Hiperlan-2 wireless informative annex as submitted to the p1394.1 committee

Dr. David V. James, Sony
3300 Zanker Road, MS SJ3C1
San Jose, CA 95134-4591
Phone: 408 955-6295
FAX: 408 955-4591
Email: dvj@alum.mit.edu

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**This contribution is one of several, presented for independent review.
An overall contribution, which provides the context for multiple contributions,
is also provided in BR047R08.**

1394 is being applied to another physical interconnects, specifically wireless media. To assist in the use of this media, an annex is desired to illustrate how 1394 services are provided.

Annexes

Annex C

(informative)

Wireless HiperLan-2 layer

C.1 HiperLan-2 overview

C.1.1 Design motivation

The HiperLan-2 supported wireless interconnect is primarily intended to support wireless bridge attachments, as well as individual node attachments, as illustrated in figure C.1. Properties of the HiperLan-2 Surreal interconnect are listed in table C.1 and described in the remainder of this annex. .

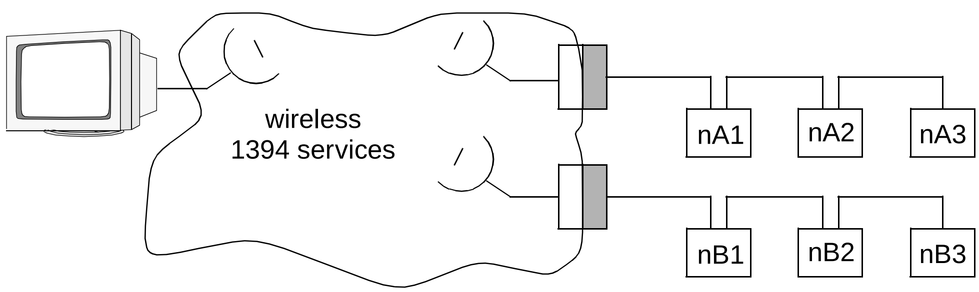

Figure C.1—HiperLan-2 phase-1 topology

C.2 Leaf bridge simplifications

C.2.1 Design motivation

Bus bridges can be simplified if one of the portals is known to be a leaf-bus portal; such bridges are called leaf-limited bridges. A leaf bus is defined to be a bus with only one bridge portal. An expected application for a leaf-limited bridge is to connect multiple cable-based Serial Bus interconnects to a common Surreal (Serial Bus like) backbone interconnect.

Leaf-limited bridges are sufficient for many applications and are attractive due to the simplicity implied by topological restrictions.

C.2.2 Homogeneous limited-leaf bridge topologies

A leaf-limited bridge is defined as asymmetric bridge that has two portals, called type-A and type-B. The type-A portal normally attached to a leaf bus (a bus with exactly one attached portal). A homogeneous leaf-bus topology has one branch bus and multiple leaf buses, as illustrated in figure C.2.

In such limited homogeneous topologies, routing decisions are simple and listed below.

1) Type-A portals. A type-A portal accepts packets addressed to itself or other buses, as follows:

Table C.1—HiperLan-2 interconnect features

Optionality	Property	Row	Description
mandatory	asynchronous formats	1	Identifier and timestamp are prepended to each packet
	isochronous	2	Timestamp labels are prepended to each packet
	independent streams	3	(—TBD—Connection conflict resolution)
	reliable transmission	4	Maximum effective error rates (see B.7)
	maximum payload	5	Supports up-to 512-byte asynchronous-packet data payloads
	-?events?-	6	ROM change, function change, attach, detach, phyId reused
optional	link-on requests	7	Automatic/transparent, activated when node is accessed
	robust events	8	Confirmed flow-controlled events supports (??)
	selective decode	9	Multiple ARP responses possible; first is accepted
	time-of-death	10	Prepended to request and response packets
	pipelined	11	Other packets can be sent before first is acknowledged
	concurrent	12	Starts other packet transmissions before first one completes

