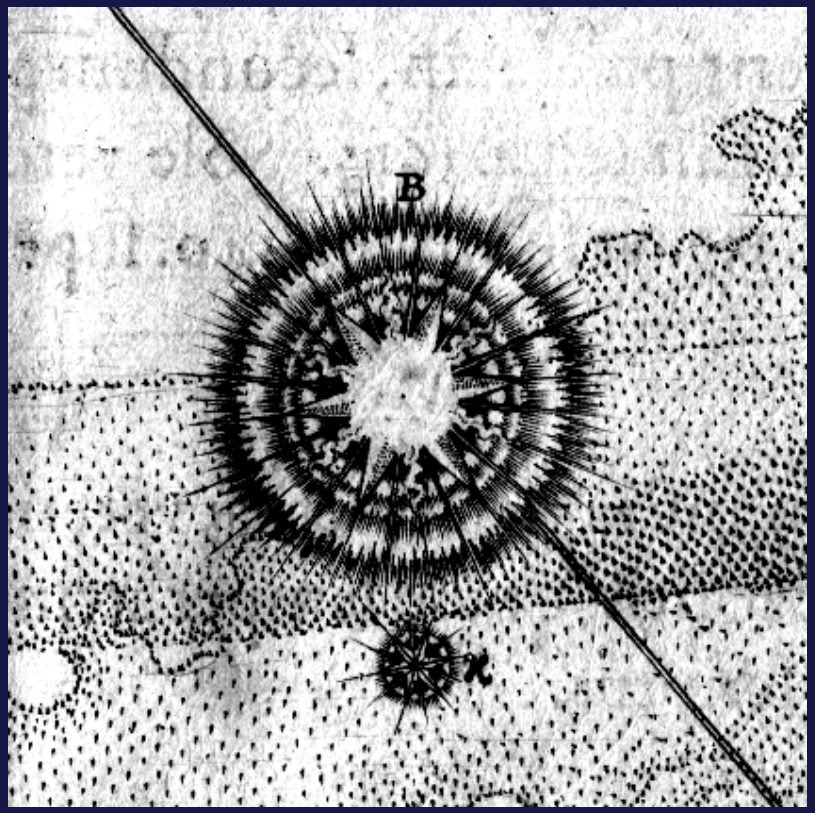


1604 image of Cas A

VO-GCN:
A New Network for Astronomical Events

Roy Williams
Andrew Drake
California Institute of Technology

Rob Seaman
Phil Warner
NOAO, Tucson

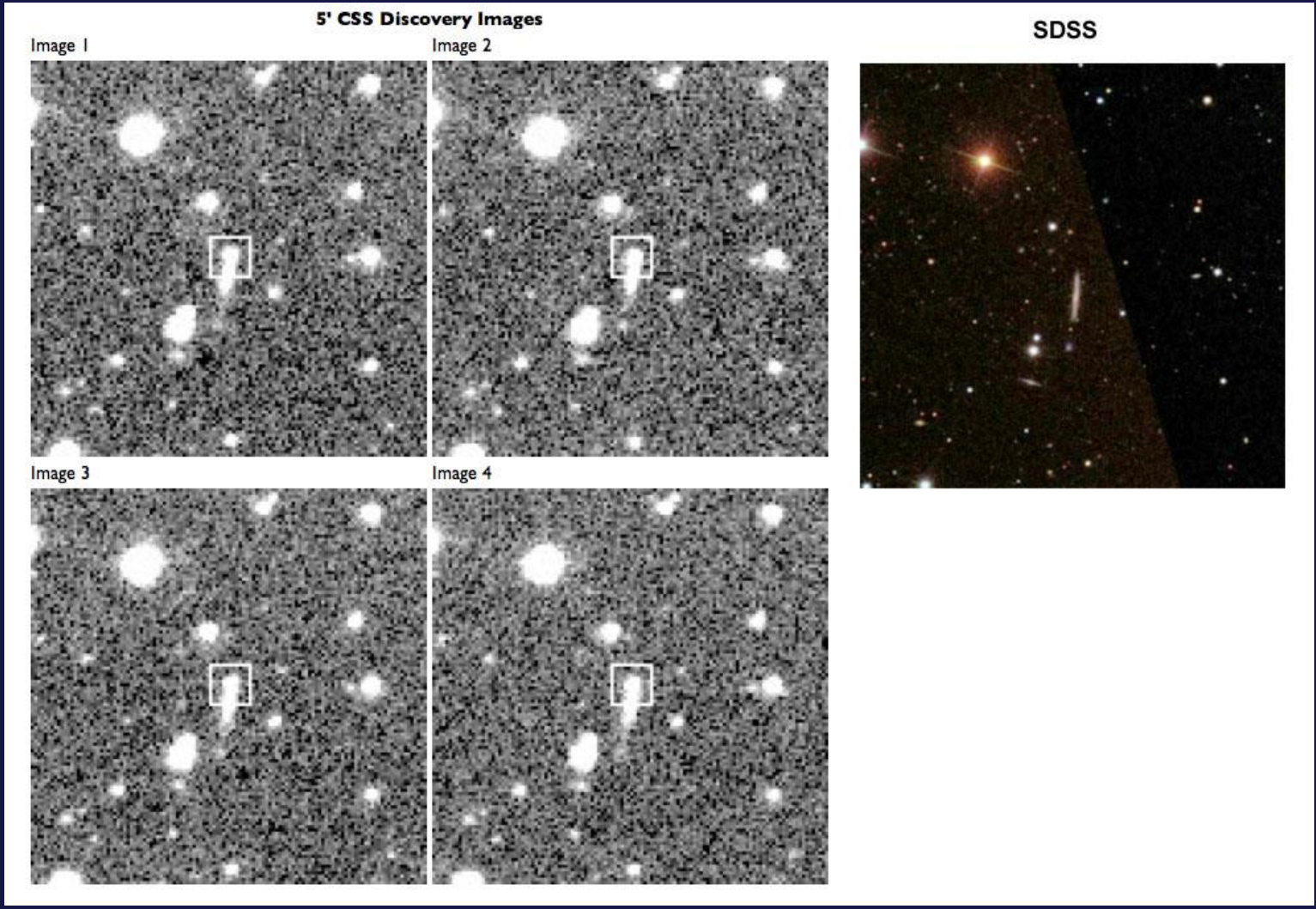
Scott Barthelmy
NASA Goddard

Transient Sources in the Sky

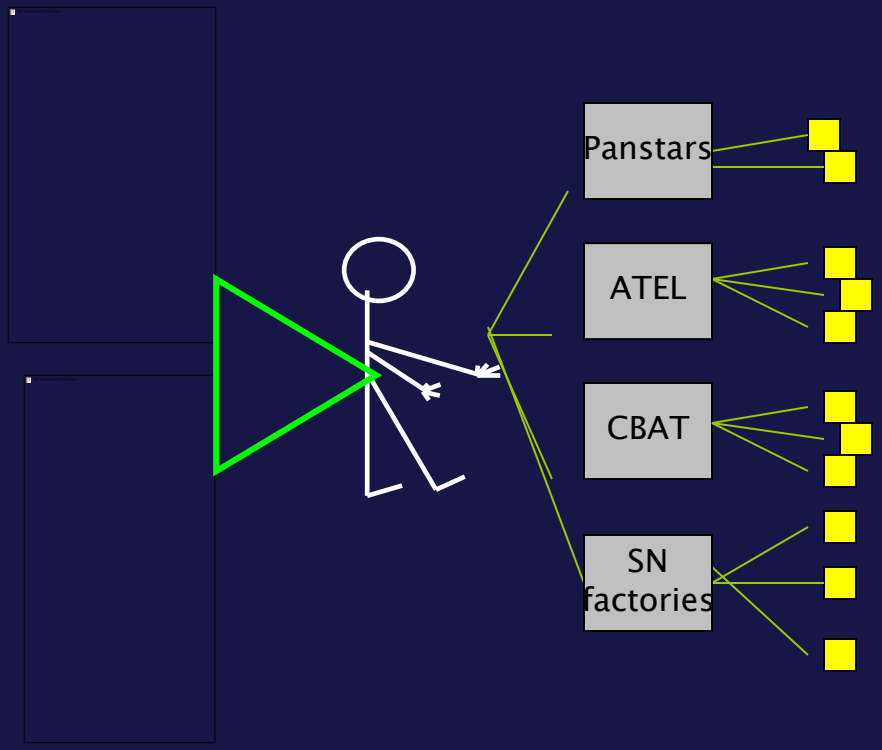
- Satellites (10000" per hour)
- Near Earth Objects (3000" per hour)
- Main Belt Asteroids (10" per hour)
- Trans-Neptunians (1" per hour)
- Radial-velocity planet searching (10 – 100 pc)
- Planet transit searching (100 – 10000 pc)
- M-dwarf flares
- Microlensing + CV + novae (100000 pc)
- RR Lyrae in the galactic halo
- Extragalactic microlensing (10 Mpc)
- Supernovae, microquasars
- Gamma Ray Bursts, Blazars
- *And …… NOT YET THOUGHT OF ….?*

Optical
Radio
Gravitational wave
Neutrino
TeV shower
etc

Supernova from NASA Catalina Survey May 5, 2008



Human Event Reporting



- All human-based
- Data entry problems
- Multiple site monitoring

of a variable source within the error circle for the improved X-ray locati
J1750.8-2900 (Steeghs et al. 2008, ATel #1431; Torres et al. 2008, ATel
The measured magnitudes are Ks = 17.1 +/- 0.1 on Mar 18 and Ks = 17.
on Mar 30. We determined a position of R.A(J2000)=17:50:24.43 and
Dec(J2000)=-29:02:15.0 (+/- 0.1" uncertainty) for this source (see also fi
chart). Note that the Mar 30 data set was acquired when the X-ray flux

