1. STC in the Registry

(cf. Fig. 1)

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(cf. Fig. 2)

We are trying to enable registry queries like

"Where can I find X-ray data near the center of the LMC?"

```
SELECT ivoid
FROM rr.stc_spatial
NATURAL JOIN rr.stc_temporal
WHERE
        1=CONTAINS(
            POINT('', 80.9, -69.8),
            coverage)
        AND ref_system_name IS NULL
        AND ivo_interval_overlaps(
            wavelength_start, wavelength_end,
            1e-8, 1e-11)
```

(cf. Fig. 3)

2. Publishing: What's missing?

Original VODataService (2010) has a `coverage` element that would define coverage using STC-X `ResourceProfile`.

Only about 1000 resources give that, and most of the time it's trivial ("all sky" with no temporal or spectral coverage). Also, STC-X is a huge beast that lets data providers use all kinds of frames, reference positions, etc, so using that information is nontrivial.

For spatial coverage there's `footprint`, containing a URL to a MOC. 70% of current resources have that, but:

- no spectral and temporal coverage
- extra harvesting step

3. Searchable: What's missing?

Current RegTAP tables don't let clients execute queries against either type of coverage metadata.

2012 RegTAP draft had one table each for the four STC axes, to be filled from STC-X metadata. Space was done through ra/dec boxes.

Was shelved due to complexity and generality concerns.

4. Roadmap

Jan 2018: IVOA Note: "A roadmap for space-time discovery in the VO registry"[1]

- VODataService addition: new `spatial`, `temporal`, `spectral` children of the (existing) `coverage` element.
- RegTAP addition: new `stc_spatial`, `stc_temporal`, `stc_spectral` tables in the `rr` schema.

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[1] `http://www.ivoa.net/documents/regstcnote`

5. Publishing Example

```
<coverage>
  <spatial>
    4/2068
    5/8263,8268-8269
    6/33045-33047,33049,33051,33069,33080-33081
  </spatial>
  <temporal>51845.1 52262.2</temporal>
  <temporal>54123 55914</temporal>
  <spectral>3e-07 1.1e-06</spectral>
  <footprint ivo-id="ivo://ivoa.net/std/moc"
    >http://dc.zah.uni-heidelberg.de/cdfspect/q/ssa/coverage</footprint>
  <waveband>Optical</waveband>
</coverage>
```

- Only one `spatial` element with an ASCII MOC
- `temporal` and `spectral` are repeatable
- Precision up to data provider (max order 6 recommended for spatial)

The recommended maximial order translates into a spatial resolution of about one degree in the Registry.

In particular the temporal coverage often has many holes (e.g., daylight or bad weather with ground based observatories). We do not define expectations on the filling factor but recommend representing different observing campaigns.

References systems and positions are fixed (ICRS, BARYCENTER), but data providers should, at least for times, provide for a big of smudging.

6. Searchable Prototype

Based on
- STC-X resource profiles ($\sim 10^3$)
- harvested footprints ($\sim 10^4$)
- prototypes of the new scheme ($\sim 10^2$)

the RegTAP service at http://dc.g-vo.org/tap already fills the three new tables.

(reg.g-vo.org only has STC-X and prototype reliably)

Only point vs. coverage is implemented right now.

7. Next Steps

- Uptake at the publishing registries (like... now)
- pgsphere updates (for general geometry vs. coverage support)
- VODataService 1.2 (for new coverage children)
- ASCII MOC format standardisation
- MOC cells in VOTables (for SELECT coverage...)
- RegTAP update (for the three new tables)

8. Open Questions

- Redshift axis? Distances? What else?
- Open intervals (ongoing programmes)?
- Other reference systems (solar system)?
- Non-EM spectral coverage? The most straightforward way would be to use energy rather than wavelength on the spectral axis – but if we were to go that way, we switch as soon as possible)
- MOC cells in VOTables?

Speak up now!