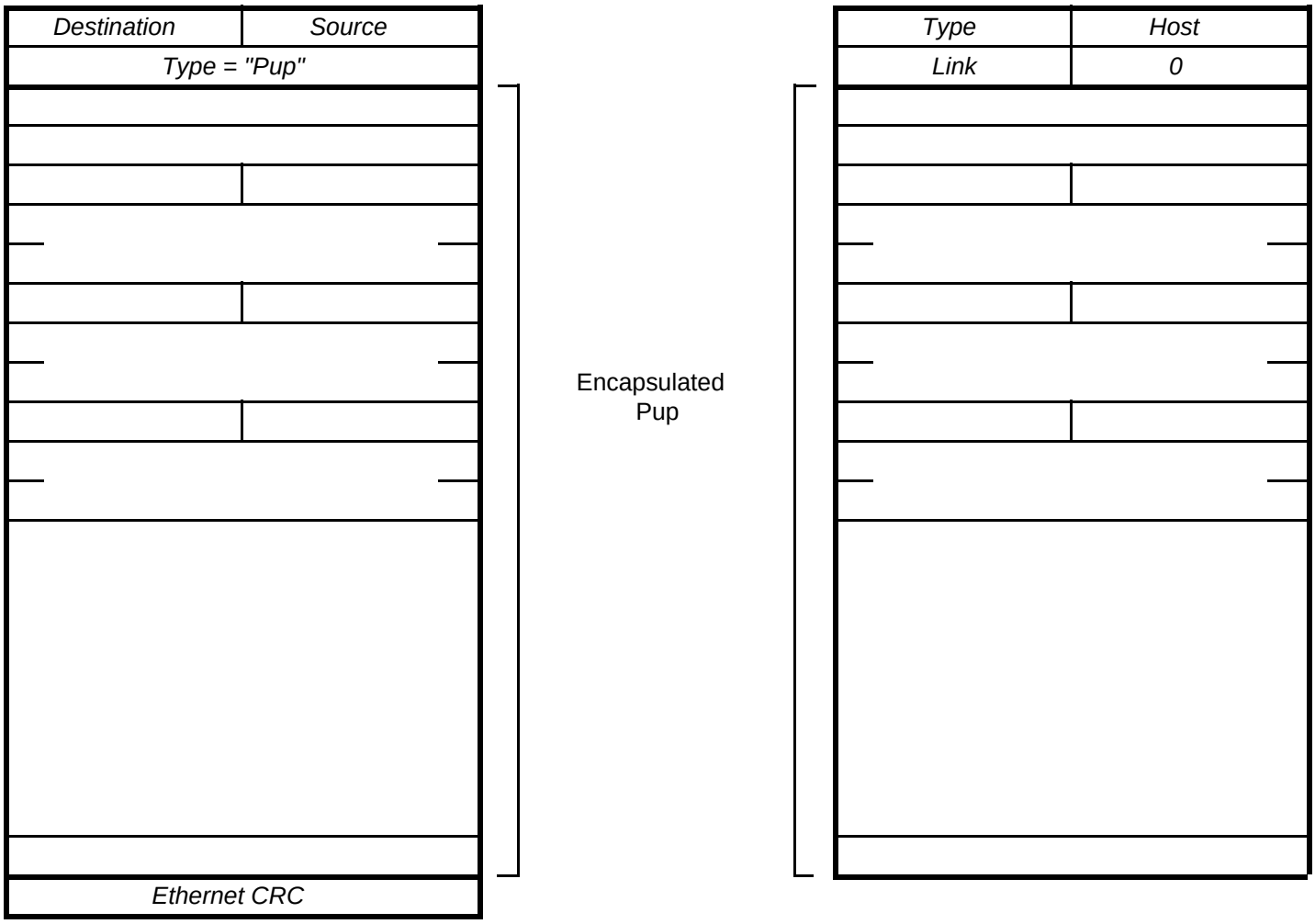
Ethernet Encapsulation

Refer to Figure 2. The *Destination* byte (*Immediate Ethernet Destination Host*) is derived from the destination port; it will be either the destination host itself, or a Gateway host throu destination can be reached.

The *Source* byte (*Immediate Ethernet Source Host*) is the hardware address of the host transmitting the encapsulated Pup through the Ethernet.