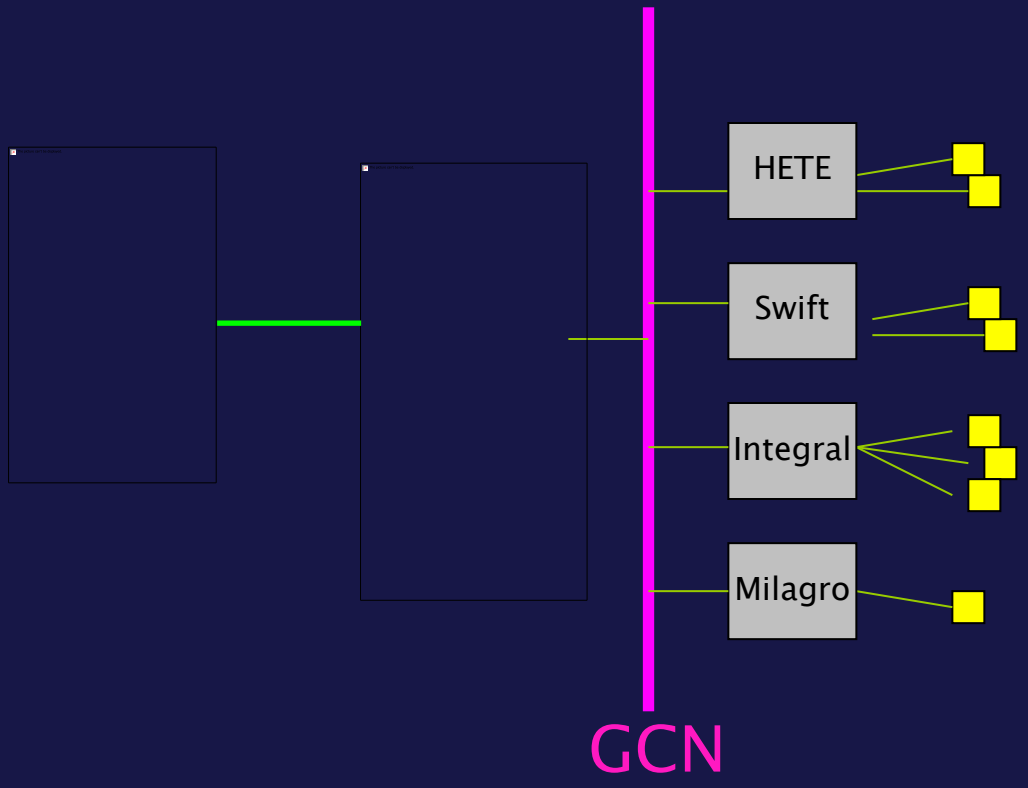
Human Event Reporting

Write with quill pen
Send by horse to Boston
Transcribe data correctly
Read and decide to follow-up
Transcribe data correctly
Write with quill pen
….etc etc

But now too many transients for quill pen!

NASA GCN (1997)

robotic observation of transients for gamma ray bursts



- Fabulous Science!
  - Optical counterpart
- Robots do the work
- Purpose built and grown
- Needs update!

GCN is Fabulous!

- GCN Data packets
  - Binary, brittle, hundreds of kinds
- GCN protocol
  - Outgoing sockets, firewall problems
  - Unclear how to scale
- Hub and spoke
  - All events come through NASA Goddard

