

# FITS and DRWG BoF

*Flexible Image Transport System : Data Representation Working Group*

L.Chiappetti *et al.*

INAF - IASF Milano  
chairman - former IAU FITS WG → new IAU DRWG

ADASS XXVI Trieste 17 October 2016



## BoF session outline – 2

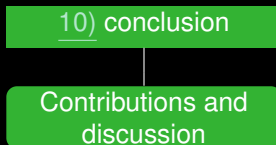
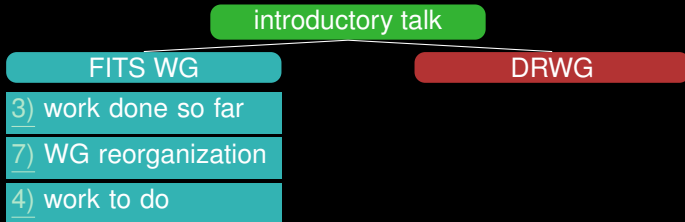


10) conclusion

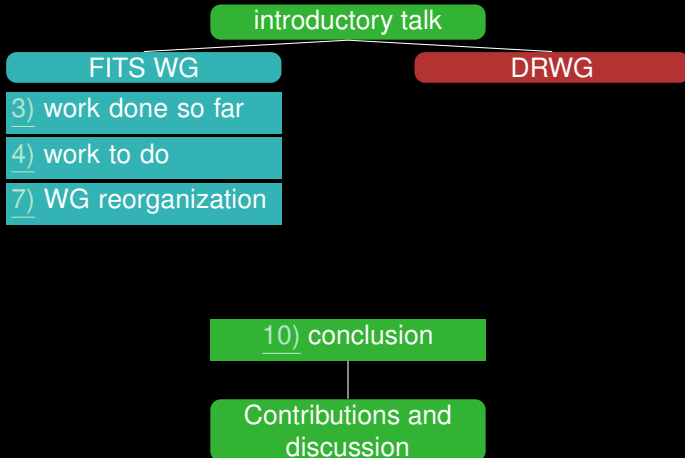
Contributions and  
discussion



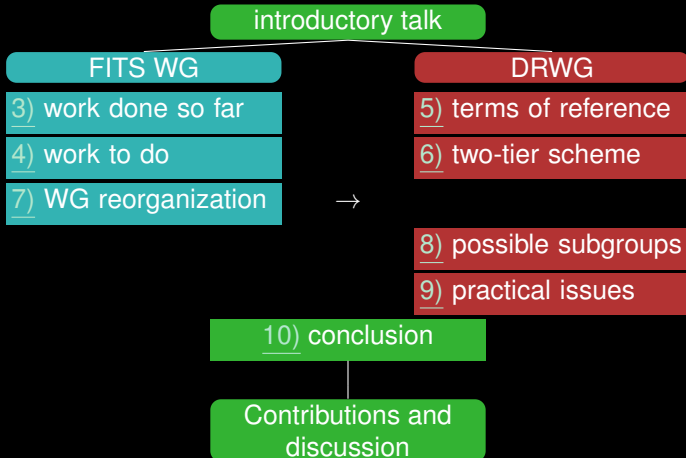
## BoF session outline – 2



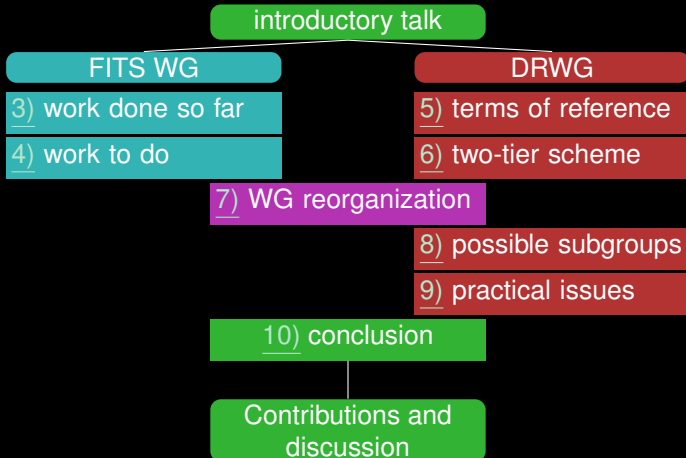
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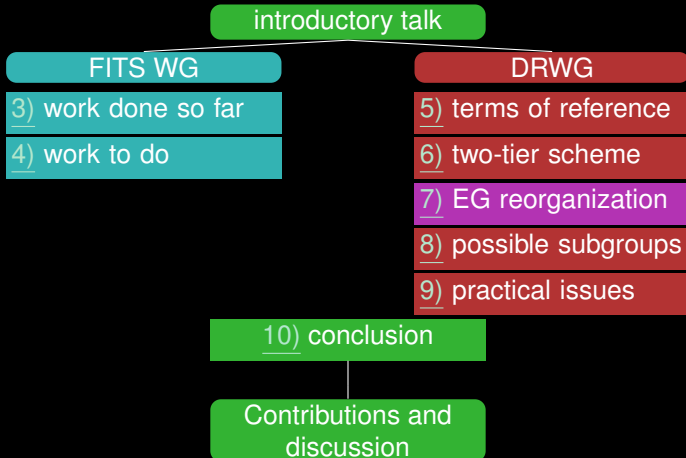
## BoF session outline – 2



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# FITS – recent updates to the standard – 3.a

A **version 4.0 draft of the FITS standard** has been released in July 2016 via [http://fits.gsfc.nasa.gov/fits\\_standard.html](http://fits.gsfc.nasa.gov/fits_standard.html).

All items in the draft have been formally voted by the IAU FITS WG and therefore are **already in effect** since their announcement on FITSBITS.

The draft is currently undergoing a mere **language editing** and will be definitively **released asap**.





# FITS – recent updates to the standard – 3.b

Refer to FITS 4.0 doc (in particular App. H.3) for details on changes/additions:

- chapter on **time WCS** ([Rots et al. 2015](#) already incorporated in 2014)
- chapter on **tiled image and table compression** (**incorporated conventions**)
- incorporated **CONTINUE** convention for **long-string valued kwds**
- **CHECKSUM** and **DATASUM** data integrity keywords
- **column limit keywords** (TLMIN<sub>n</sub>, TLMAX<sub>n</sub> ...)
- incorporated *usage* convention for **preallocating scratch space** in a FITS header
- mention of the **Green Bank convention** (App. L)
- reserved **INHERIT** keyword to support **relevant convention** (App. K)



## FITS – forthcoming work – 4.a

- reorganization of FITS WG **membership** ▶
- procedural vote on **FITS 4.0 document** ◀