The *Type* word identifies the packet as being a Pup so that it can be given Pup processing arrives at the immediate destination host. The Type of a Pup is 512.

The *Ethernet CRC* (Cyclic Redundancy Check) is shown to distinguish it from the Pup's checks Pups will get the Ethernet's kind of error checking while exposed to the Ethernet's kind The CRC is computed and checked totally in the bit-serial portion of the local source an destination Ethernet interfaces.



Ethernet Encapsulation

Arpanet Encapsulation

Figure 2. Pup Encapsulation

Arpanet Encapsulation

At present, Pups are encapsulated within Arpanet packets using the "old" Imp-Host leader

The *Type* byte is zero, to denote that the packet is an Arpanet "Regular message".

The *Host* byte (*Immediate Arpanet Destination Host*) is derived from the Pup Destination Port as described previously. Note that when the message arrives at its immediate destination, this byte will have been changed by the Imps to identify the message's sender.

The *Link* identifies the message as being a Pup. It should be 152.

BiSync Encapsulation

Pups are encapsulated for transmission on low-speed synchronous lines using a data frame that is a subset of the BiSync protocol. Synchronous line drivers also implement a netw dependent (non-Pup) line control protocol that enables maintenance of sub-network connec routing information. That protocol is not described in this document.

Echo Protocol

For test and diagnosis purposes, a process receiving an EchoMe Pup may echo it (Figure 3 doing so, the receiving process should check the packet's checksum and the validity of t port. If the packet checks out, it should be returned to its source as an *ImAnEcho* Pup w recomputed checksum. If it fails to check out, but there is evidence that its source is identified, then the packet should be returned as an *ImABadEcho* Pup. Note that the sourc destination ports must be exchanged, the Gateway hop count zeroed, and the type changed; the checksum must be recomputed. If the receiving process accepts broadcast Pups, it (or the host's Pup handling software) must substitute the local host's actual address for the (zero) Pup Destination Host.

The process controlling any port may choose to respond to EchoMe Pups according to the E protocol; it is expected that most hosts will have a process prepared to echo and that p certain socket on each host will be reserved for this purpose. Well-known socket 5 is presently assigned to Echo servers.

Rendezvous/Termination Protocol

Some terminology. Packets (including Pups) have a *source* and *destination*. A Rendezvous has *listener* and *initiator*. Services have a *server* and *user*. Data, specifically byte streams, have a and *receiver*. These are independent descriptors. Usually the listener is also the server may be either the sender or the receiver of a byte stream depending on the service being

The Rendezvous/Termination Protocol is a convention by means of which a *connection* between ports may be established and later broken. The manner in which the the processes commun over an existing connection is the subject of other protocols (for example, the Byte Str to be described later).

Rendezvous

A Rendezvous is accomplished with an exchange of packets, each called an *RFC*, a *Request For Connection* (Figure 4).

RFCs may be exchanged to establish a connection between a user process and a server proc ports between which the RFCs are sent we call *Rendezvous Ports*. A user initiates by transmi an RFC to a listening (server) rendezvous port. The listener confirms by returning an R matching Pup ID. In addition to the rendezvous ports carried in the Pup header, each RF the address of a *Connection Port* through which the RFC's source intends to maintain the newl

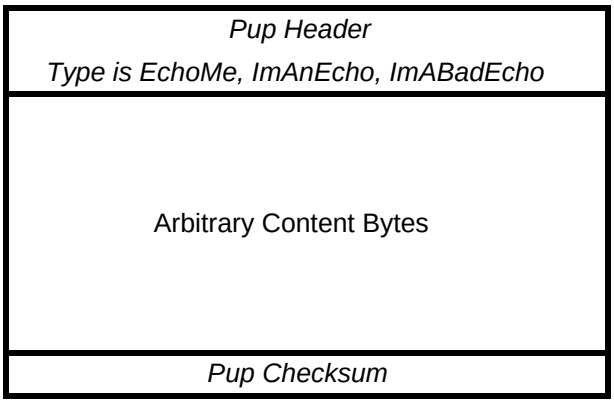
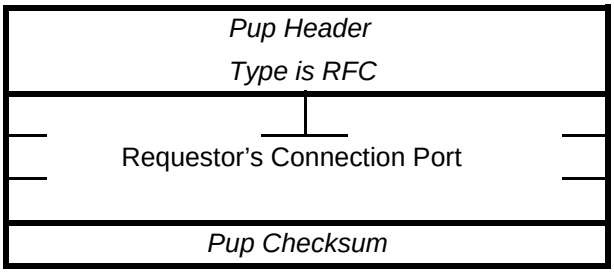
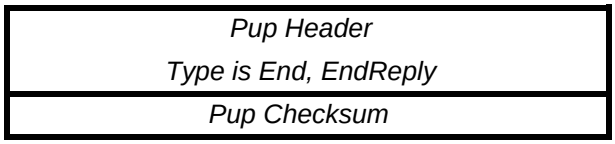