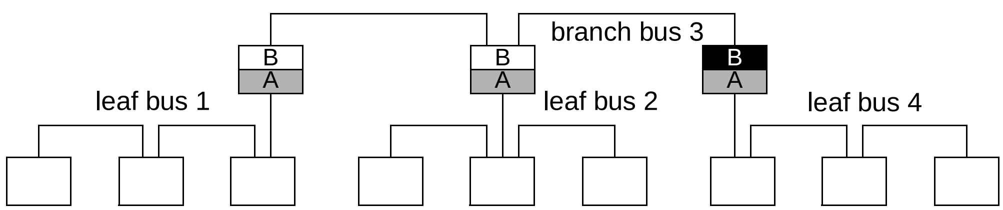

Figure C.2—Homogeneous limited-leaf bridge topology

a) Physical portal. Accepted if *destination_ID.busId*=$3FF_{16}$ and *destination_ID.localId=phyId*.
b) Virtual bus. Accepted and forwarded if *destination_ID.busId*!=$3FF_{16}$.

2) Type-B portals. A type-B portal accepts packets addressed to it or the adjacent bus, as follows:
   a) Physical portal. Accepted if *destination_ID.busId*=$3FF_{16}$ and *destination_ID.localId=phyId*.
   b) Virtual portal. Accepted if *destination_ID.busId*=000_{16} and *destination_ID.localId=phyId*.
   c) Selected bus. Accepted and forwarded if *destination_ID.busId==phyId+1*.

These decoding rules are based on the assumption that transactions are predecoded by the producer, which replaces virtual local-bus addresses with their physical address equivalents.

C.2.3 Heterogeneous bridge topologies

Generalized (non leaf-limited) bridges are architecturally symmetric, with two type-C portals. An illustrative topology, that contains leaf-limited as well as generalized bridges, as illustrated in figure C.3.

An expected application for a leaf-limited bridge is to connect multiple cable-based Serial Bus interconnects to a common Surreal (Serial Bus like) backbone interconnect. Within this environment, portal routing decisions are simple, as listed below.

1) Type-A portals. A type-A portal accepts packets addressed to itself or other buses, as follows:

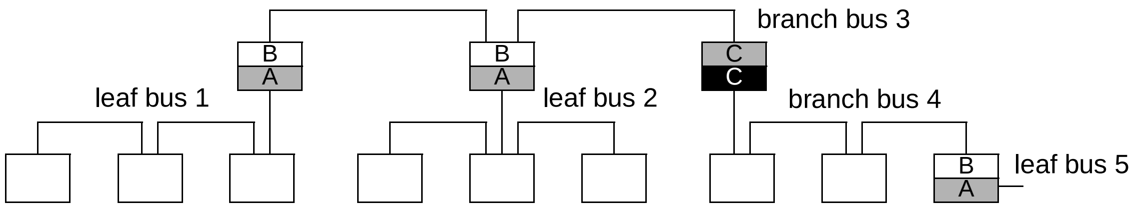

Figure C.3—Heterogeneous bridge topology

   a) Physical portal. Accepted if *destination_ID.busId*=3FF$_{16}$ and *destination_ID.localId*=*phyId*.
   b) Virtual bus. Accepted and forwarded if *destination_ID.busId*!=3FF$_{16}$.
2) Type-B portals. A type-B portal accepts packets addressed to it or the adjacent bus, as follows:
   a) Physical portal. Accepted if *destination_ID.busId*=3FF$_{16}$ and *destination_ID.localId*=*phyId*.
   b) Virtual portal. Accepted if *destination_ID.busId*=*branchId* and *destination_ID.localId*=*phyId*.
   c) Selected bus. Accepted and forwarded if *destination_ID.busId*==*leafBusId*.

C.2.4 Type-A bus resets

To avoid use of possibly inconsistent state, a leaf-bus reset has the side effect of assigning a new phyId to the adjacent portal, when this is not possible. When this is not possible, because the bus lacks this capability (Serial Bus) or because a phyID is reassigned (HiperLan-2), the branch-bus shall also be reset. A reset of the branch bus has the effect of resetting attached leaf buses.

This simplified bus reset strategy eliminates the need to support quarantine bits when operating in a homogeneous limited-leaf topology.