- reorganization of FITS **voting rules** ▶
- **resuming actions already initiated** or mentioned
- anything else



# FITS – forthcoming work – 4.b

initiated by old task force/s (→Jan 2015) or mentioned otherwise (by me)

- long keyword names (55-74 char)
- extended character set (a-z \_-\$ . : blank?)
  - (incorp.) spatial region convention
  - (incorp.) various WCS conventions (SIP, TNX, TPV, ZPX)
  - (incorp.) ESO HIERARCH
  - (incorp.) Hierarchical grouping
  - (incorp.)
  - (incorp.) substring array in BINTABLEs
  - (incorp.) various complex project-specific conventions
- dedicated METADATA extension
- support to Unicode strings
- an INDEX HDU for MEFs (FAR = FITS ARchive)
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## DRWG – terms of reference – 5.a

from original [Letter of Intent](#) for IAU Commission B2 "Data and Documentation" by Bob Hanisch

2.5 A **WG for Data Representations** (an **expanded WG FITS**) will help ensure and maintain the fluent interoperability of telescope data that has not only made multi-wavelength astronomical research commonplace, but has also made astronomy's data management practices the envy of many other disciplines. The WG FITS has been the custodian and advocate for the **Flexible Image Transport System** format since it was **formally endorsed by the IAU in 1982**; however, the more recent data landscape has broadened substantially, and many **new facilities are exploring alternatives** to the FITS standard in order to manage their issues of data scale and complexity. The WG FITS will therefore be expanded, and renamed Data Representations. It is vital to manage a careful and **minimally disruptive transition from FITS to more modern and capable data representations**, and in order to assure that continuity we plan to retain the FITS governance structure through a **FITS Subcommittee** that is part of the new WG. **Subcommittees focused on other data representation standards** can also be created as needed.