Figure 3. Echo Protocol Pup Format





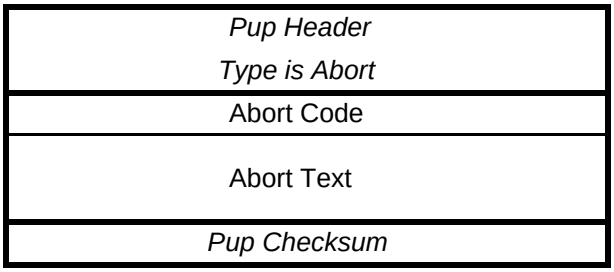


Figure 4. Rendezvous/Termination Protocol Pup Formats

established connection.

The Connection Port is separately specified so that, for example, a server can handle re service at a single, widely advertised rendezvous port and provide the service concurren number of users via a number of connection ports. The connection port may be the same a rendezvous port, and we expect this will be the case for most user processes and for ser capable of spawning multiple instances of themselves.

The Pup ID of the initiating RFC also defines the *Connection ID* for the resulting connectio should be chosen in such a way as to reduce the probability of confusion among connectio established near in time; the identifier in the complementing and confirming RFC must ma connection IDs are generated from an appropriate real-time clock, for example, the proba Pups from an extinct connection being mistaken for Pups in a new connection between the pair of ports may be made vanishingly small.

If an initiator's RFC is lost, it should be retransmitted by the initiator after enough for a normal answer, say something like 1 or 5 seconds. Duplicate RFC's can, at best, b on the basis of state information kept in the normal course of providing service. Upon det duplicate RFC, the receiver must, of course, retransmit the appropriate answering RFC before discarding the duplicate.
At worst, multiple servers will be generated to which no packets are ever sent; these s eventually time out and destroy themselves.

Normal Terminaton

A connection is normally terminated by a three-way handshake consisting of an *End* Pup an *EndReply* Pups. The end of a connection may be initiated from either of its ports by trans of an End Pup whose ID matches the Connection ID. The End Pup must be retransmitted unt matching EndReply Pup is received. Upon receiving an EndReply, the initiator of the End then send an EndReply in response and promptly self destruct.

The receiver of the End Pup responds by returning an EndReply Pup with matching ID and t *dallying* up to some reasonably long timeout interval (say, 10 seconds) in order to respond retransmitted End Pup should its initial EndReply be lost. If and when the dallying end stream connection receives its EndReply, it may immediately self destruct.

In the normal case, an End Pup and two EndReply Pups will be required to promptly close connection. The receiver of an End Pup must dally after sending its EndReply just in ca EndReply is lost and the End is retransmitted. The longer the dallying period, the high probability that both ends of a stream connection will be able to agree on its normal te The purpose of the second EndReply, the one sent by the end initiator, is to attempt to dallying end that it need not dally longer. Thus, in the normal case, three Pups and it slightly less normal case (the End initiator's final EndReply is lost), the dallying end timeout wasting resources; in the arbitrarily unlikely case that the dallying end self d an EndReply has been successfully received by the end-initiating port, the initiator wil stream was terminated abnormally while the dallying end will feel everything went AOK.

It may happen that both processes choose to send End Pups simultaneously. Upon receivin End Pup in seeming answer to an End Pup of its own, a port should at once send an EndRep begin dallying in the normal fashion (i.e., it should abandon sending Ends).

Abnormal Termination

The *Abort* Pup should be used to terminate a connection (or a connection attempt) in the e detected catastrophe. An Abort can be sent to reject an RFC or to terminate a connectio event of a catastrophe, say storage overflow or continuing checksum errors. A listener reject a rendezvous should try to send an Abort Pup with an explanation (e.g., "disk ful jam" or "tape busy"). Either end of a connection in progress, with its back against the try to send an Abort before self destructing, though its demise will eventually be detec

(by timeout).

