1394 Open HCI
Isochronous Receive DMA

Eric Anderson
Apple Computer

1394 HCI OPEN

Agenda

- Context Programs (Descriptors)
- Buffer Modes
- Command & Control
- Channel Selection
- Using the IR DMA
- Packet Data Formats

Isoch Receieve Context Program (Descriptors)

1394 OpenHCI
10.1

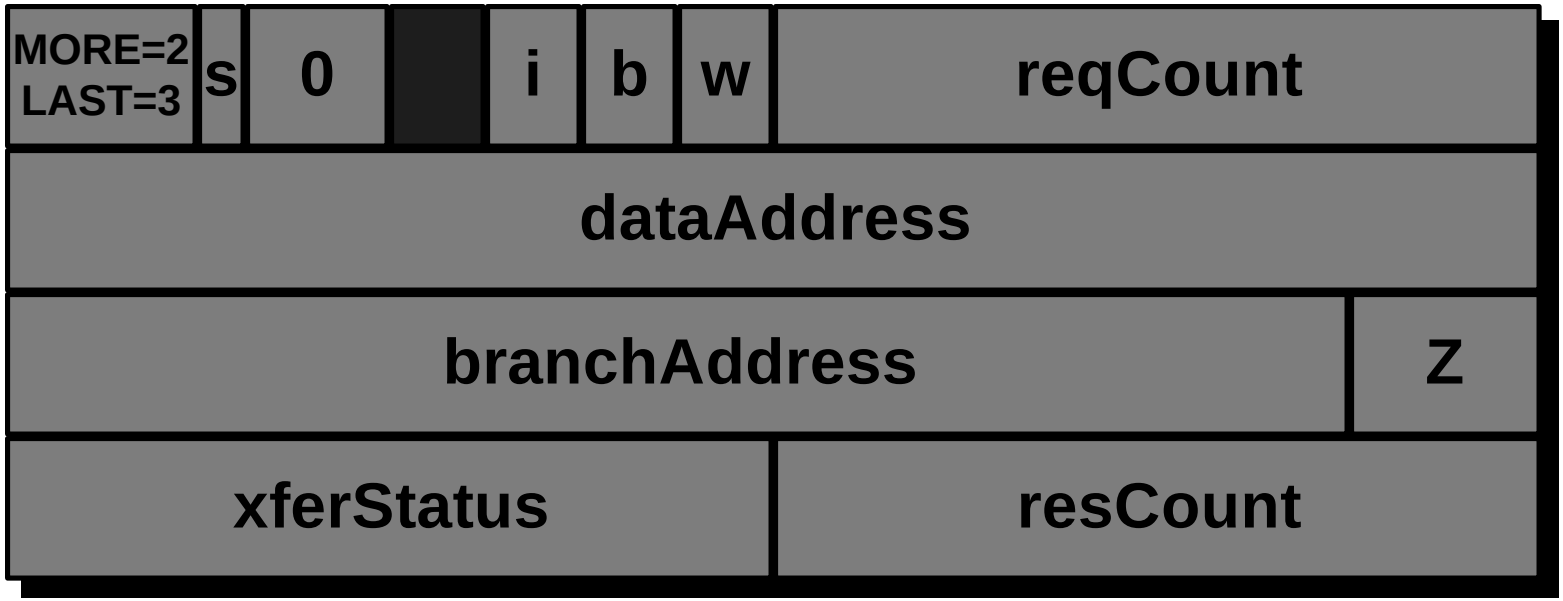
1394 HCI OPEN

IR Descriptors

- Two descriptors to choose from
  - INPUT_MORE
  - INPUT_LAST
- Use depends on buffering mode