3. Associates The remit of this Commission encompasses the understanding of astronomical data in many forms, and requires **both scientific and technical expertise**. Commission 5 routinely relied upon **Associates**, particularly in the WG Libraries and WG FITS, and we expect that need to continue.



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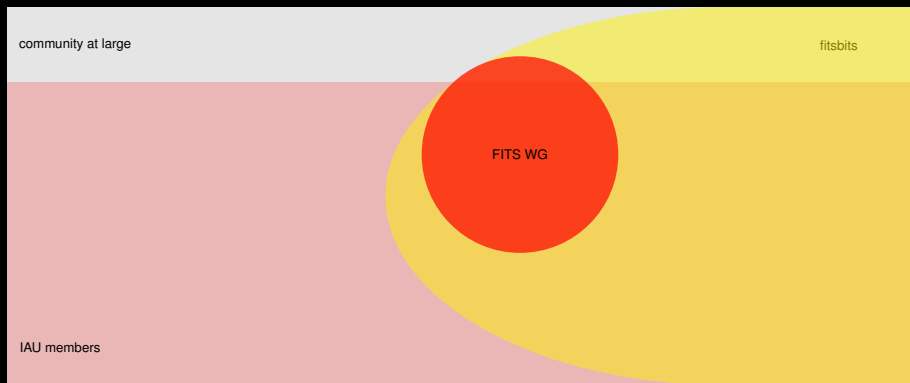
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Outer tier: forum for IAU members interested in the matter

Inner tier: Special Expert Groups (SEGs)



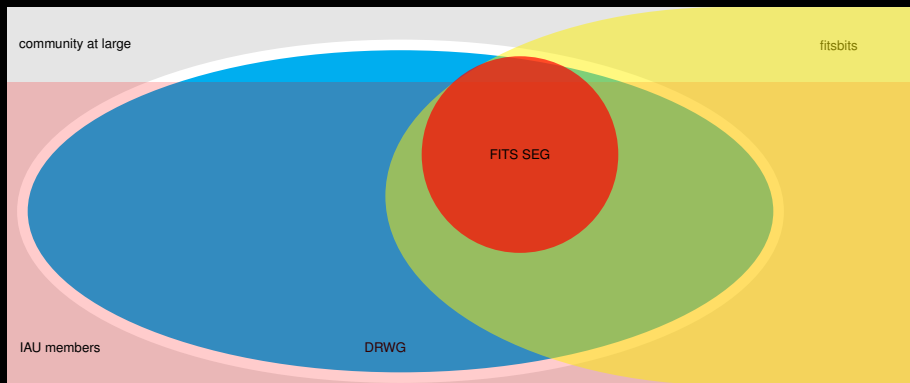
mimicked on FITS WG vs FITSBITS: community contributes, WG decides



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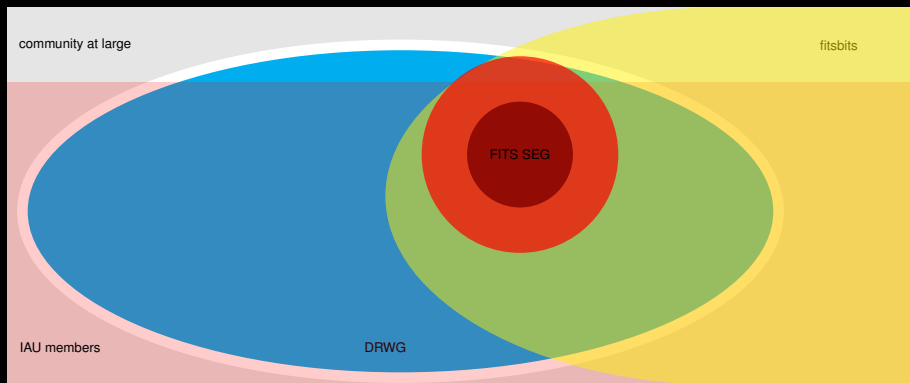
FITS WG becomes first SEG



