Portfolios: a framework for time-critical automated decisions
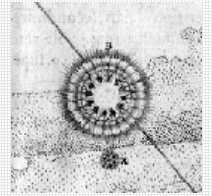
By Matthew J. Graham (Caltech)

The star that makes the captains of the ships err
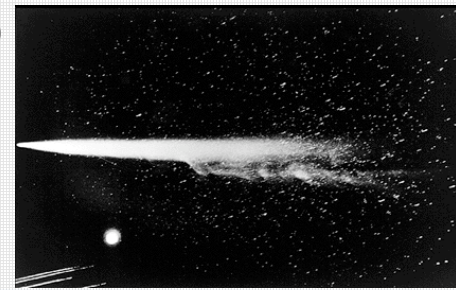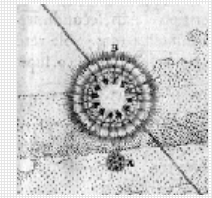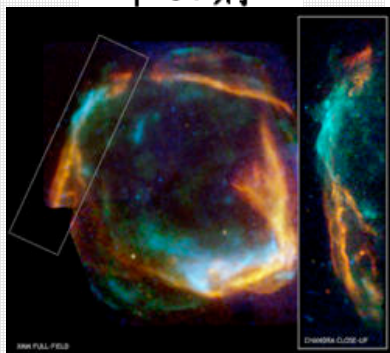
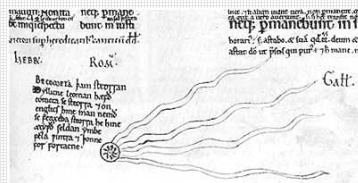# Guest stars
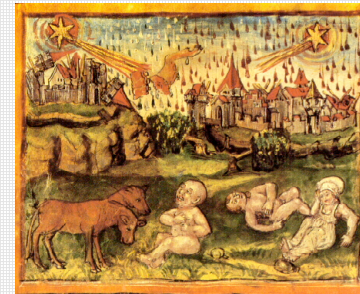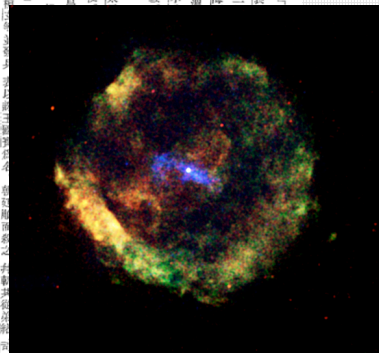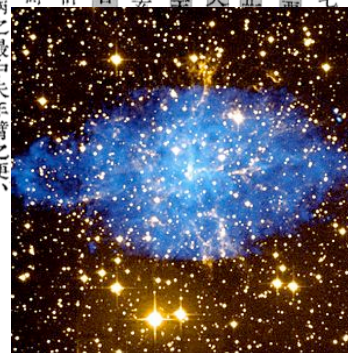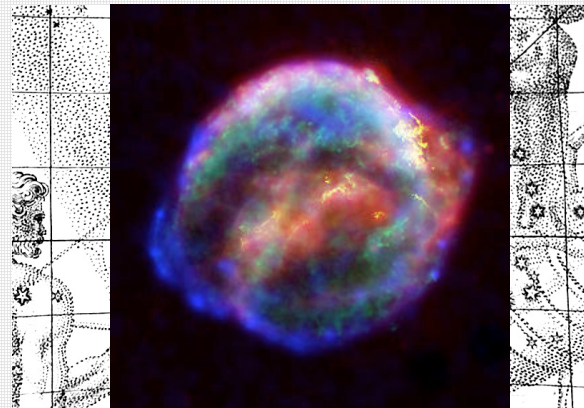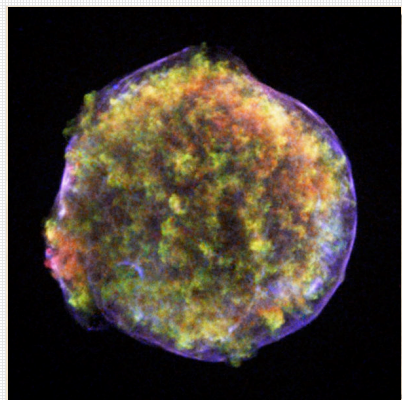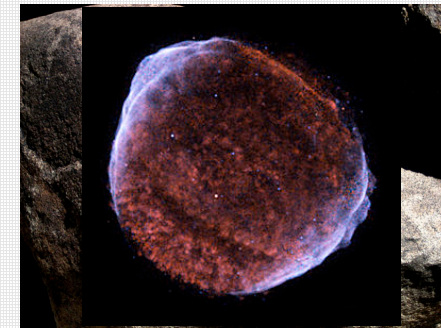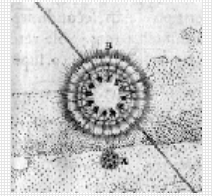
Things that go bang in the night

- Solar: sunspots, solar flares
- Solar system: asteroids, comets, KBOs, TNOs
- Galactic: variable stars, binary systems, gravitational microlensing, extrasolar planets, novae: dwarf, super-, hyper-, luminous red, CVs
- Extragalactic: SNe, GRBs, blazars (OVVs, BL Lacs)