1394 HCI OPEN

INPUT Descriptors

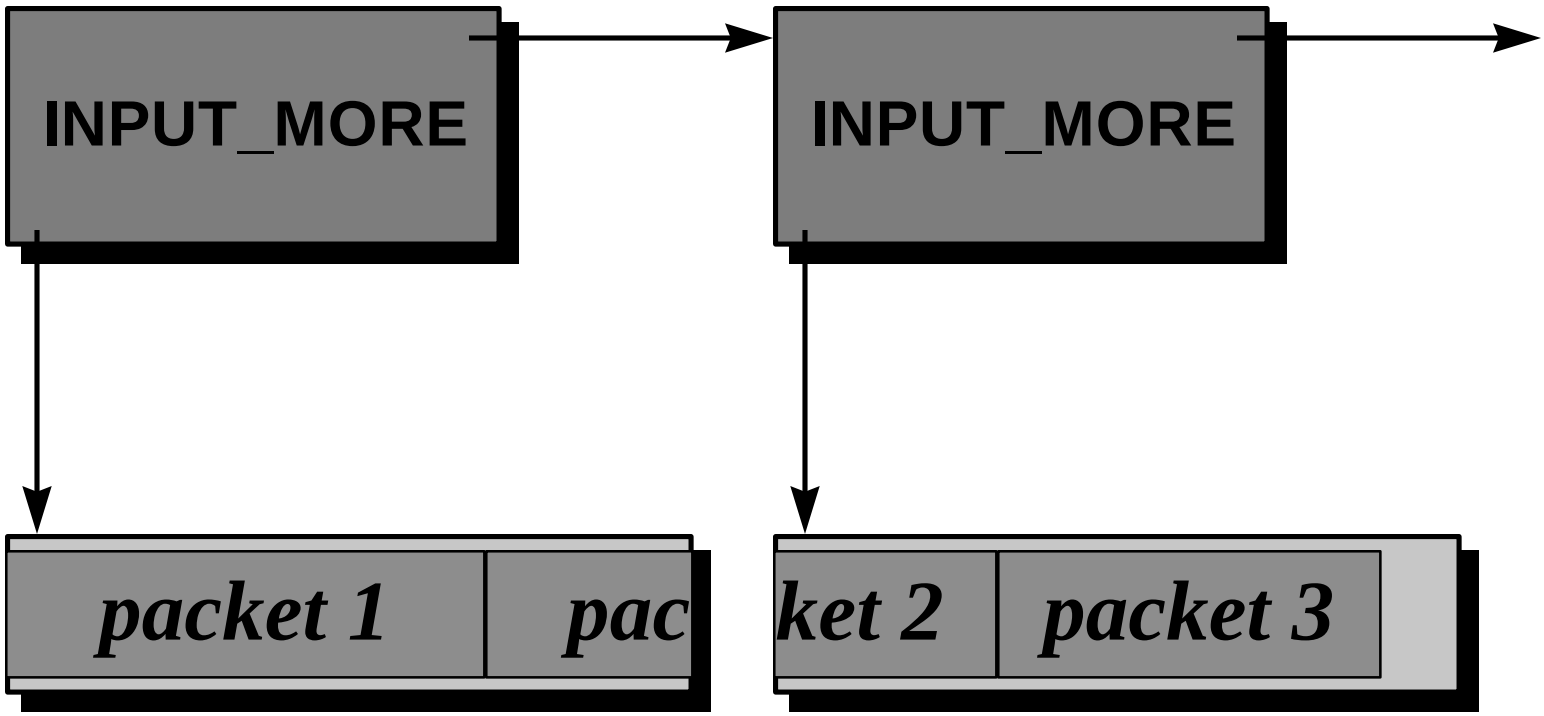


Isoch Receive Buffer Modes

1394 OpenHCI
10.2

1394 HCI PEN

Buffer Fill Mode

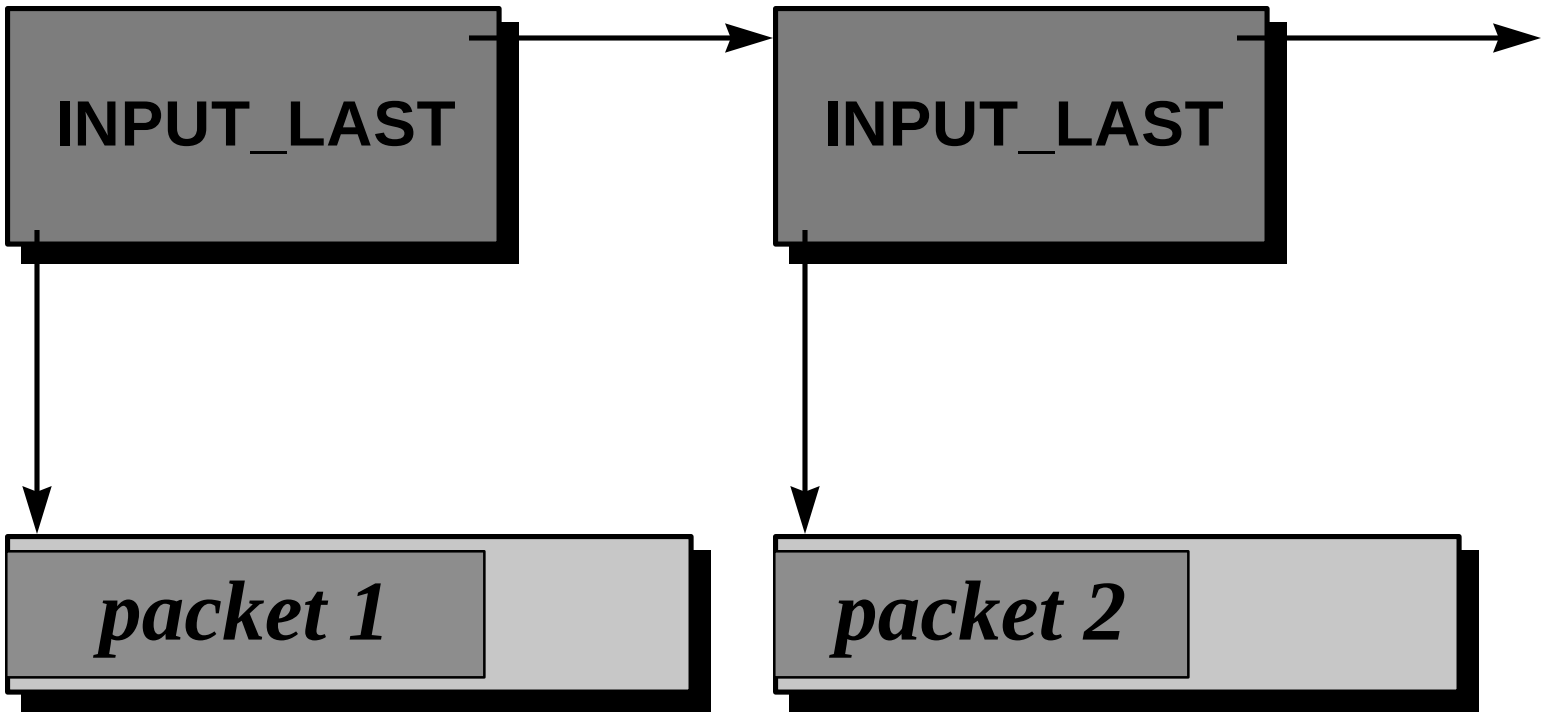