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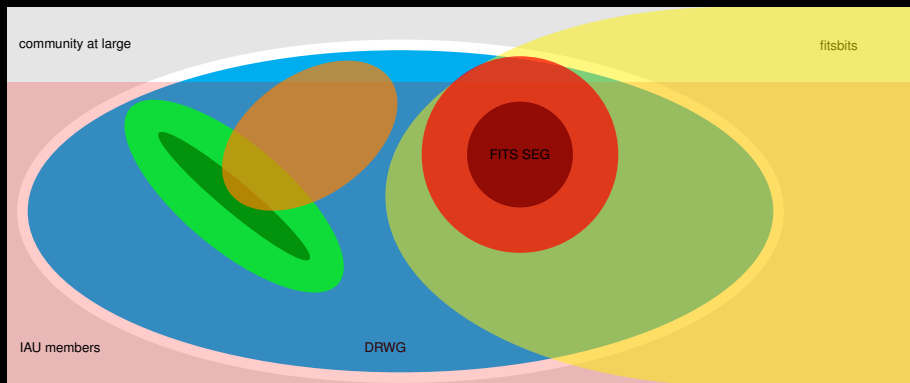
institutional vs individual members ?



## DRWG – two-tier scheme – 6.d

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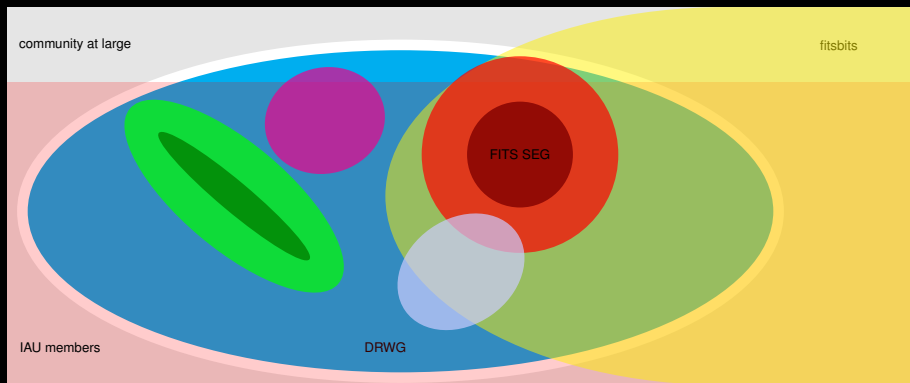
add other SEGs: community DRWG community contributes, SEG decides



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overlapping or distinct, permanent or short-term ...

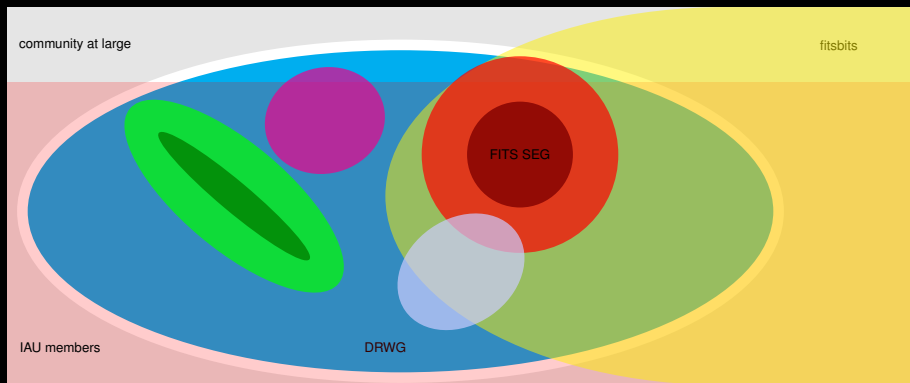




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# FITS in DRWG – reorganization – 7.a

A rearranged FITS WG will become the **FITS SEG**.