- Gamma-ray to radio, neutrinos, gravitational waves, high-energy cosmic rays

Modern notification systems

- CBAT (Central Bureau for Astronomical Telegrams)
  - IAU Circulars
  - CBET (Central Bureau Electronic Telegram)
- ATEL (Astronomer's Telegram)
- GCN (Gamma-ray Burst Coordination Network)
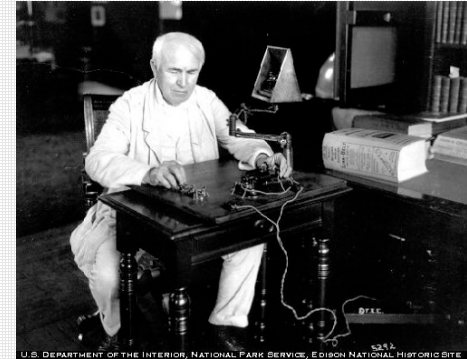
Welcome to the 21st century: VOEvent

```
<VOEvent>
    <Who> - Author identification
    <What> - Event characterisation
    <WhereWhen> - Space-Time Coordinates
    <How> - Instrument Configuration
    <Why> - Initial Scientific Assessment

    <Citations> - Follow-up Observations
    <Description> - Human-oriented content
    <Reference> - External Content
</VOEvent>
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Synoptic sky surveys

- Palomar-Quest (PQ)
- Catalina Sky Survey
- Palomar Transient Factory (PTF)*
- SkyMapper*
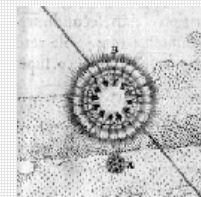- Allan Telescope Array (ATA)*