C.2.5 Prime portal responsibilities

During net refresh operations, type-B portals observe whether other type-C portals are also attached. When no type-C portals are found, the lowest-phyId type-B portal becomes the prime-alpha portal with a limited set of responsibilities, listed below:

1) Subtractive decode. Nonexistent addresses are accepted and a rejection response is returned. Nonexistent addresses include the following:
   a) Virtual node. Address *destination_ID.busId*=*branchId* and *valid*[*destination_ID.localId*]==0.
   b) Physical node. Address *destination_ID.busId*=3FF$_{16}$ and *valid*[*destination_ID.localId*]==0.
   c) Core buses. Address *destination_ID.busId*<64 and *valid*[*destination_ID.busId*]==0.
   d) Other buses. Address *destination_ID.busId*>=64.

When a branch-bus type-C portal is discovered, the type-B portals abstain from the prime portal selection process. The intent it to allow the use of more sophisticated type-C bus-identifier assignment protocols.

C.3 Illegal leaf-bus topologies

A type-A portal is designed to operate as the only portal on the bus. However, to ensure correct operation their behaviors is also defined in the presence of other portals. Their conflict resolution protocols are simple; the type-A nodes shall disable themselves when other portals are observed on their bus, listed below and illustrated in figure C.4:

1) Redundant. When multiple type-A portals exist, all but the lowest phyId port shall be disabled.
2) Conflicting. When a type-B or type-C portal exists, all type-A portals shall be disabled.

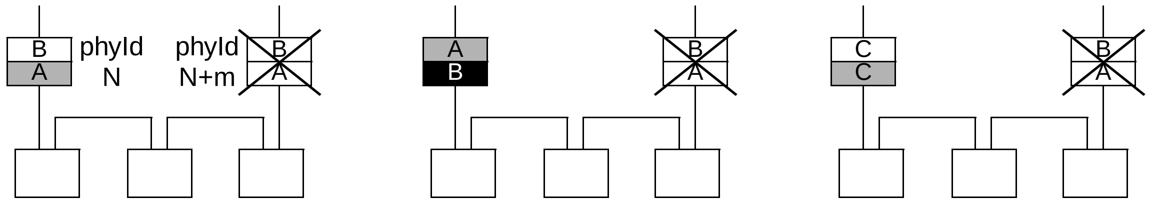

Figure C.4—Heterogeneous bridge topology

C.4 Special services

C.4.1 Self-id services

In addition to attached phyId information, HiperLan-2 provides supplemental information, listed below, for each of the 63-possible Serial Bus specified phyID addresses.

1) EUI-64. The EUI-64 of the attached node.
2) MAC-ID. The HiperLan-2-specified local-bus identifier for the node.
3) Class. The following classification services simplify bus-bridge configuration services.
    a) Aware. This is a bridge-aware nonporta.l node
    b) Portal, type-A. The leaf-side portal of a leaf-limited bridge.
    c) Portal, type-B. The attach-side portal of a leaf-limited bridge (not supported in phase1).
    d) Portal, type-C. Either side of an non-leaf-limited bridge (phase 2).

C.5 Local ARP

All HiperLan-2 packets are directed to another node based on that node's 8-bit MAC-ID address. Nodes are expected to cache recently used phyId-to-MAC-ID address translations. When no address exists, LARP is used, and the result of that LARP is cached for future use.

C.6 Request-response services

All HiperLan-2 communications are performed over logically independent point-to-point full-duplex connections. Since the lower-level protocols do not distinguish between requests and responses, and requests cannot block responses, acknowledgements allow requests to be "busied" at higher levels, as illustrated in figure C.5.