1394 HCI OPEN

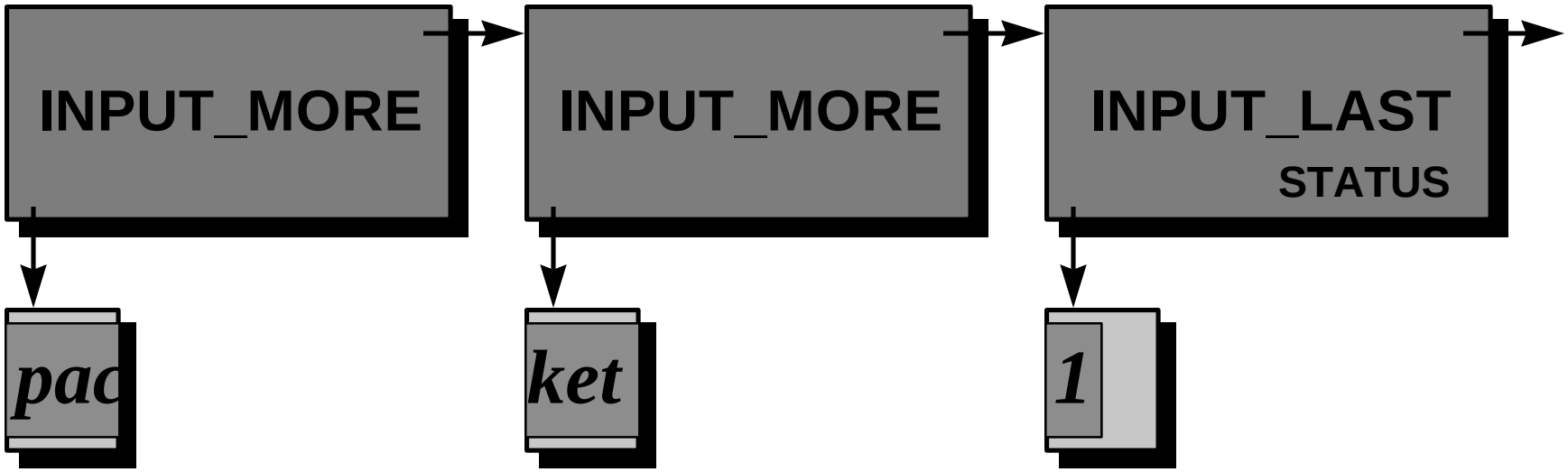
Buffer Fill Mode (2)

- Use only INPUT_MORE
- Z = 1, b = 3
- Status update for each packet
- Mandatory for multi-channel receive