… but
needs update to grow
scientifically

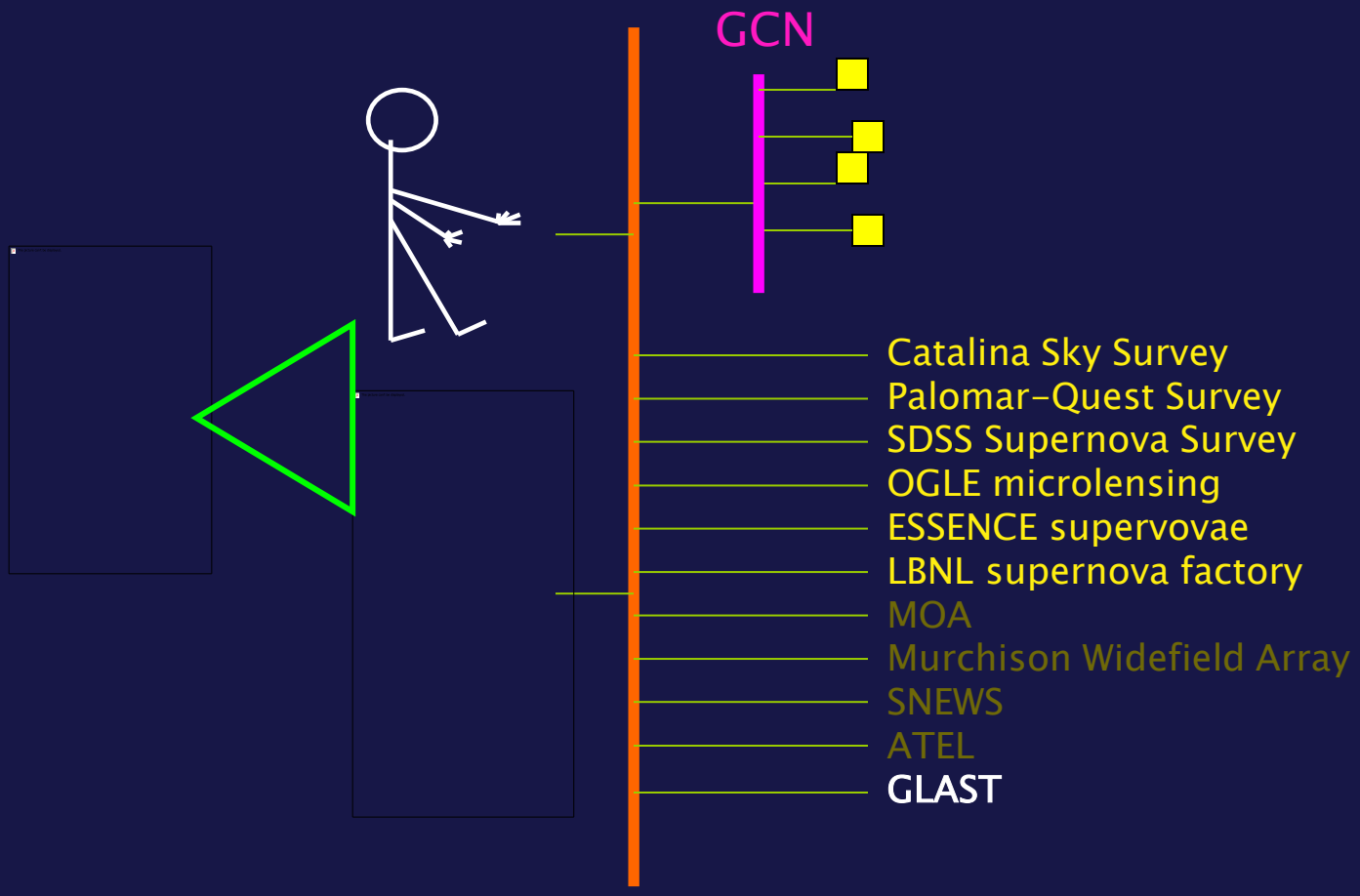
VO-GCN is Evolution of GCN

- Clear roles in extensible, distributed network
  - Author, Publisher, Repository, Subscriber
- Int'l agreement on XML packet
  - Not just bytes and message types
- Follow-ups published in the same framework
- Sophisticated coordinate systems
- Multiple transports: socket, RSS, HTML, KML
- Digital signature
- Semantics and ontology
- Orbital elements and light curves can be expressed
- External schema -- eg solar physics events
- Global identifiers