It will be the initial nucleus of DRWG and **resume work asap**. ▶

Rearrangement will be dealt with *internally*.

- some members are stepping down or have retired  
replacements and new members (CDS StScI LSST China India ...)  
maintain total number within 25
- possible change in voting rules : institutional vs individual membership  
e.g. quorum of 50% of all members and 3/4 of institutional members  
institutional members *must* vote  
institutional NO delays by 3 months



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## DRWG – possible SEGs – 8.a

- **Curation SEGs** are long-term.  
Time commitment limited (except occasional task forces).  
Max 24 members. Member rotation ?
- **Topical SEGs** have a limited duration (specific charter).  
Require significant time effort and competence.  
Max 12 members.
- DRWG Executive made by SEG chairs/vice-chairs ?  
Incompatibility DRWG chair vs SEG chair ?  
Ex-officio members or observers (B2 chair, VO) ?

For discussion ...



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- SEG n : curation SEG for astronomical usage of **data format xxxx** (proposals ?)
- ...
- SEG 1 : **Next Generation data format SEG**  
design, prototype, formulate proposal
- SEG 2 : **Data Provenance SEG**  
define an IAU standard ?
- SEG 3 : **Event Stream SEG**  
formalize protocols, VO cooperation, define an IAU standard
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# DRWG – practical issues – 9.a

## Needed operational tools

- a DRWG **website**
- a DRWG **mailing list**
- SEG tools (each on its own)

Current FITS WG tools (website @ HEASARC, lists FITSBITS and IAUFWG @ NRAO) *will continue*

I have the **capability** to maintain an **Apache** website and a **mailman** mailing list, but may not have the time (and ... *in the long run we will be all ... retired*).

- Find a permanent hosting institution ? volunteers ?
- Are there **IAU-provided facilities** ?
- Use (**ad interim** ?) external tools (pbworks wiki ?)

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# DRWG – final remarks – 10

I solicit contributions and open discussion on

- FITS related ideas
- Other formats related ideas
- DRWG member candidatures
- Proposals for DRWG SEGs
- Setting up the DRWG (tools)



... the word to you

SIC TRANSIT GLORIA MVNDI



... the word to you

SIC TRANSIT GLORIA

... the word to you

SIC TRANSIT

... the word to you

SIC

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*It is a bit freaky with this wireless technology*

# A voice from the past – 12.a

## XAS format (*circa* 1996)

- not FITS but **mappable to FITS**
- except for smaller calibration files (plain ASCII)
- defined as working format as opposed to transport format
- X-ray astronomy *data model*:
- two physical binary formats (**BINTABLE** was just being standardized at the time)
- issue at the time: portability (VAX/Unix, big/little endian), efficiency
- binary format used native representation (for work and export)
- unidirectional utility to import and localize in place
- files used native record length (**image** or **table** row)
- 28-byte **miniheader** (magic number, record length, number of data and header records)
- 1 or exceptionally more minih records followed by **data area** then ...
- metadata **header** (actually trailer) at end
- header arranged in binary **keywords** with binary type, length byte, name, value
- kwd names limited to **8 char**
- numeric (I J E D) kwds could be array-valued (potentially up to 255 bytes)
- string kwds **limited to 68 bytes** for FITS compatibility
- hence all other arrays limited to same max length
- mandatory** kwds: BITPIX, NAXIS1 and NAXIS2, TFIELDs, TFORMn, *TTYPEn*
- ev. unnamed columns (record length padded to 4n bytes for Fortran direct access)

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- mandatory** kwds: BITPIX, NAXIS1 and NAXIS2, TFIELDs, TFORMn, *TTYPEn*
- ev. unnamed columns (record length padded to 4n bytes for Fortran direct access)