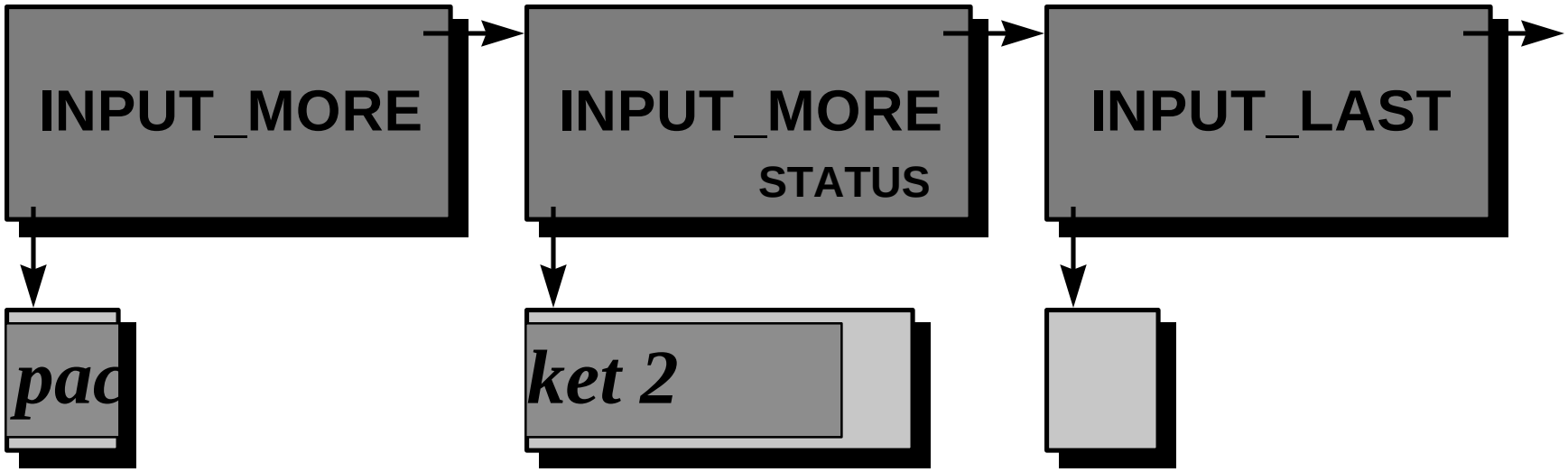
Packet-per-Buffer Mode



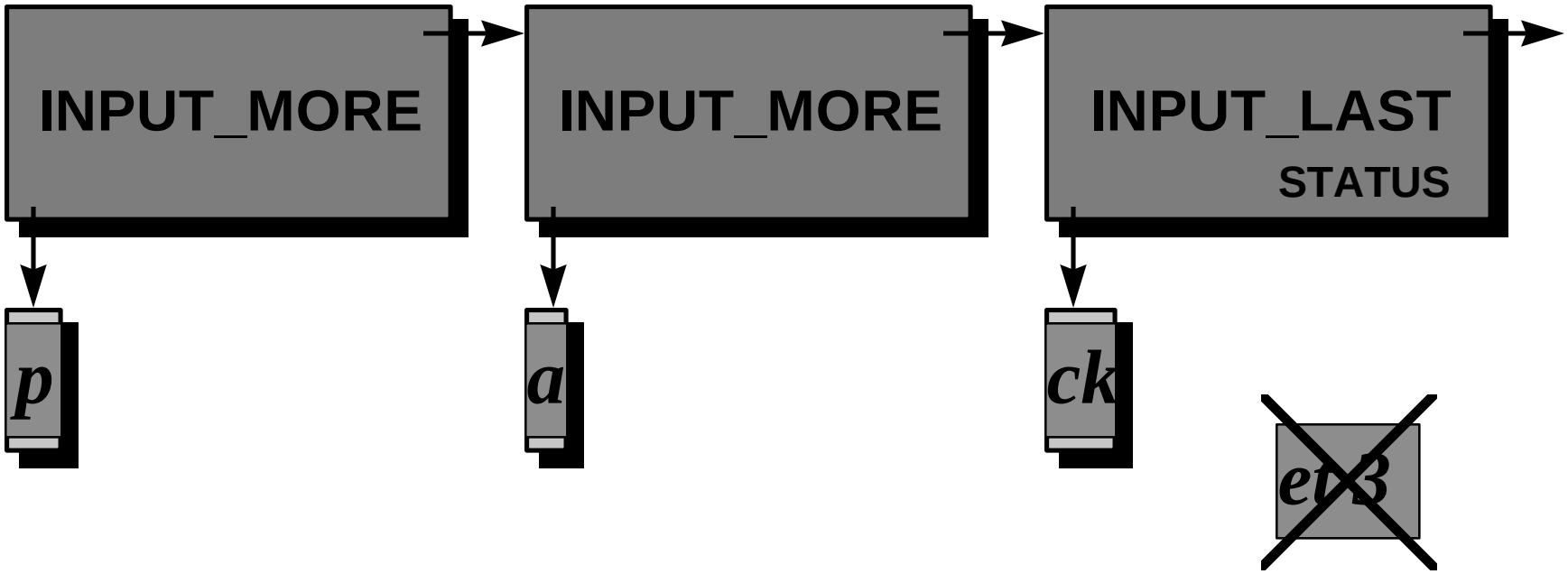
Packet-per-Buffer Mode (2)



Packet-per-Buffer Mode (3)



Packet-per-Buffer Mode (4)



Packet-per-Buffer Mode (5)

- One INPUT_LAST per packet
  - Packet could end in INPUT_MORE
  - Overflow bytes lost
  - Exactly one Z block per packet
- Status update for descriptor that receives final byte (or trailer)
- Not allowed in multi-channel mode

Isoch Receive Command & Control

1394 OpenHCI
10.3

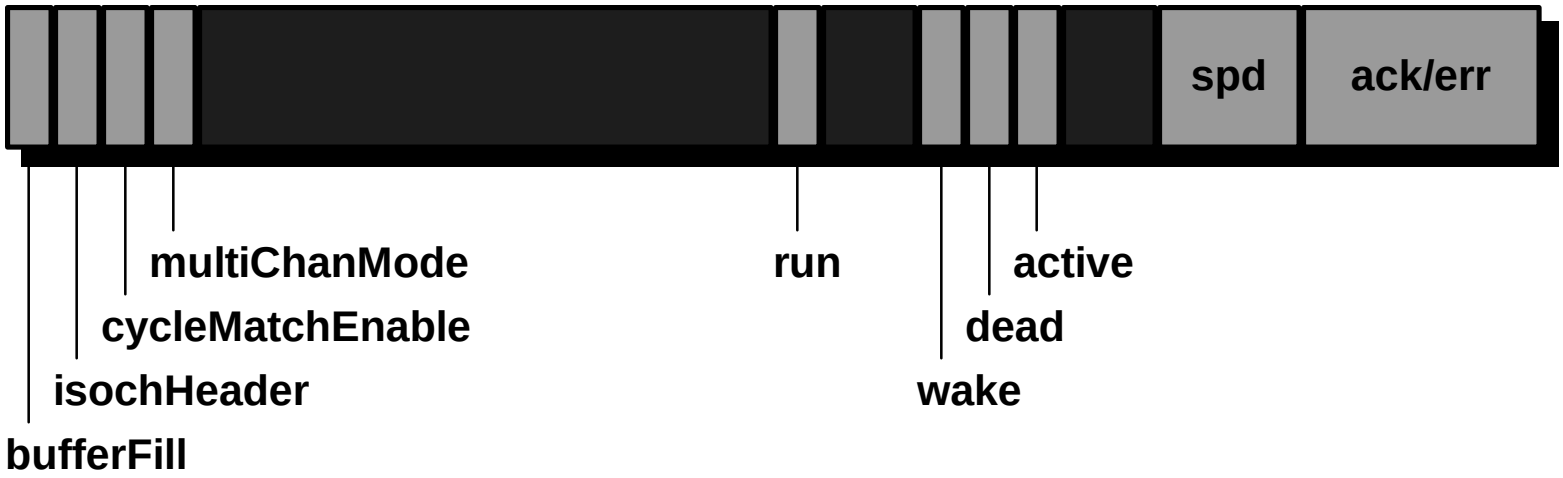
1394 HCI OPEN

Command Pointer

- To start an isoch receive context:
  - Load CommandPtr register
  - Set run bit in Control register
- When a context stops (active = 0), CommandPtr indicates end location