VOEvent

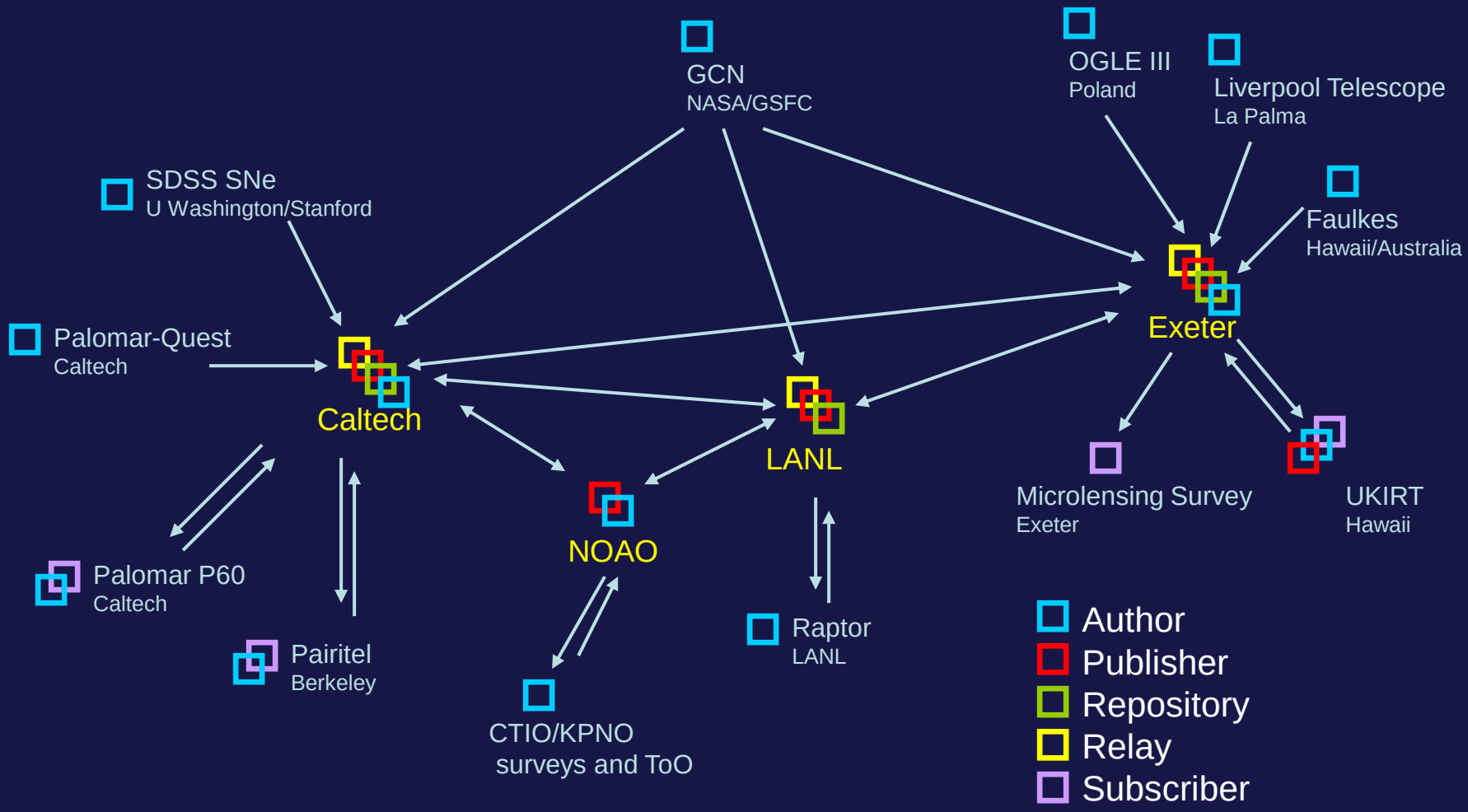
Describing,
automating,
transporting,
persisting,
querying,
correlating,
securing,
sharing,
naming,
and displaying
coherent threads of scientific
monitoring of celestial transient
alerts

VO-GCN (2008)



VO-GCN

VOEvent Int'l Network



What is VOEvent

- Author, Publisher, Subscriber, Repository
- Information not Imperative
    - Receiver must Decide
    - “Look what I found”
- Follow-ups are other VOEvents
    - Connected in citation graph
- Event aggregation and selection
- Personal subscription (what is above my horizon)
- Publish *and* subscribe
- LSST and Panstars on board
- Global identifiers
    - Resolvable at any VO registry
- HTN robotic network
- Correlation science

Delivery protocols

Socket
HTML
KML
RSS
XMPP (IM)
SMS

VOEvent Structure

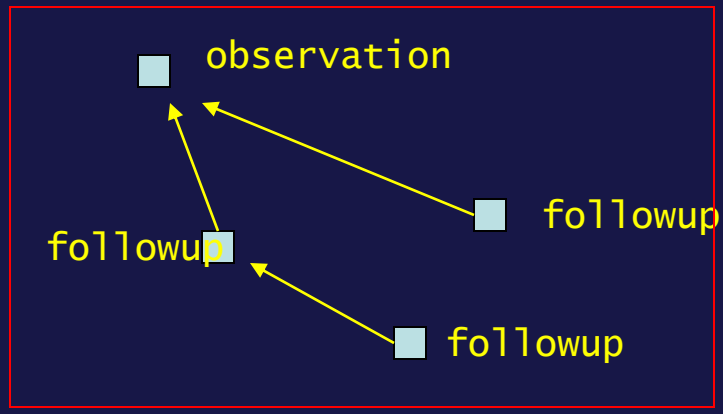
- Who
  - Publisher, Contact, etc
  - Subscribers will use AuthorID to select
- WhereWhen (== IVOA STC)
  - Can be simple eg RA, Dec, eg UTC
  - Can be sophisticated, eg multiple frames, near objects, etc
  - Orbital elements
- What
  - Hierarchy of named parameters
  - Units, Semantic type (UCD)
  - References, Descriptions
  - Light curves
- How
  - How was the evidence gathered: camera, telescope, etc
- Why
  - probability list of interpretation
    - supernova, comet, asteroid, ...
- Citation
  - Link to other VOEvent: Followup, Supercede, Retraction,
  - Link to support data
- Signature