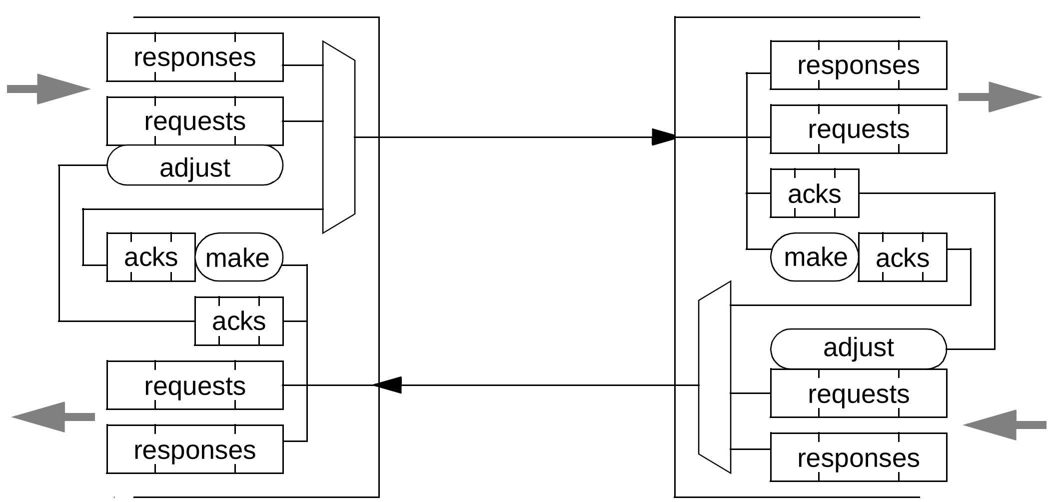

Figure C.5—Shared partially acknowledged request/response queues

C.7 Packet formats

C.7.1 Asynchronous packet formats

The HiperLan-2 asynchronous packet consists of a Serial Bus packet with a prepended quadlet, as illustrated in figure C.6.

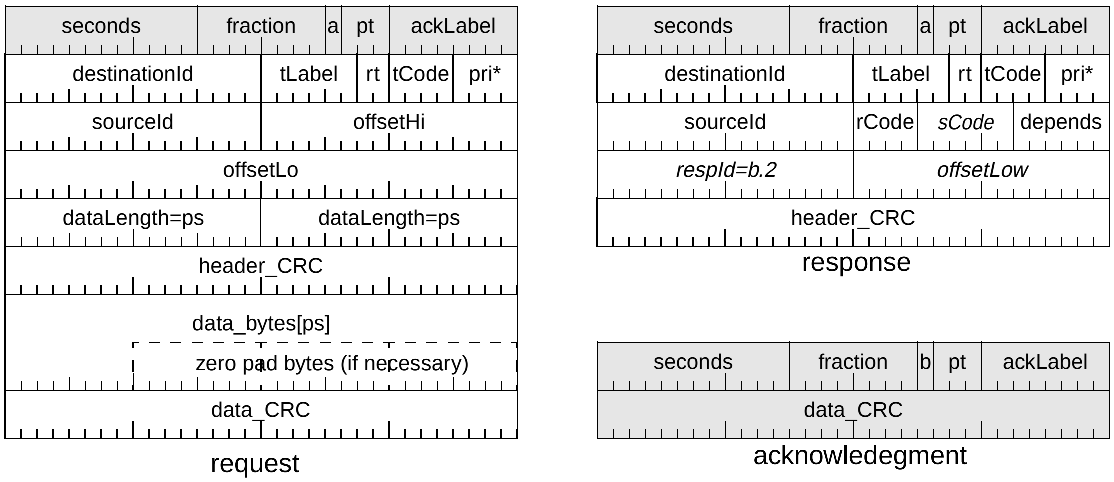

Figure C.6—Encapsulated request/response subactions

The 16-bit ***seconds*** and *fraction* fields are set by the free-running timer and represent the time in integer seconds and fraction seconds. The purpose of these fields is to specify the packet's time-of-death, so that it can be safely discarded within the specified interval.

The ***a*** bit is one when an acknowledge is requested (even though not busied); otherwise this bit shall be zero. The ***r*** bit shall be reserved.

The 3-bit ***pt*** (packet thype) field differentiates between distinct packet types, as specified in table C.2.

Table C.2—Defined *pt* values

Value	Name	Definition
0	UNACKNOWLEDGED	Only busy acknowledgments are necessary
1	ACKNOWLEDGED	An acknowledgment shall always be returned
2-6	—	Reserved
7	ACKNOWLEDGE	Done acknowledge: should be discarded

The trailing zero-pad bytes extend the packet to the next quadlet boundary, as is done on SerialBus. The remaining fields, including the 32-bit ***header_CRC*** and 32-bit ***data_CRC*** fields, are the same as those used on cable 1394.

The acknowledge packet is a copy of the request and response packet, with the exception of the ***rt*** field that is changed to identify the acknowledge packet and the *b* bit. The ***b*** bit is 1 if the packet was discarded and shold be retransmitted; otherwise this bit shall be zero.

