VDIF2

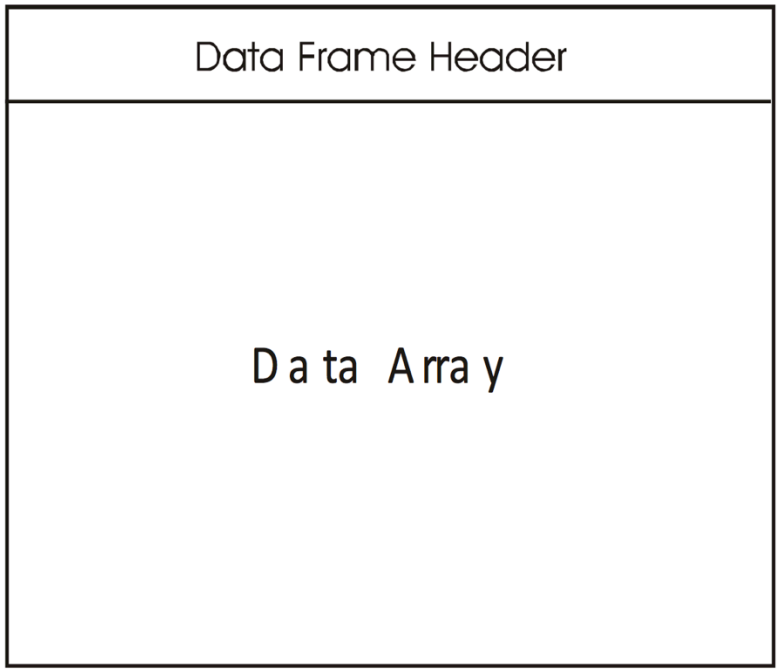
Addressing VDIF limitations

Chris Phillips | LBA Lead Scientist

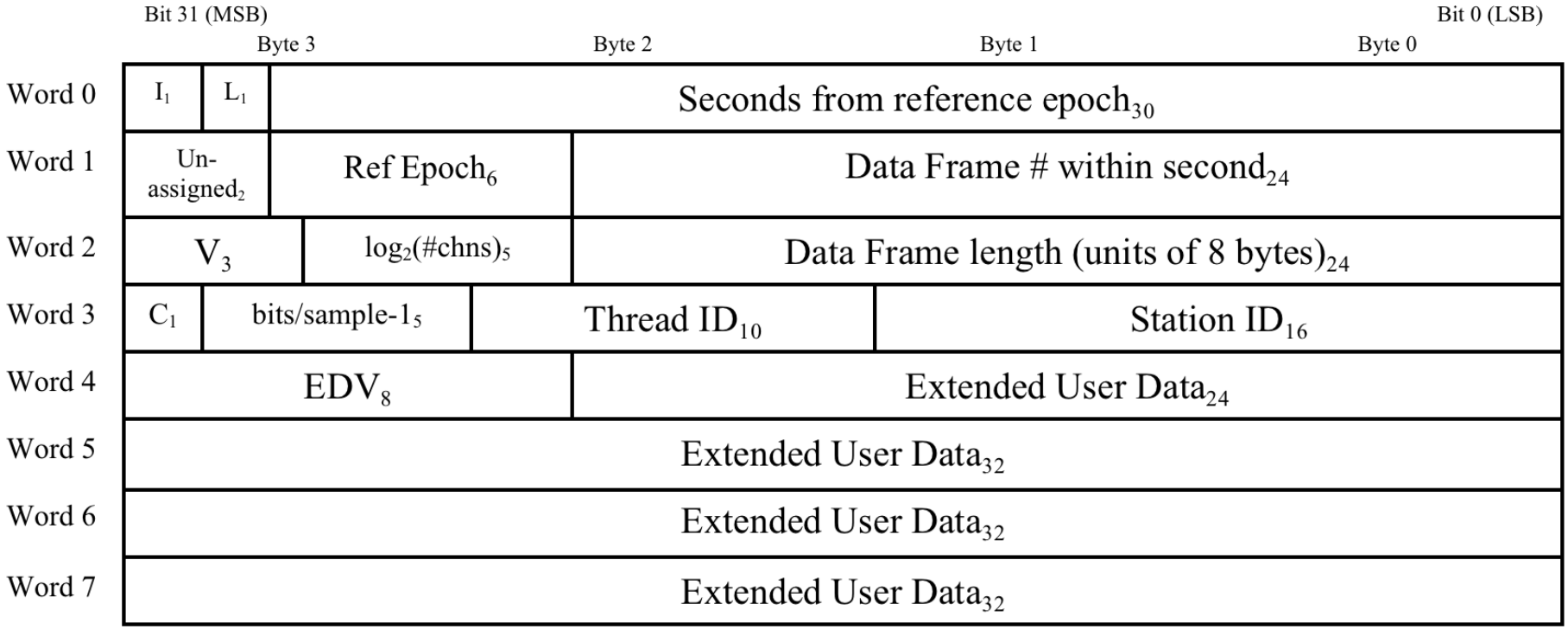
24 November 2015

VDIF

- Developed in 2009 as a “unified” VLBI data format
  - Suitable for disk and eVLBI
  - Ratified 26 June 2009 8th International eVLBI workshop (Madrid)



VDIF - Header


Bit 31 (MSB)
Bit 0 (LSB)
Byte 3
Byte 2
Byte 1
Byte 0
Word 0
I1
L1
Seconds from reference epoch30
Word 1
Un-assigned2
Ref Epoch6
Data Frame # within second24
Word 2
V3
log2(#chns)5
Data Frame length (units of 8 bytes)24
Word 3
C1
bits/sample-15
Thread ID10
Station ID16
Word 4
EDV8
Extended User Data24
Word 5
Extended User Data32