Citation

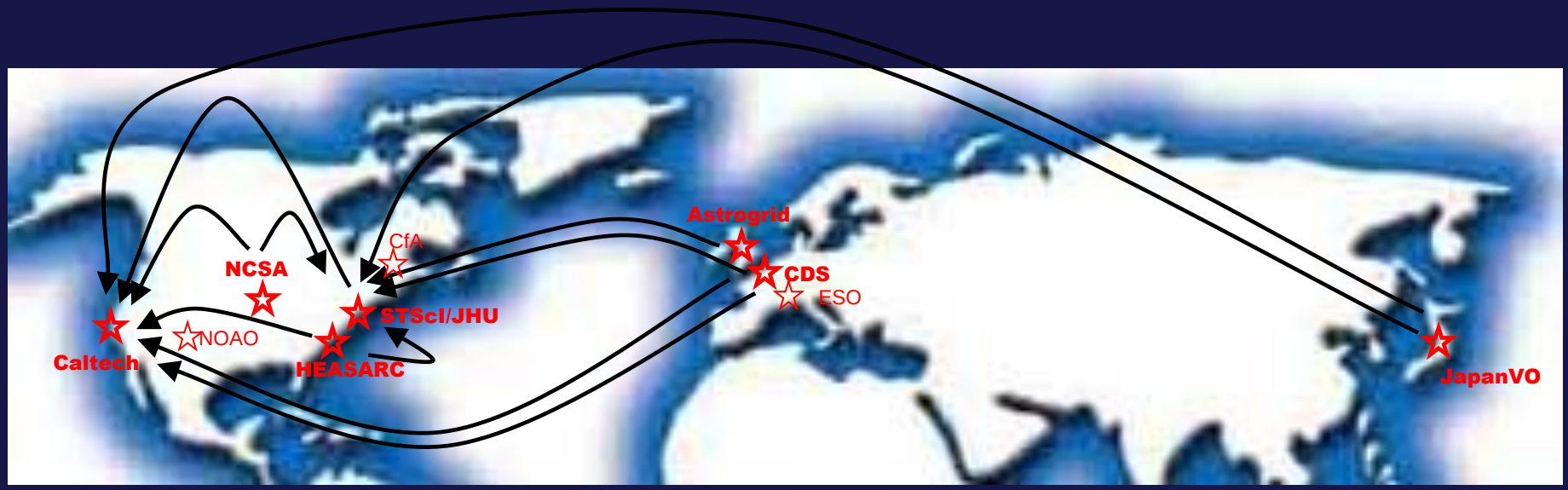
- An event can cite another

```
<Citations><EventID cite="followup">
            ivo://gcn.nasa/VOEvent#hete_389241a_20050808_230931
</EventID> </Citations>
```