- Pan-STARRs*
- Large Synoptic Survey Telescope (LSST)*
- LOFAR*/SKA*
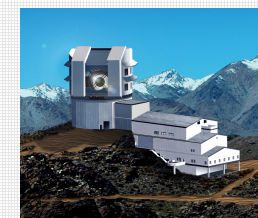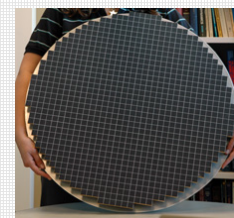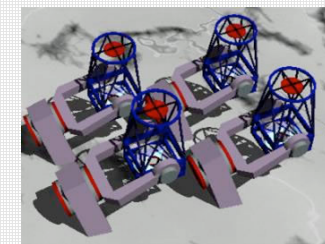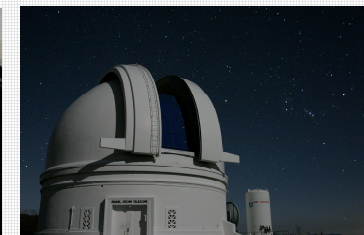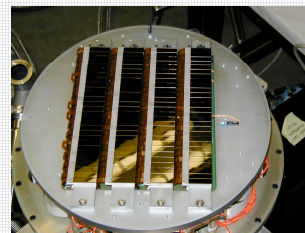
Who's listening? VOEventNet
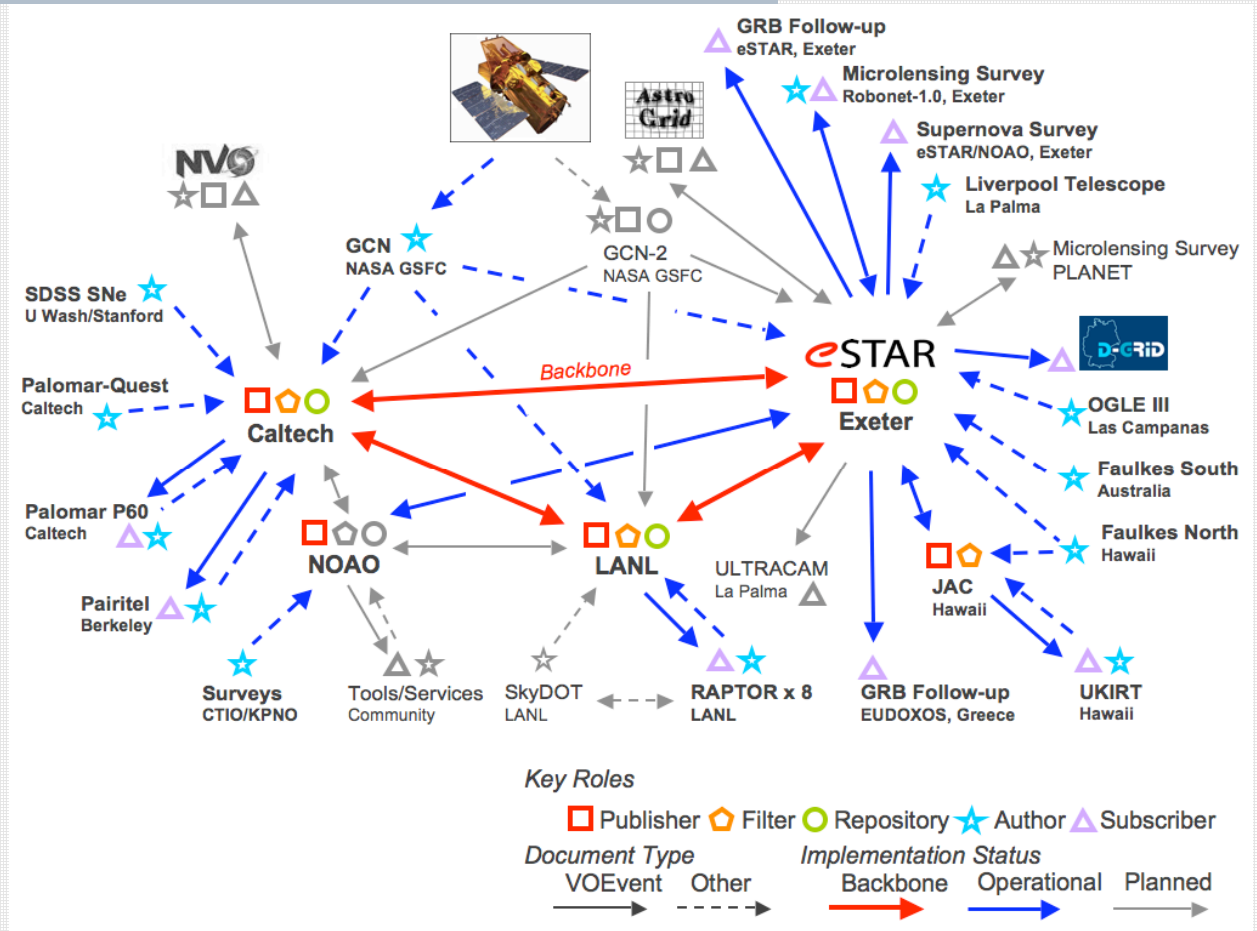
A follow-up case study: I

- 10/8-11/07, PQ detects 6 strong optical transients:
    - Not asteroids or other moving objects
    - No matches in DSS, FIRST, NVSS, NED or SIMBAD
    - One transient appears to have associated source in archival PQ images but is now 2 mag brighter and has increased by 0.5 in prior 2 days

A follow-up case study: II

- Low-resolution spectra obtained with Palomar 200":

PQT071008:224527+103932	SNIa, sim. to SN2000cx, around max, z=0.046
PQT071008:230627+095342	SNIa, about 1 month past max, z~0.07
PQT071010:015849-022627	Poss. SNIa before max