1394 HCI OPEN

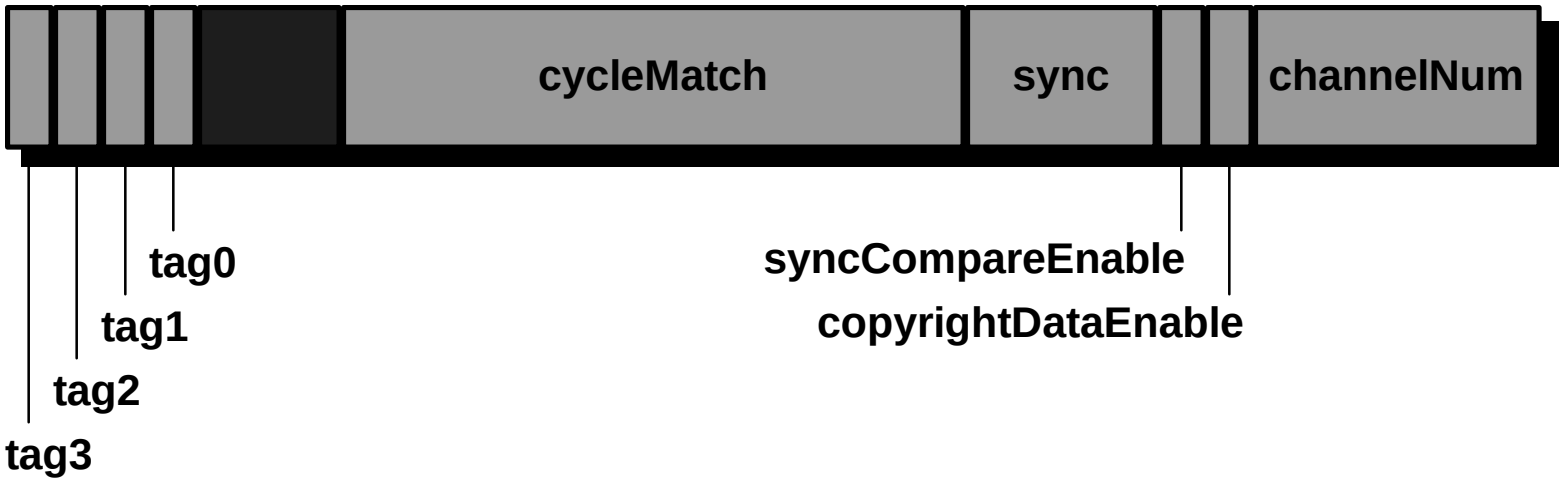
Context Control



- Set run to start immediately
- Set run and cycleMatchEnable to start on specific cycle

1394 HCI OPEN

Context Match



- Set DMA wait and sync to wait for matching sync
- Filter packets with tag bits

1394 HCI OPEN

Multiple Contexts

- **Implement 4 to 32 Contexts**
  - **Determine count via isoRecvIntMask**
- **Each Context...**
  - **Has one CommandPtr**
  - **Has one ContextControl**
  - **Has one ContextMatch**
  - **Has one interrupt bit**

1394 HCI OPEN

Interrupts

- One (isochRx) in IntEvent register
- Per-Context interrupt bits
  - isoRecvIntEvent
  - isoRecvIntMask (also context count)
  - isochRx = ((Event & Mask) != 0)
- Interrupts triggered by INPUT_*with i = 3