Word 6
Extended User Data32
Word 7
Extended User Data32

VDIF Limitations

- Must be an integral number of frames per second
  - Implies integral number of samples/sec
- Must be 2^n channels/thread
- All channels must fit within single frame
  - Limited # channels for network based transport
- Poor efficiency packing non-power 2 bits
  - *Do we really care*?
- Does not support multibeam instruments

Real word examples

ASKAP

- Sampling rate of 32/27 MHz
  - 18% oversampling to reduce baseline ripple with multi-stage filterbanks
  - Effelsberg/Parkes PAF same formatting

GMRT

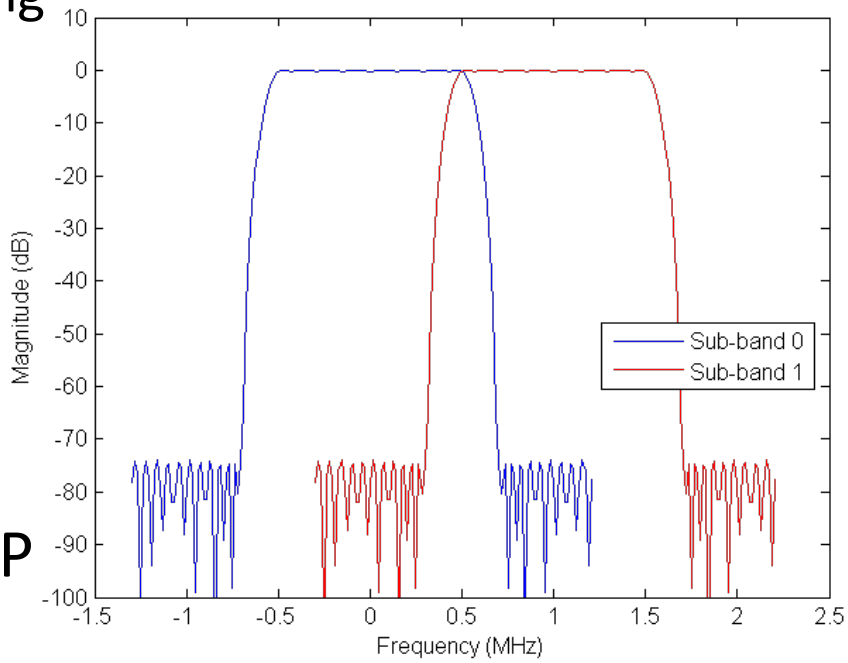
- 16⅔ MHz bandwidth
  - Phased in frequency domain

