

Units for the VO

- Used in many places
- No IVOA Recommendation
- Hot topic
 - passionate discussions
 - cultural implications
 - strict ruling vs accommodating existing usage
- Time to define a reference document

Units in the IVOA standards

- Search all IVOA Standards for mentions of Units
- Get a comprehensive view of :
 - where units are used
 - how they are used
- What / how can we standardize ?

Units Where and How ?

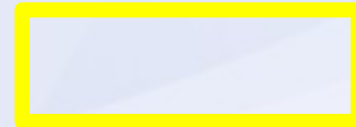
- Where
 - Unit attribute : `<FOO ... unit="" ... />`
 - Unit element : `<TAG>unit here</TAG>`
 - corresponding utype “ns.This.Is.My.Unit”
- How Units are spelled (scheme) :
basic units + rules for combining (km/s)
 - IAU style 1989 : more typographic rules
 - Standard for catalogues (2000: CDS, AAS)
 - OGIP (1993: HEASARC)

Units in VO Standards

- Through VOTable 1.2



- OGIP conventions



- Dedicated entities in Data Models, utypes
(possibly with dimensional equations)



- Remarks, no clear restrictions



- Restricted or implicit Units values ©

LEVEL 2

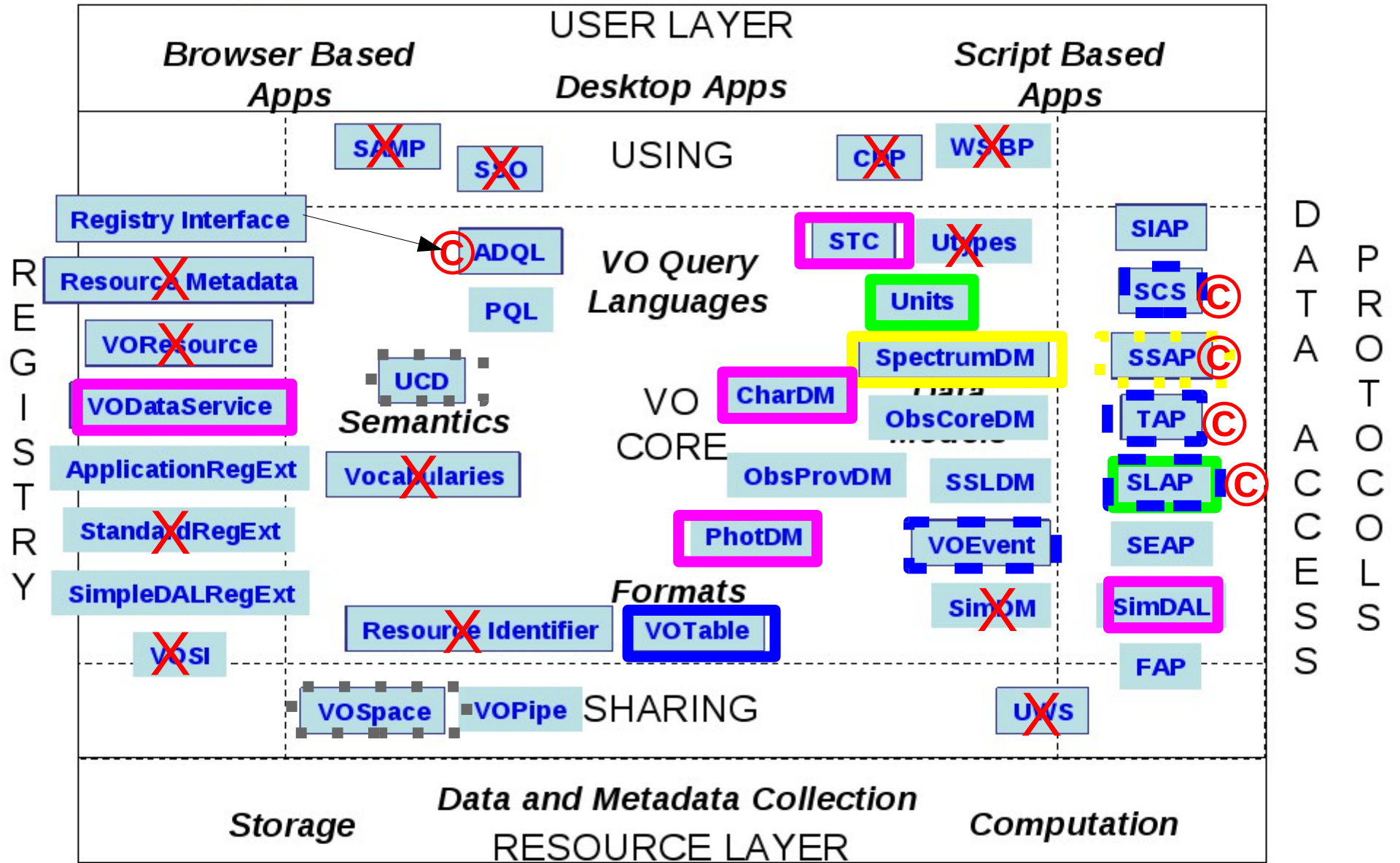
USERS



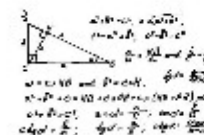
COMPUTERS

REC

InProgress



PROVIDERS



Units in VOTable 1.2

```
<FIELD ... unit="" ... />
```

```
<PARAM ... unit="" ... />
```

- Section 4.4 of VOTable 1.2 Rec
 - String without blanks or spaces
 - Relies on
 - IAU 1989 recommendation
 - Section 4 in Greisen and Calabretta 2002, A&A 395, 1061
 - Catalogues standard description @CDS
- Not always compliant in examples !!

DM vs DAL

- Data Models often do not constrain Unit strings, no recommended scheme
- DAL protocols often
 - restrict possible units
 - have implicit units

Restricted Units (enumerated)

- SIAP
 - Field VOX:BandPass_Unit = meters | hertz | keV
- SLAP
 - ssldm:Line.*****Level.energy.value : Joules
 - char:TimeAxis.Coverage.Bounds.**** days
- SSAP
 - POS, TIME (degrees), BAND (meters)
TIME (ISO 8601 UTC??)

Implicit Units in protocols

- CS : RA, DEC SR in decimal degrees
- SIA 1.0 : POS, SIZE in decimal degrees
- SLAP : WAVELENGTH in meters,
EINSTEIN_A in s⁻¹
- ADQL 2.0 : coordinates angles in decimal degrees

Non-compliant Units examples

- SLAP : `<TD>micron</TD>`
- ObsCore DM : `kbyte, kB, Kbytes`