Isoch Receive Channel Selection

1394 OpenHCI
10.4

Single-Channel Receive

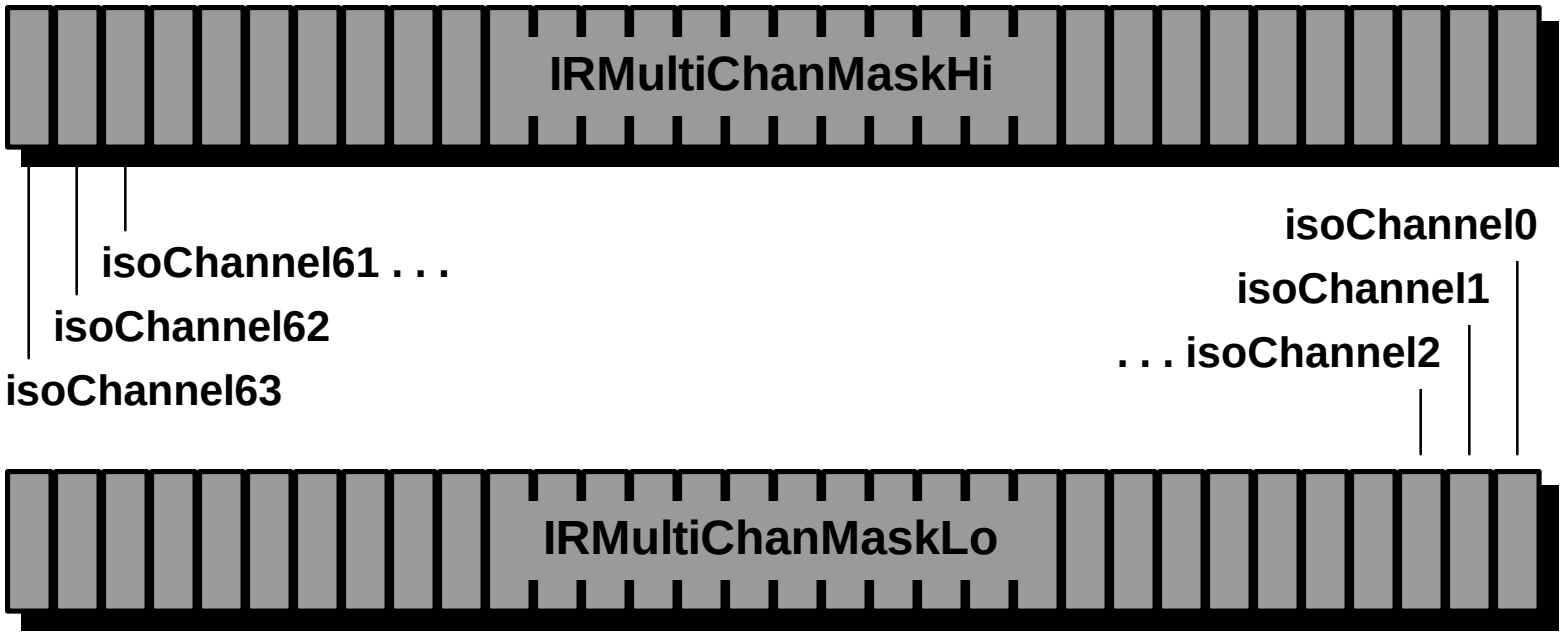
- Most Contexts receive a single isochronous channel
- Set channel number in contextMatch register
- Can start immediately, on cycle number match, or sync bits match

Multi-Channel Receive

- One IR DMA Context can receive multiple isochronous channels
- Set ContextControl.multiChanMode
- Set channels in IRMultiChanMask
- Must set bufferFill and isochHeader

IRMultiChanMask

- **Set / Clear and Hi / Lo (4 total)**



Synchronization

- Typically, some Contexts are running, and some are not
- Contexts can start / stop at any time
- Start on cycle, sync, or immediate
  - Specify cycle, sync in ContextMatch
- Stop on Z = 0, error, or immediate

Isoch Receive Using the IR DMA

1394 OpenHCI
10.4.4, 10.5, etc.

1394 HCI OPEN

Using the IR DMA

- Iso Receive may continue for hours
- Not possible to have all data or all descriptors in host memory at start
- Common solutions:
  - Write descriptor loop, refresh buffers
  - Append descriptors on the fly
  - Either way, use interrupts for timing

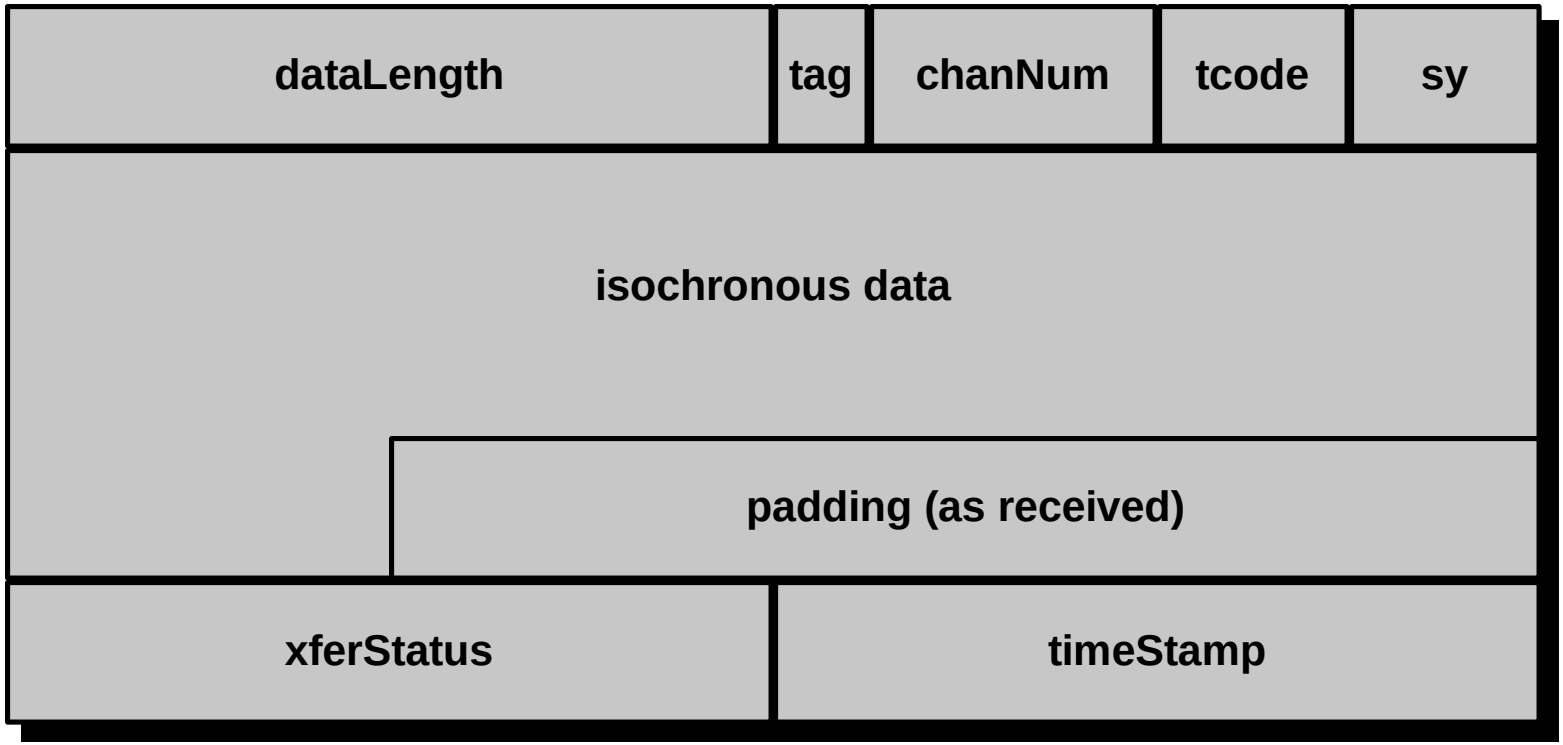
Using the IR DMA (2)