- Observations can be federated by mutual citation



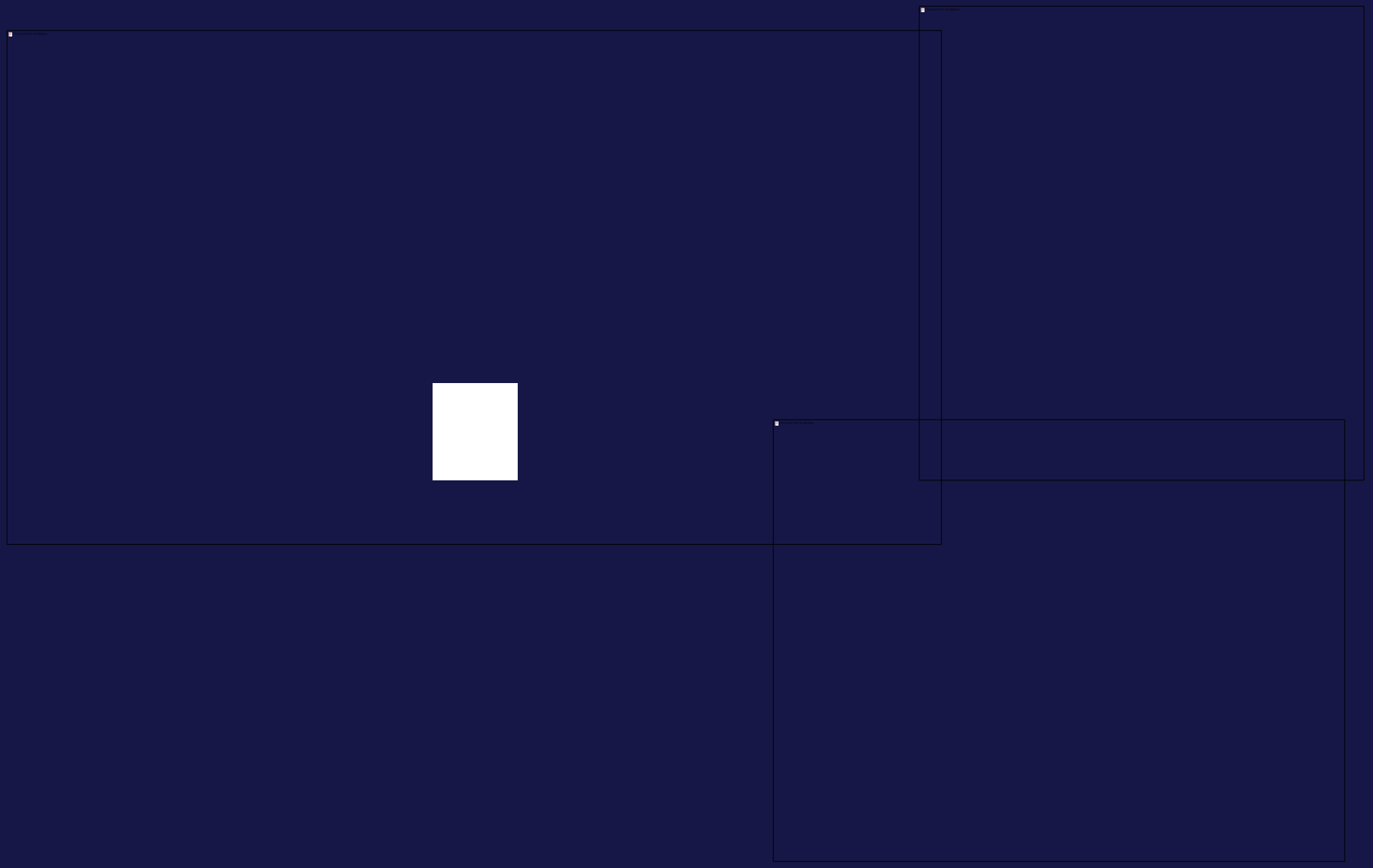
Distributed VO Registry



Events resolvable through distributed VO registry (soon)