Keep it simple !

- Units are attached to physical quantities
- But units don't tell what the quantity is
 - use UCD, utypes
- Units don't describe data processing
 - spectra normalized to Vega one : DM issue
- They don't describe special formatting
 - sexagesimal coordinates
 - ISO 8601
- Be reasonable
 - no “apple” or “banana” unit

So how to standardize things?

- Take the reference documents :
 - IAU style manual, section 5.1, 1989
<http://www.iau.org/static/publications/stylemanual1989.pdf>
 - OGIP memo OGIP/93-001, 1993
ftp://legacy.gsfc.nasa.gov/fits_info/fits_formats/docs/general/ogip_93_001/ogip_93_001.ps
 - Standards for Astronomical Catalogues, Version 2.0, section 3.2, 2000
<http://cdsweb.u-strasbg.fr/doc/catstd-3.2.htx>
 - FITS v3.0, section 4.3, W.D. Pence et al., A&A 524, A42, 2010
- And merge them all to find common rules and differences !

Big reference table !

- Agree on common aspects
- Discuss (a little) / vote (yes/no) to decide what to do on open issues

Vocabulary

- SI = Système International
- Base units (SI + angle), derived units
 - base symbols
- (Sub)Multiple (scale) factors, prefixes
- Astronomy-related symbols
- Deprecated units
- Other units (number of things)
- Compound units
 - mathematical combinations & representation

VO Units

- Proposal : case sensitive string
 - don't deal with typography
- Vote on :
 - list of symbols to use
 - consensus on needed ones (exotic, deprecated?)
 - how they are spelled
 - (sub)multipliers / prefixes
 - apply on all / some symbols
 - restrictions per symbol ?
 - ensure consistency

VO Units

- Vote on :
 - how to write compound units
 - numeric factor
 - supported math operations
 - syntax for composition
 - should we include (numeric) equivalent SI(?) values in the reference document ?

VO Units services

- From the unit string, methods to derive :
 - validation level
 - human-readable name
 - SI equivalent
 - recommended spelling
 - dimensional equation, scaling factor
 - styled symbol (HTML, LaTeX)
 - ...

Stay tuned

- <http://www.ivoa.net/cgi-bin/twiki/bin/view/IVOA/UnitsDesc>
- Units in the VO WD v0.3
 - soon v0.4
- To do :
 - get feedback / consensus on comparison table
 - write corresponding BNF
- Plans to develop unit tools ?