- Use bufferFill or packet-per-buffer per Context, based on application
  - Multi-channel must be bufferFill
- Choose tag / sync values per Context

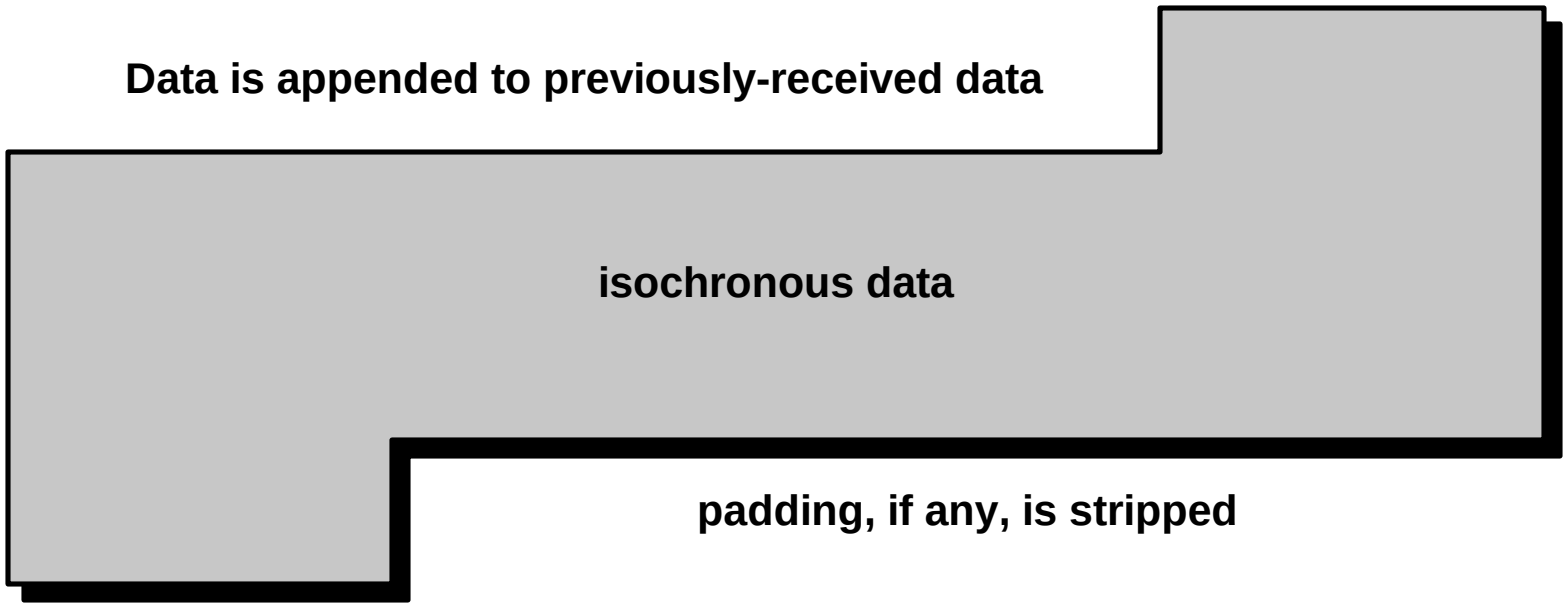
Isoch Receive Packet Data Formats

1394 OpenHCI
10.6

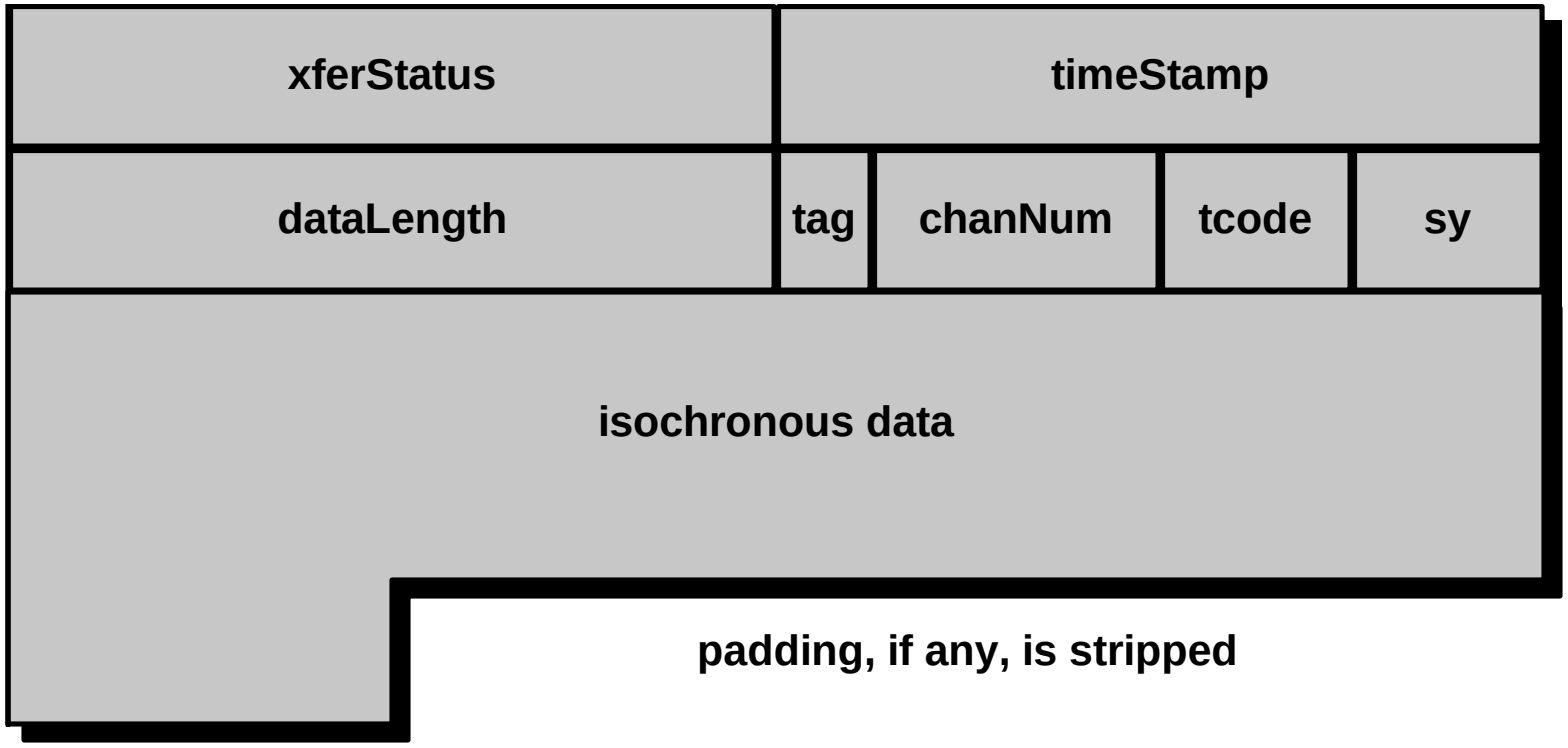