Google Sky

Google Sky



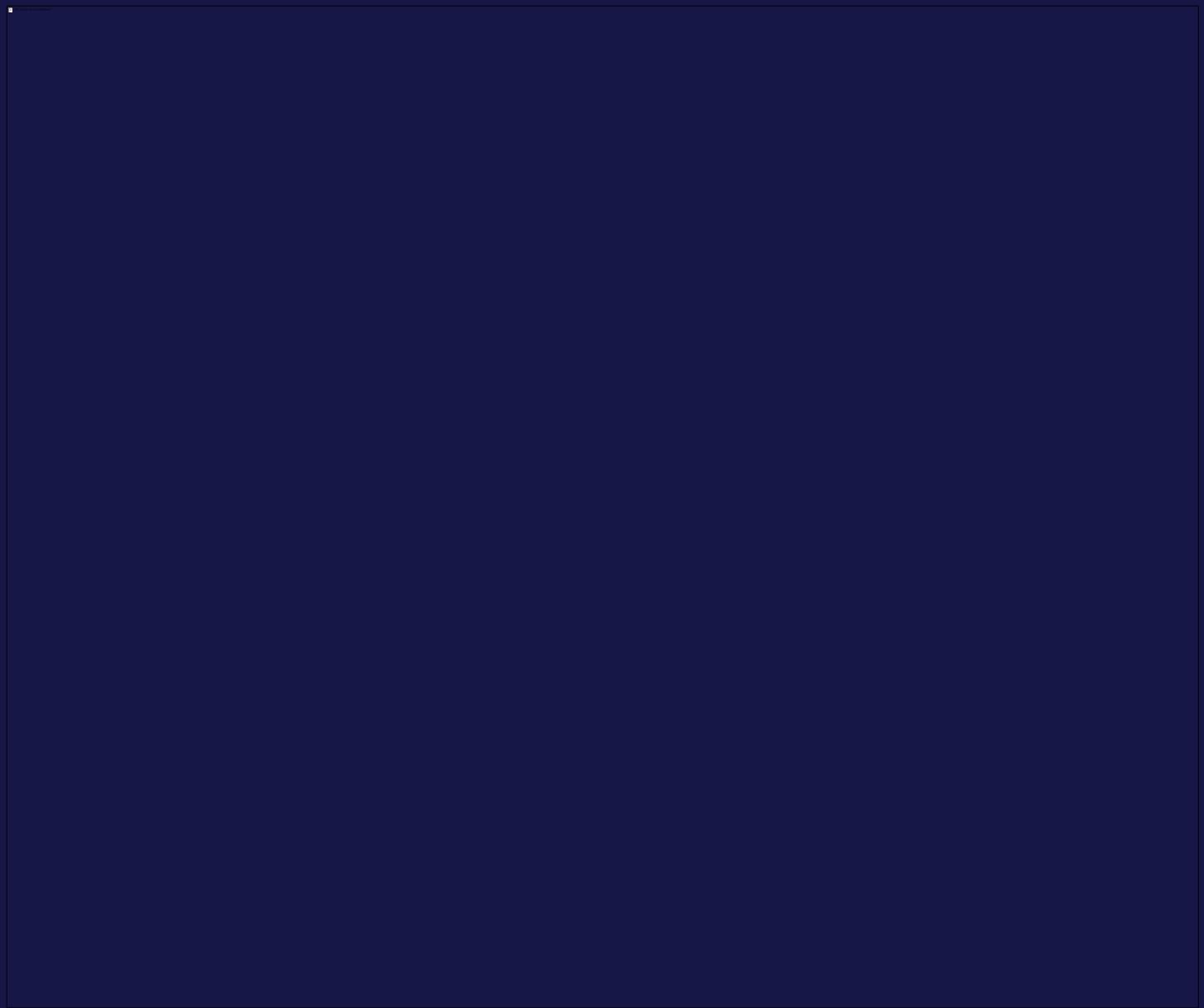
Usage

Delivering KML events to GSky

Ten hits a second

Serving event KML

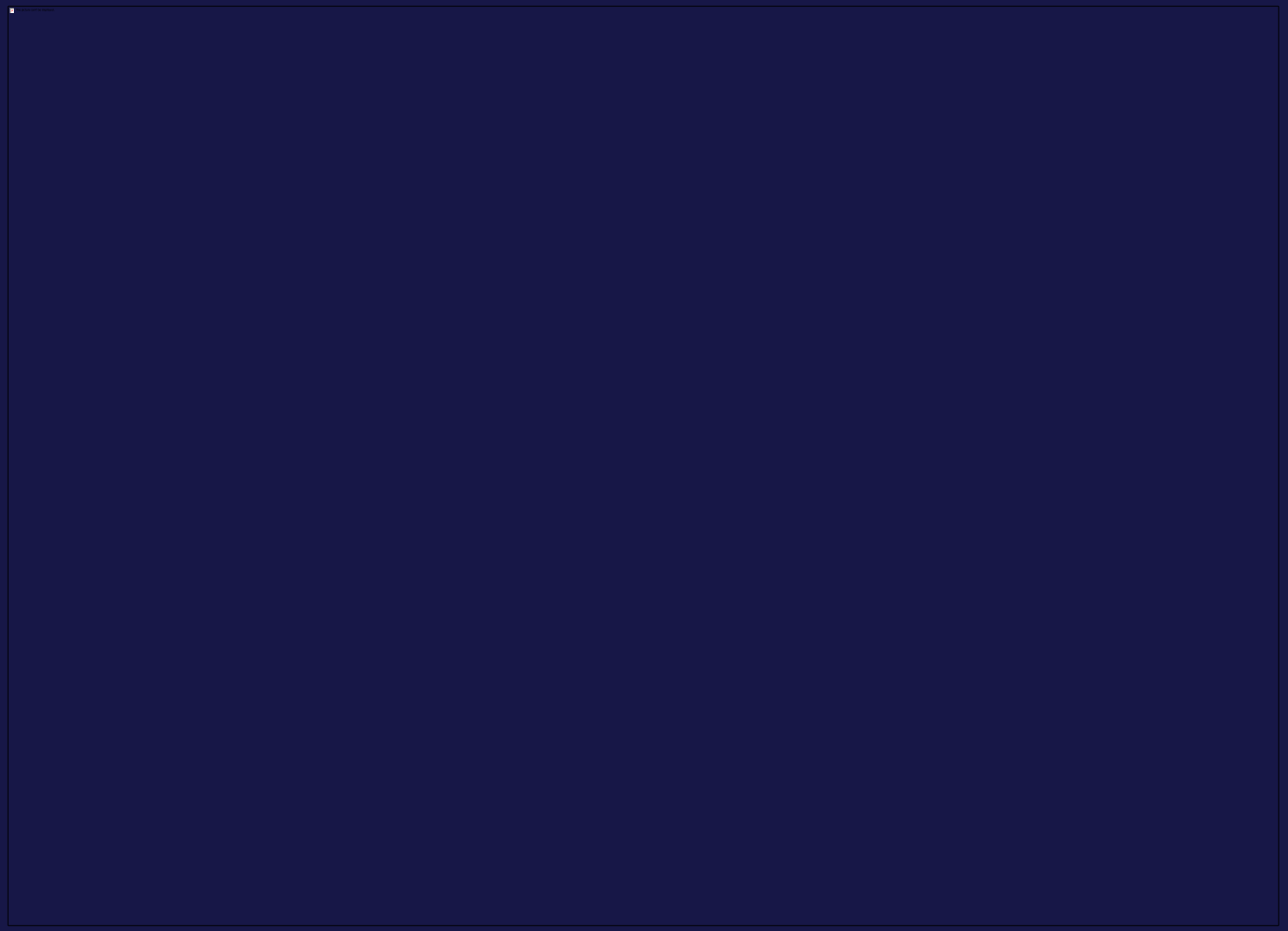
VO-GCN example:
Swift and historical supernovae



VO-GCN: Novae in M31

Correlation

Example: Swift events and TeV gamma events



Exploitation Challenge

More Information

Standards process
http://voevent.org

VOEventNet with multiple feeds
http://voeventnet.caltech.edu/

VO-GCN with historical event repository
http://voevent.noao.edu/