PQT071009:024105-033814	SNIa, sim. to SN1999a, about 9 days before max, z ~ 0.135
PQT071011:031515-034914	Quasar, z = 1.26
PQT071010:034520-012111	Probable blazar, featureless continuum

A follow-up case study: III

- Photometry with FTN:
  - First and third transients have no associated nearby galaxies; fourth might be with B023830.10-035020.9
  - Light curves from PQ + FTN R-band data show first transient only exhibiting clear increasing brightness
- Coadded archival NEAT images:
 - Third transient has no host galaxy to R ~ 23.5
- High-resolution spectrum of first transient with University of Hawaii 2.2-m telescope:
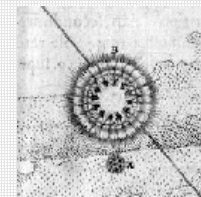 - Type Ic supernova

Portfolios

- A heterogeneous collection of:
  - source material
  - derived and summary information
  - tables, images, and words
  - different media formats
  - different network locations
  - the relationships between them
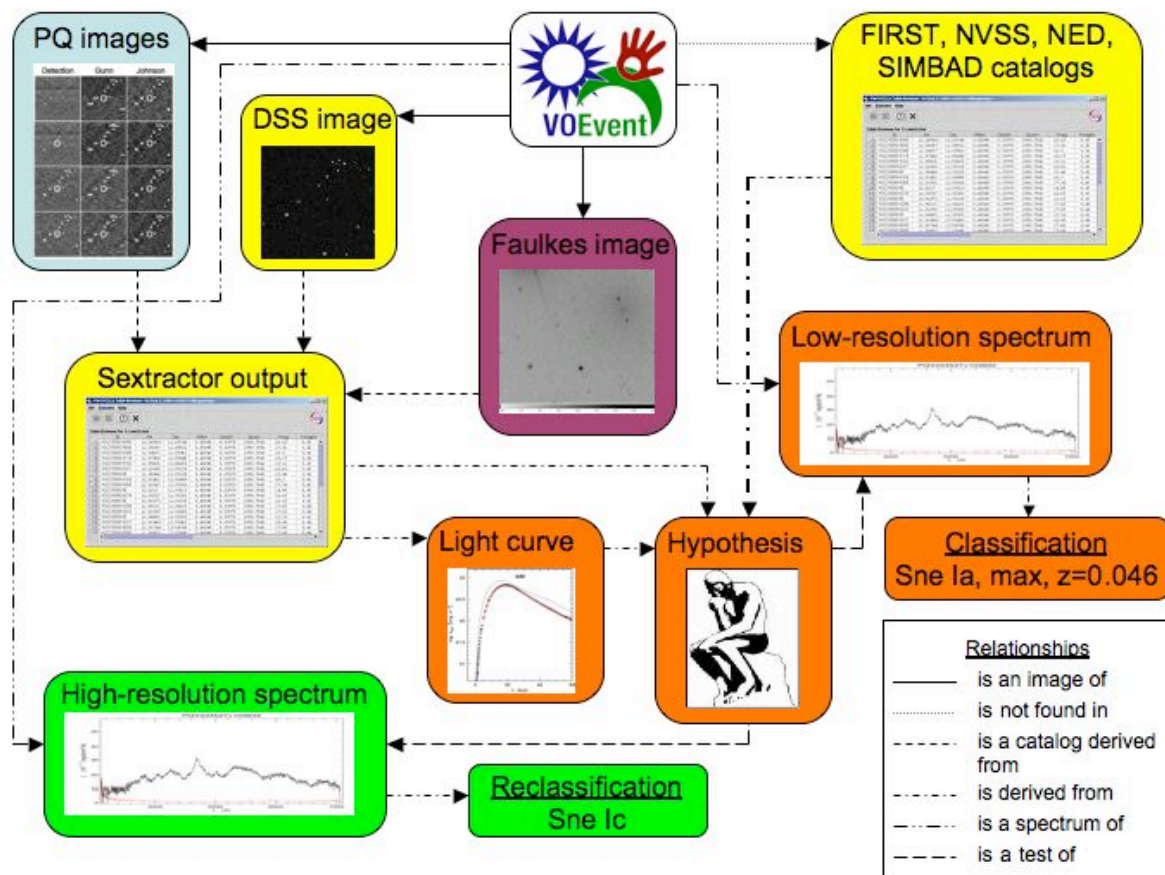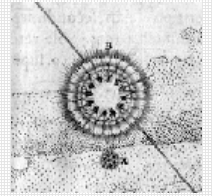- Human and machine operable

Object Re-use and Exchange (ORE)
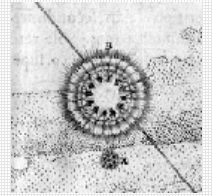
- Open Archives Initiative (OAI) standard
- Aggregation of data objects described as a named graph
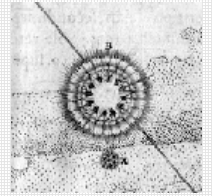- Serialized as a *Resource Map*
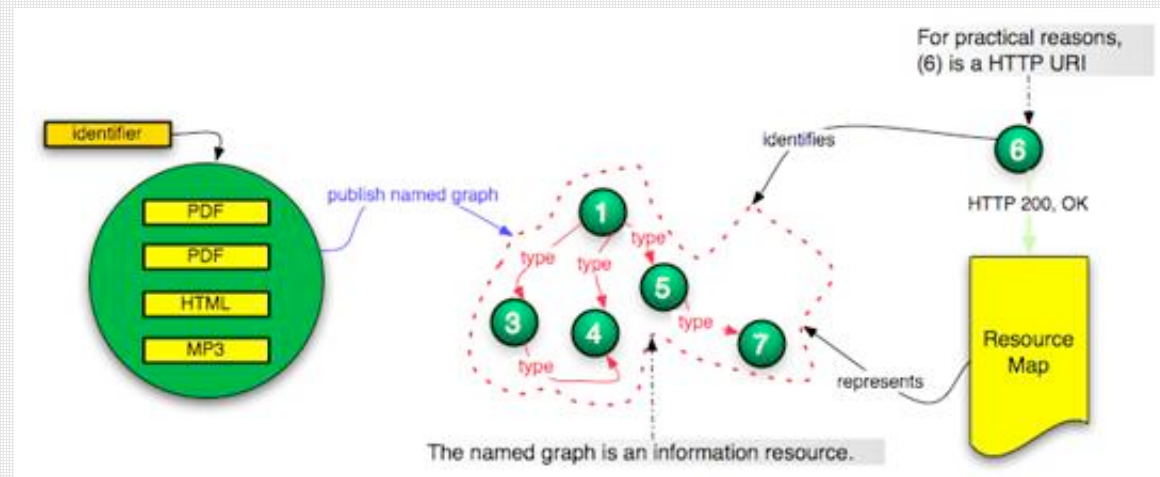
Reimagining the case study

Machines that blog

- PortfolioWiki
  - Every VOEvent has an ORE-based portfolio
  - Human sees it as a wiki page
  - Metadata marked up with RDFa
  - Machine accessible via RESTful interface
  - Agent converts email to annotation
  - Other agents can data mine and annotate

Summary

- In spite of a long history, transient astronomy is now a burgeoning field

- Orchestrate follow-up data cascade

- Human and machine accessibility

- Significance of data relationships for classification

- ORE provides framework for portfolios