BufferFill with Header & Trailer



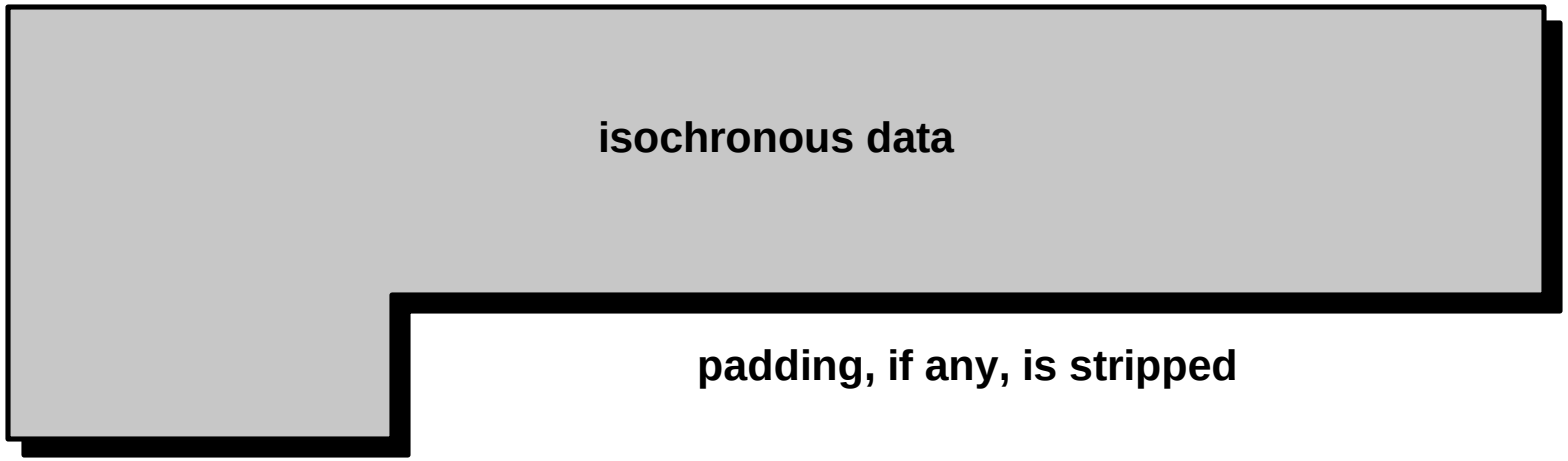
BufferFill without Header & Trailer



Packet-per-buffer with Header & Trailer



Packet-per-buffer w/o Header & Trailer



1394 Open HCI
Isochronous Receive DMA

ContextControl.run = 0

(End)