# A voice from the past – 12.e

## XAS format (*circa* 1996)

- not FITS but **mappable to FITS**
- except for smaller calibration files (plain ASCII)
- defined as working format as opposed to transport format
- X-ray astronomy *data model*: **images**, **resp. matrices**, **spectra**, **time profiles**, **photon lists**, **gen. histo**
- two physical binary formats (**image** and **tabular**) (**BINTABLE** was just being standardized **at the time**)
- issue at the time: **portability** (VAX/Unix, big/little endian), **efficiency**
- binary format used **native representation** (for work and export)
- unidirectional utility to import and localize in place
- files used **native record length** (**image** or **table** row)
- 28-byte **miniheader** (magic number, record length, number of data and header records)
- 1 or exceptionally more minih records followed by **data area** then ...
- metadata **header** (actually trailer) at end
  - header arranged in binary **keywords** with binary type, length byte, name, value
  - kwd names limited to **8 char**
  - numeric (I J E D) kwds could be array-valued (potentially up to 255 bytes)
  - string kwds **limited to 68 bytes** for FITS compatibility
  - hence all other arrays limited to same max length
  - mandatory** kwds: BITPIX, NAXIS1 and NAXIS2, TFIELDs, TFORMn, *TTYPEn*
  - ev. unnamed columns (record length padded to 4n bytes for Fortran direct access)

# A voice from the past – 12.f

## XAS format (*circa* 1996)

- not FITS but **mappable to FITS**
- except for smaller calibration files (plain ASCII)
- defined as working format as opposed to transport format
- X-ray astronomy *data model*: **images**, **resp. matrices**, **spectra**, **time profiles**, **photon lists**, **gen. histo**
- two physical binary formats (**image** and **tabular**) (**BINTABLE** was just being standardized **at the time**)
- issue at the time: **portability** (VAX/Unix, big/little endian), **efficiency**
- binary format used **native representation** (for work and export)
- unidirectional utility to import and localize in place
- files used **native record length** (**image** or **table** row)
- 28-byte **miniheader** (magic number, record length, number of data and header records)
- 1 or exceptionally more minih records followed by **data area** then ...
- metadata **header** (actually trailer) at end
- header arranged in **binary keywords** with binary type, length byte, name, value
- kwd names limited to **8 char**
- numeric (I J E D) kwds could be array-valued (potentially up to 255 bytes)
- string kwds **limited to 68 bytes** for FITS compatibility
- hence all other arrays limited to same max length
- mandatory** kwds: BITPIX, NAXIS1 and NAXIS2, TFIELDs, TFORMn, *TTYPEn*
- ev. unnamed columns (record length padded to 4n bytes for Fortran direct access)

# A voice from the past – 12.g

## XAS format (*circa* 1996)

- not FITS but **mappable to FITS**
- except for smaller calibration files (plain ASCII)
- defined as working format as opposed to transport format
- X-ray astronomy *data model*: **images**, **resp. matrices**, **spectra**, **time profiles**, **photon lists**, **gen. histo**
- two physical binary formats (**image** and **tabular**) (**BINTABLE** was just being standardized **at the time**)
- issue at the time: **portability** (VAX/Unix, big/little endian), **efficiency**
- binary format used **native representation** (for work and export)
- unidirectional utility to import and localize in place
- files used **native record length** (**image** or **table** row)
- 28-byte **miniheader** (magic number, record length, number of data and header records)
- 1 or exceptionally more minih records followed by **data area** then ...
- metadata **header** (actually trailer) at end
- header arranged in **binary keywords** with binary type, length byte, name, value
- kwd names limited to **8 char**
- numeric (I J E D) kwds could be array-valued (potentially up to 255 bytes)
- string kwds **limited to 68 bytes** for FITS compatibility
- hence all other arrays limited to same max length
- mandatory** kwds: BITPIX, NAXIS1 and NAXIS2, TFIELDs, TFORMn, *TTYPEn*
- ev. unnamed columns (record length padded to 4n bytes for **Fortran direct access**)