The Abort Pup carries a program interpretable code and a human readable explanation of s
abnormal condition. An Abort must carry as its Pup ID the ID of the connection being ab
the ID of the connection's initiating RFC. Abort Pups need not be acknowledged because
presumed that there would be nobody to receive the acknowledgment. Of course, receiving
Abort is itself something of a catastrophe and an Abort might be sent in seeming answer,
completeness--it would most likely arrive at an inactive port and be discarded.

The Abort code is for program interpretation and the Abort text is for human consumption
codes should be registered and the text printable.

Byte Stream Protocol

The error- and flow-controlled transfer of bytes between two processes may be accomplish
bidirectional byte stream maintained using the Byte Stream Protocol (BSP). A byte-strea
connection between two ports is generally established and destroyed by means of the
Rendezvous/Termination protocol described previously.

Byte Stream Maintenance

Bytes in a stream are numbered consecutively by a 32-bit number referred to as the Byte
is initialized to the Connection ID (i.e., the Pup ID used for the rendezvous) when the
created. A byte stream is carried from one port to another by *Data* Pups, each containing
532 consecutive bytes starting with the one identified by the Pup's ID. In return for t
transmitted Acknowledgment packets with matching identifiers (though not necessarily on
one basis) which verify correct receipt and control flow. The streams of data flowing i
direction, while starting with the same initial byte ID, are independent.

Data packets should not be sent unless space has been allocated for them at the stream r
The sender is informed about receiver allocations in the *Acknowledgment* Pups returned by th
stream receiver. These allocations are not additive; each one reflects the current stat
receiver's space allocation at the time of departure of its transporting Acknowledgment.
therefore allocations travel in both directions, independently for each direction of dat

There are two kinds of data Pup under the BSP, one which demands an immediate
acknowledgment, called the *AData* Pup, and one which doesn't, called the *Data* Pup. All da
be positively acknowledged, but not on a strict packet-for-packet basis. It is intended
be transmitted in a number of Data Pups followed by an AData Pup asking for acknowledgme
receipt of all.

Data which have been transmitted but not acknowledged must be retransmitted after some t
If there are too many retransmissions, a stream connection may be aborted.

We expect that null AData Pups (containing no data bytes) will be used to probe a receiv
update of the allocation block and receiver byte ID. This will probably happen when a b
is first established and the sender has no allocation information or when the sender has
up for some time with a zero allocation and wants to verify that the receiver is still a

The Ack Pup indicates to the sender that all bytes previous to that identified by its Pu
been received correctly. A received Ack whose Pup ID is less than the previous one should be considered a delayed
duplicate and discarded. Also, it carries a 3-word allocation block indicating the receiver's stat
time the Ack was sent. The stream sender should update its state to reflect the cumulat
acknowledgment denoted by the Pup ID (e.g., discard Data packets being held for possible
retransmission) before considering the updated allocations.

The most recent allocation block indicates the maximum number of bytes per Pup that the
is willing to accept. Similarly, the number of Pups and number of bytes total which can