MWA

- 10 kHz phase array data

SKA-Low

- Oversampled data rate like ASKAP
- Many beams, many stations



Real word examples (cont)

Parkes PAF

- Sampling rate of 32/27 MHz
- 36 beams
- 48 Threads
  - Cannot encode as 1024 unique threads
- 14 channels/beam
  - Dual pol

VDIF2

- VDIF2 proposed by Alan Whitney 2011
- Reviving as need format for Parkes PAF ***now***
- Addresses sampling rate, packing efficiency, large number of channels
- Much more flexible than VDIF……

	Bit 31 (MSB) Byte 3		Byte 2		Byte 1	Byte 0 Bit 0 (LSB)
Word 0	I_1	C_1	Seconds from reference epoch at beginning of current $Period_{30}$			
Word 1	Data Frame # within current $Period_{32}$					
Word 2	V_3	bits/$sample_5$	Data Array length-1 (units of 8 bytes)$_{24}$			
Word 3	Ref $Epoch_6$		R_4	$Unassigned_6$	Station ID_{16}	
Word 4	Sample Block length-1 (units of 8 bytes)$_{16}$				#chns-1_{16}	
Word 5	Thread ID_{16}				Group ID_{16}	
Word 6	Reserved for future use_{16}				Period-1 (seconds)$_{16}$	
Word 7	Reserved for future use_{32}					
Word 8	#Sample Intervals per Period (MSB)$_{32}$					
Word 9	#Sample Intervals per Period (LSB)$_{32}$					
Word 10	Synchronization $word_{32}$					
Word 11	Reserved for VTP use_{32}					
Word 12	EDV_8		Extended User $Data_{24}$			
Word 13	Extended User $Data_{32}$					
Word 14	Extended User $Data_{32}$					
Word 15	Extended User $Data_{32}$					

VDIF2 sample rate

- Relax requirement of integral # frames/sec
- Introduce frame period
  - Must be integral # frames/period
  - Frame count increases monotonically over period
    - Does not reset every second
- ASKAP 32/27 MHz needs period of 27 seconds
- GMRT 16⅔ MHz needs period of 3 seconds

VDIF2 channel layout

- Pack individual channel samples tightly, regardless of # bits. This forms a “complete sample”.
- Pack 1 or more complete samples into a sample block
  - Samples blocks are an integral # 64bit words.
  - Sample block not necessarily completely filled
- Data array within data frame not constrained by size of sample block
  - Sample block can be larger, the same or smaller than data array size

VDIF2 - Pros

- Encode sample rates which are impossible with VDIF and exist in current or next generation telescopes.
- More efficient for “odd” bit encoding
- Allow larger number of channels

VDIF2 - Cons

- Much, much more complicated
- Introduces yet another data format
- VDIF2 naming introduces expectation that correlators will universally be able to cope with it (and of all types)
- Much more complicated

Options

- Embraced VDIF2 as necessary
  - It's just software, after all
- Reject it as a bad idea
- Suggest different VDIF inspired data format to be used
  - Format exists in parallel with VDIF
  - But how does the VLBI community deal with data which cannot be handled with VDIF1

ATNF have engineers waiting for an answer….

Thank you

Astronomy and Space Science
Dr Chris Phillips
LBA Lead Scientist

t +61 2 93724608
e Chris.Phillips@csiro.au
w www.atnf.csiro.au