C.7.2 Isochronous packet formats

NOTE—If transmission of a source identifier is found to be necessary, the reserved field will be used for this purpose

Most of the HiperLan-2 isochronous packet is the same as 1394, but a small portion of these packets are not, as illustrated in figure C.7.

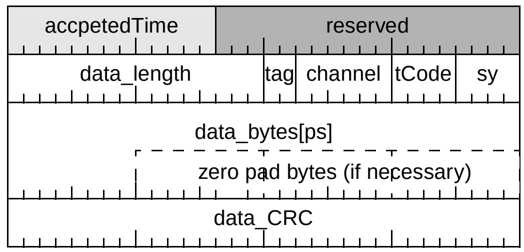

Figure C.7—Isochronous packet format

A smaller 12-bit ***data_length*** field is sufficient to support up to 16Mbyte/sec data transfers, beyond the limitations or current and forseen physical layers. The 13-bit ***cycle_number*** time-stamp value identifies the isochronous cycle in which the isochronous packet was first accepted by the bridge.

The trailing zero-pad bytes extend the packet to the next quadlet boundary, as is done on SerialBus. No 32-bit ***header_CRC*** is provided on isochronous packets (transport-level ECC covers each isochronous packet segment). The 32-bit ***data_CRC*** field (the same as that used on cable 1394) is provided to reliably detect segment-lost conditions.

A portion of this header sometimes contains a time stamp, that must be modified as these packets pass through bridges (see D.2.1). These fields are not modified when passing from Serial Bus to HiperLan-2, but supplements the isochronous packet with a ***cycle_number*** time stamp. The CIP-header time stamps are adjusted when these packets pass from HiperLan-2 to Serial Bus.

The CIP header also contains a 6-bit *sid* (source identifier) field. Since this information is implied by the isochronous channel number, this field remains unchanged when the isochronous packet passes from Serial Bus to HiperLan-2. When passing from HiperLan-2 to Serial Bus, this field is set to identify the Serial Bus source portal.

C.7.3 GASP packet formats

The GASP packet format is the same as specified for SerialBus, with the exception that no header CRC is transported, as illustrated in figure C.8.

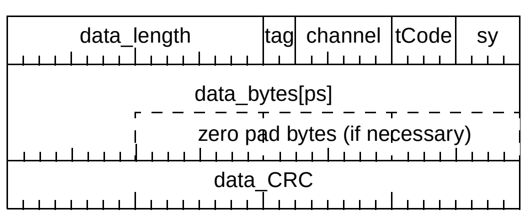

Figure C.8—HiperLan-2 GASP packet format

C.7.4 Isochronous delivery times

Data delivered in frames, where frames are sent periodically approximately once every 2ms. The 2ms clock is not necessarily synchronized to the net's 125ms isochronous cycle, as illustrated in figure C.9. This implies that each frame may contain 8 or 9 isochronous packets, depending on relative timings of HiperLan-2 frames and isochronous cycles on the interface.