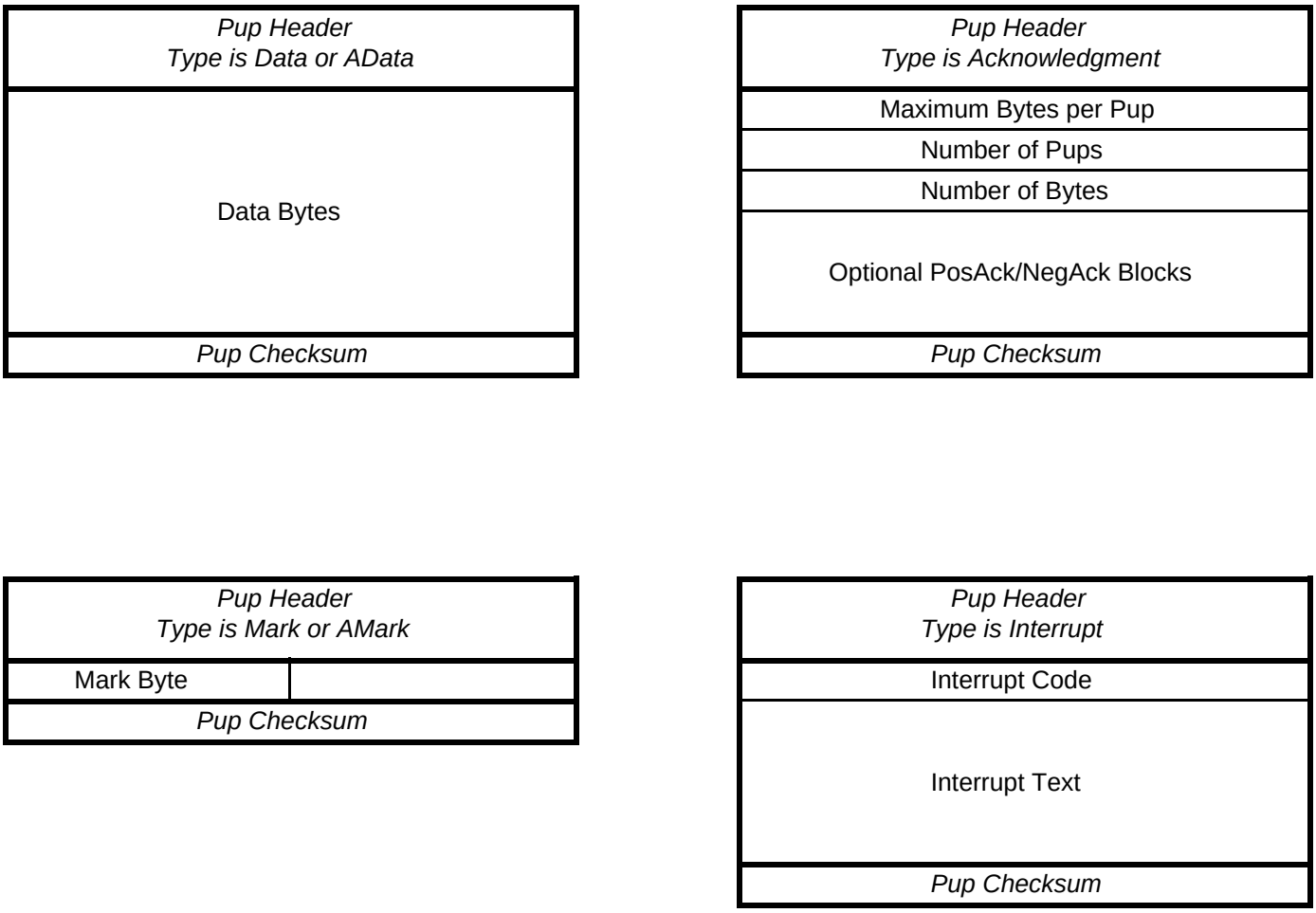


Figure 5. Byte Stream Protocol Pup Formats

sent are limited. The maximum number of bytes per Pup and the number of bytes total are expressed in terms of the number of *data* bytes, exclusive of the fixed-length Pup headers

The "Number of Pups" allocation indicates the maximum number of additional Data Pups the stream receiver is prepared to handle, over and above any Data Pups it has already recei may be holding in its buffers. In making use of this allocation, the stream sender shou that any Data Pups that it has transmitted but which have not been acknowledged have in (yet) reached the receiver. Hence, the "Number of Pups" allocation should be compared t number of unacknowledged output Data packets in order to determine whether or not it is generate additional Data packets.

The "Number of Bytes" allocation should be interpreted relative to the Ack's ID, i.e., t the first byte yet to be acknowledged. Adding the allocation to the Pup ID of the Ack i came yields the ID of the last byte in the stream which the receiver is prepared to acce ID implied in Acks should be monotonically increasing so that stream senders need not ho existing data Pups they had previously committed to transmit. In general, this means that a stream receiver should not decrease the total amount of storage allocated for buffering received Data Pups during the life of a connection. However, strict adherence to this policy may be difficult to implement; hence, small, short-term decreases in allocation should be tolerated by stream senders. Similarly, the maximum number of bytes per Pup should not be decreased during the life of a BSP connection, so that stream senders need not take exis Pups and break them apart.

Optionally, an Ack Pup may carry up to 85 *specific acknowledgments*, described by *Pos/NegAck Blocks*. Each is a 3-word item indicating that a specified interval of bytes in the *unackno* part of the byte stream is known by the receiver to be either received or lost. The pur indications is to hasten the retransmission of bytes known to be missing and to avoid th retransmission of bytes already received. Once a receiver indicates with a PosAck Block interval of bytes has been received, the sender may discard the packets which contain th that they will not require retransmission.