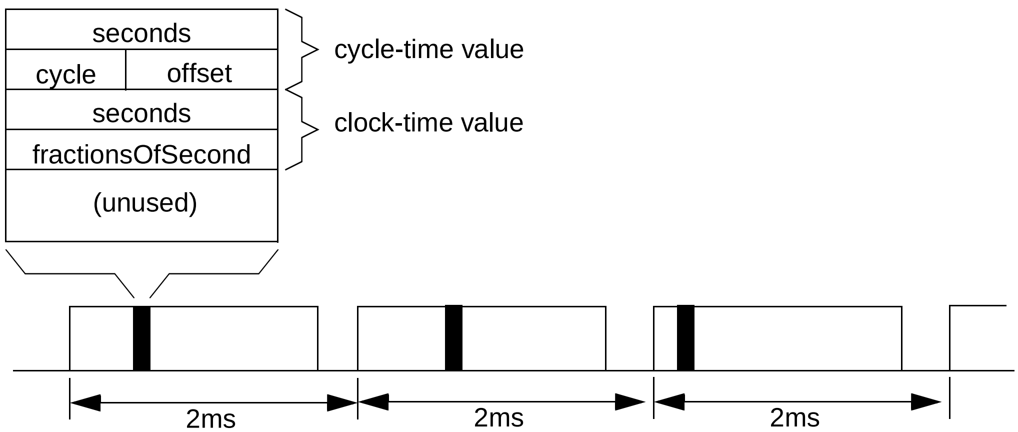

Figure C.9—Clock synchronization facilities

Hiperlan-2 clock distribution is done once within every 2ms frame. Time estimation involves latching the local-time value at the beginning of each frame, on all nodes. The clock-master copies its sampled time into a "packet" that is placed within the following frame (not illustrated). The clock-slave nodes compare their sampled time to the "packet" time, to estimate the error between clock-master and clock-slave clocks. The error value is latched (when stable) and used to compensate for the clock-slave's node timer, as illustrated in figure C.10.

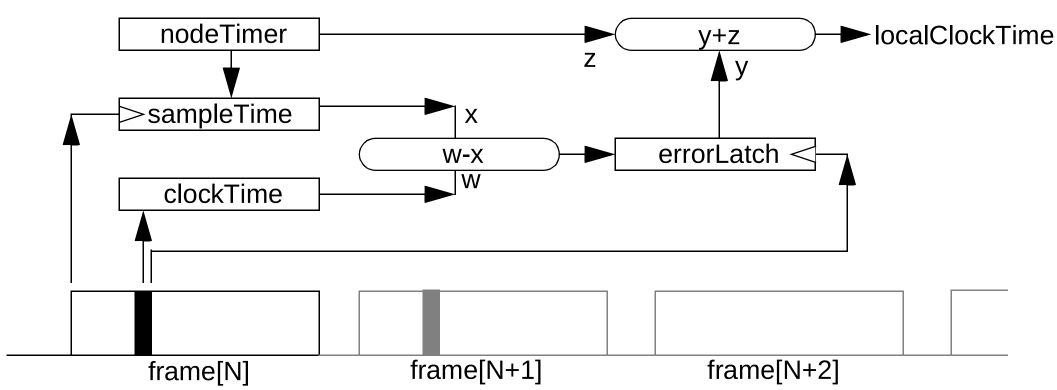

Figure C.10—Per-frame time adjustments

C.7.5 Isochronous services

Timely delivery in the presence of arbitrary request and response traffic.

1) IRM (isochronous resource manager). The IRM services, which are available to nodes and portals, provides a pass/fail indication and channel number to isochronous resource requests.

C.7.6 Bus-local query services

Query services that are provided include the following:

1) LARP. Local address resolution protocols return the MAC_ID of the local consumer.
   Two types of addresses may be broadcast in the ARP request, as follows:
   a) Local ID. A 6-bit phyId, corresponding a local-bus node or portal that accepts this subaction.
   b) Remote ID. A 10-bit busId, corresponding to the portal which maps this remote-bus address.
2) Events. Information contained within a bus reset is broadcast to others:
   a) Attached. A new node has been assigned to a previously unused phyId address.
   b) Detached. An existing node no longer responds to a previously used phyId address.
   c) Conflict. A new node has been assigned a previously used phyId
      (to ensure data integrity, a new bus_ID is assigned).
   d) Revised. An adjacent node has received a revised (previously unused) phyID assignment.
   e) ROM change. A local-bus node's ROM contents may have changed.

TBD—
How are query transport errors detected? What happens after an error? How is the delivery confirmed?

C.8 Effective packet-transmission error rates

Estimates of the effective HiperLan-2 error rates are documented in table C.3. The are raw bit-error rates and have not been adjusted for expected packet-sizes..

Table C.3—Worst-case error rate estimates

Traffic	Error type	Value	Row	Description
Asynchronous	detected-payload	(10^{-10})	1	Effective data_error response rate
	detected-header	(10^{-10})	2	Effective asynchronous packet-loss rate
	undetected	(10^{-20})	3	Effective asynchronous packet-corruption rate
GASP packets (TBD)	detected-payload	(10^{-8})	4	Effective indication-lost rate
	detected-header	(10^{-8})	5	Effective payload-loss rate
	undetected	(10^{-18})	6	Effective false-indication rate
Isochronous	detected-payload	(10^{-12})	7	Effective data_error interpretation rate
	detected-header	(10^{-12})	8	Effective isochronous packet-loss rate
	undetected	(10^{-22})	9	Effective isochronous packet-corruption rate