Each 3-word Pos/NegAck Block begins with a bit indicating whether the interval is known missing or received: a one indicates that the bytes in the interval have been received. bits hold the number of bytes in the interval. And the next 2 words hold the byte ID of byte in the interval. To simplify processing of Pos/NegAck Blocks by the stream sender, intervals denoted by successive blocks in the same Ack should start at monotonically inc IDs and should not overlap.

The transfer of bytes from stream sender to stream receiver should not depend on these Pos/NegAck Blocks being used by either end, except that bytes might flow with less effic without them. A receiver may choose not to include Pos/NegAck Blocks in its Ack Pups an sender may choose to ignore them if present.

Experience has shown that when communicating over high-bandwidth, low-loss networks such as the Ethernet, the software overhead required to generate and interpret specific acknowledgments is not rewarded by any noticeable improvement in performance. No software presently implements specific acknowledgments.

Marks and Interrupts

The *Mark* is a distinguished byte in the byte stream. It is analogous to the file mark f magnetic tapes. The length of a Mark Pup is always 23. It carries exactly one content indicates which of a possible 256 types of mark is being signalled.

While reading the data from a stream, a process reads up to a Mark and is then signalled the same way as when reading up to an end-of-file. The type of Mark should then be acce After clearing mark status, the user should be able to read on in the stream.

For purposes of transmission and flow control, Marks are treated exactly the same as Dat They occupy one position in the Byte ID sequence, and are acknowledged in the same manne any other byte in the stream. An *AMark* Pup is simply a Mark that demands an immediate acknowledgment (in the same manner as an AData).

An *Interrupt* Pup is used to signal some asynchronous event requiring immediate action by th
end of a stream. The Interrupt Pup is not subject to BSP flow control allocations and j
any and all buffered data. We envision using the Interrupt Pup in conjunction with the
for flushing buffered data from a stream in response to some abnormal condition.

An Interrupt Pup should not be sent until the previous Interrupt Pup has been acknowledg
an *InterruptReply* Pup. Interrupt Pup IDs are generated from the stream's send Interrupt ID,
is initially the Connection ID. Successive interrupts advance the Interrupt ID. An Int
be retransmitted until acknowledged.

Upon receipt of an Interrupt Pup, it should be acknowledged with an InterruptReply Pup o
ID is equal to or one less than the current Interrupt ID. If its ID matches the current
the using process should be signalled and the Interrupt ID advanced. If its ID is one l
current Interrupt ID, it is a duplicate and should therefore be acknowledged without giv
new signal to the process.

Interaction with Rendezvous/Termination Protocol

The Byte Stream Protocol interacts with the Rendezvous/Termination Protocol in two impor
ways. First, the Connection ID (i.e., the Pup ID of the initiating RFC) is used to init
stream's Byte IDs and Interrupt IDs for both directions, as has already been explained.

Second, to ensure clean and unambiguous termination of the byte stream, it is required t
stream sender delay transmitting either an End or an EndReply until all outstanding Data
Interrupt Pups have been acknowledged. For the same reason, it is forbidden to transmit
retransmit) Data Pups once an End or EndReply has been sent.

In the typical scenario for terminating a BSP connection, one of the processes decides t
connection should be closed. It first waits until no unacknowledged Data or Interrupt p
remain, then transmits an End.

At the other end of the connection, the process eventually exhausts the incoming byte st
notified that an End has been received, thereby terminating the stream. It now proceeds
transmit any remaining data, wait until no unacknowleged Data or Interrupt packets remai
transmits an End Reply, and begins dallying.

In the meantime, the first process (the one that originally requested termination) reads
of the incoming byte stream. When the stream is exhausted and the End Reply has been re
the process is notified of termination of the incoming stream. It now sends the answeri
(to terminate the other, dallying process) and is free to destroy the port.

Registered Pup Types

The Pup Types for the protocols described in this document are assigned the following va

Type	*Assignment*
EchoMe	1
ImAnEcho	2
ImABadEcho	3
Error	4
RFC	8
Abort	9
End	10
EndReply	11
Data	16
AData	17
Ack	18

Mark	19
Interrupt	20
InterruptReply	21
AMark	22