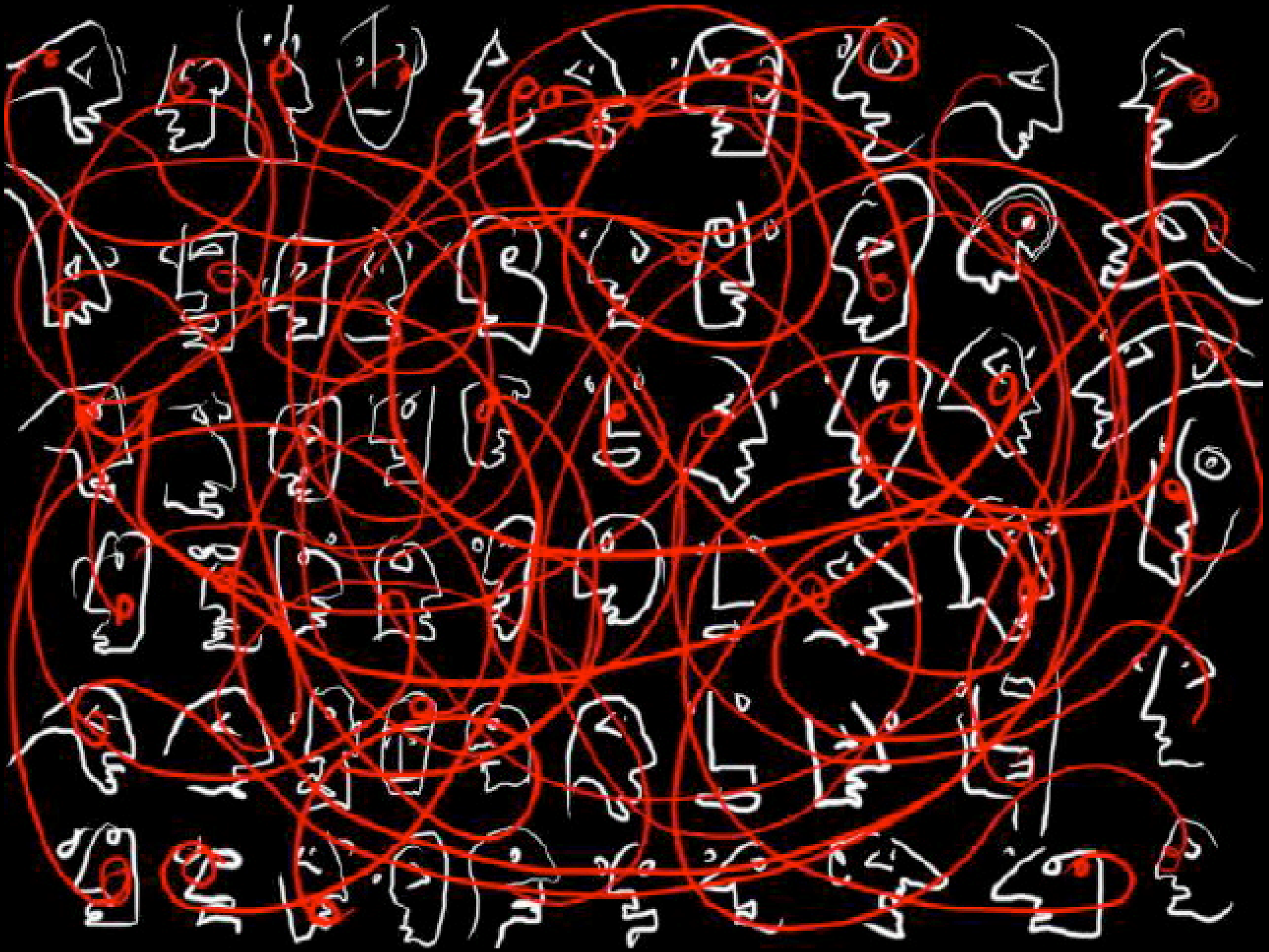


Susani 2002

Implementing a Real-Time VOEvents Network

Joshua Bloom
UC Berkeley Astronomy Department

VOEvent Workshop; 13 April 2005

Outline

- ✳ Example (==plug):
  Time-domain enabled by Existing Network
- ✳ Technical (Abstract)
  - ⊙ A Simple VOEvent Network:
    Interplay between
    Provider/Listening Agents & Aggregators
  - ⊙ Building towards a Complex Network:
    Meta-Aggregation, De-centralization, &
    self-organization → emergence
- ✳ Proposed Benchmarks

http://pairitel.org

PAIRITEL

PETERS AUTOMATED INFRARED IMAGING TELESCOPE

1.3m, dedicated robotic telescope

Burst-to-image time = ~1-2 min

2 Dichroics (=3 filters):
J (1.25 μm), H (1.65 μm) ,Ks (2.16 μm)

PI: JSB

Automation Team:

C. Blake (CfA), D. Starr (Gemini), A. Szentgyorgyi, E. Falco (CfA),
M. Skrutskie (U. Virginia)

PAIRITEL Status at 2005-04-13 21:12:57.59 UT

dqm **RUNNING**	*dictqmc* **LOV**	*pointing* **OFF**	*dome shutter* **CLOSED**	*light* **OFF**	*user-qmc* **SUSPEND**
secmt **LOCAL-UP__UNKNOWN**	*tcc* **ONLINE**	*dome* **OK**	*user-weather* **CLEAR**	*weather* **GOOD**	*mfc* **UP**
dome shutter-room **UP**	*mirror* **CLOSED**	*master* **RUNNING**	*daynight* **DAY**	*obc* **SUSPENDED**	*dome-floor* **CLEAR**
telescope **STABLE**					

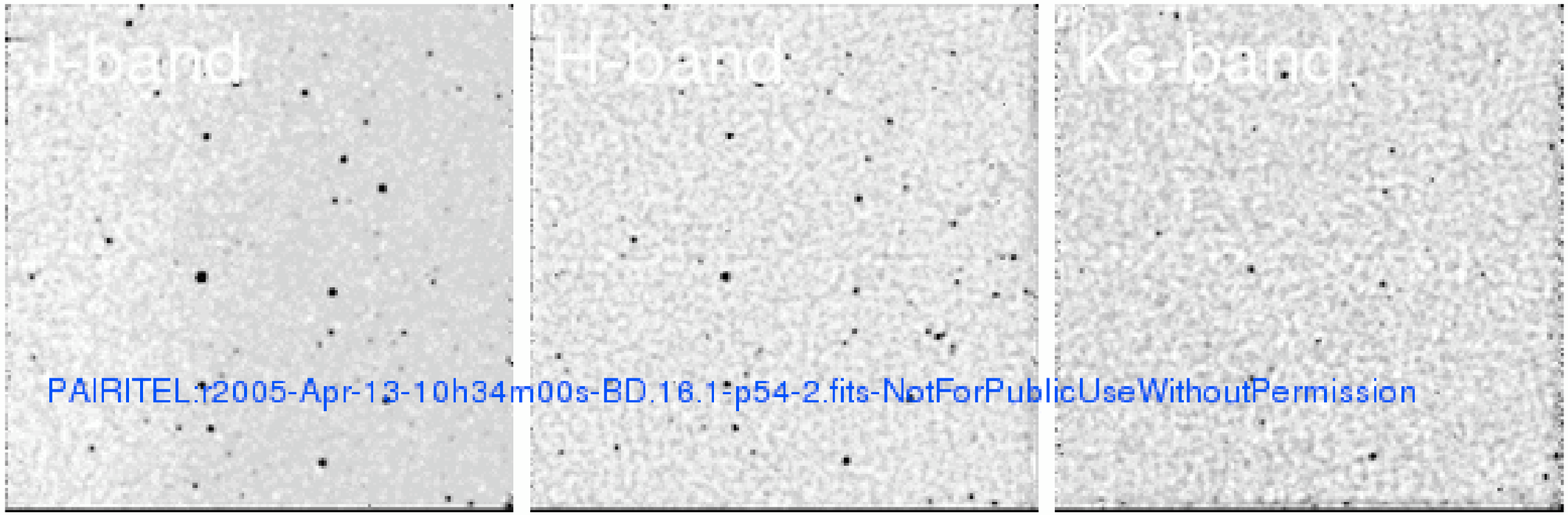
operations history

α:03:18:01.11 δ:+31:40:52.3
LST:03:18:01 **HA**:-00:00:16
UTC:21:12:56 **seeing**:1.0

Recent Image:
r2005-Apr-13-10h34m00s-BD.16.1-p54-2.fits

Age (h:m:s):
10:38:32.641307

http://pteld.sao.arizona.edu – Mozilla Firefox



http://status.pairitel.org

Intimate Connection with Swift

GCN

Quicklook Website

SDSS
DSS-II
NEAT
2MASS
DPOSS

Socket Handler

External Image Ingest

Telescope Scheduler

Image Comparison

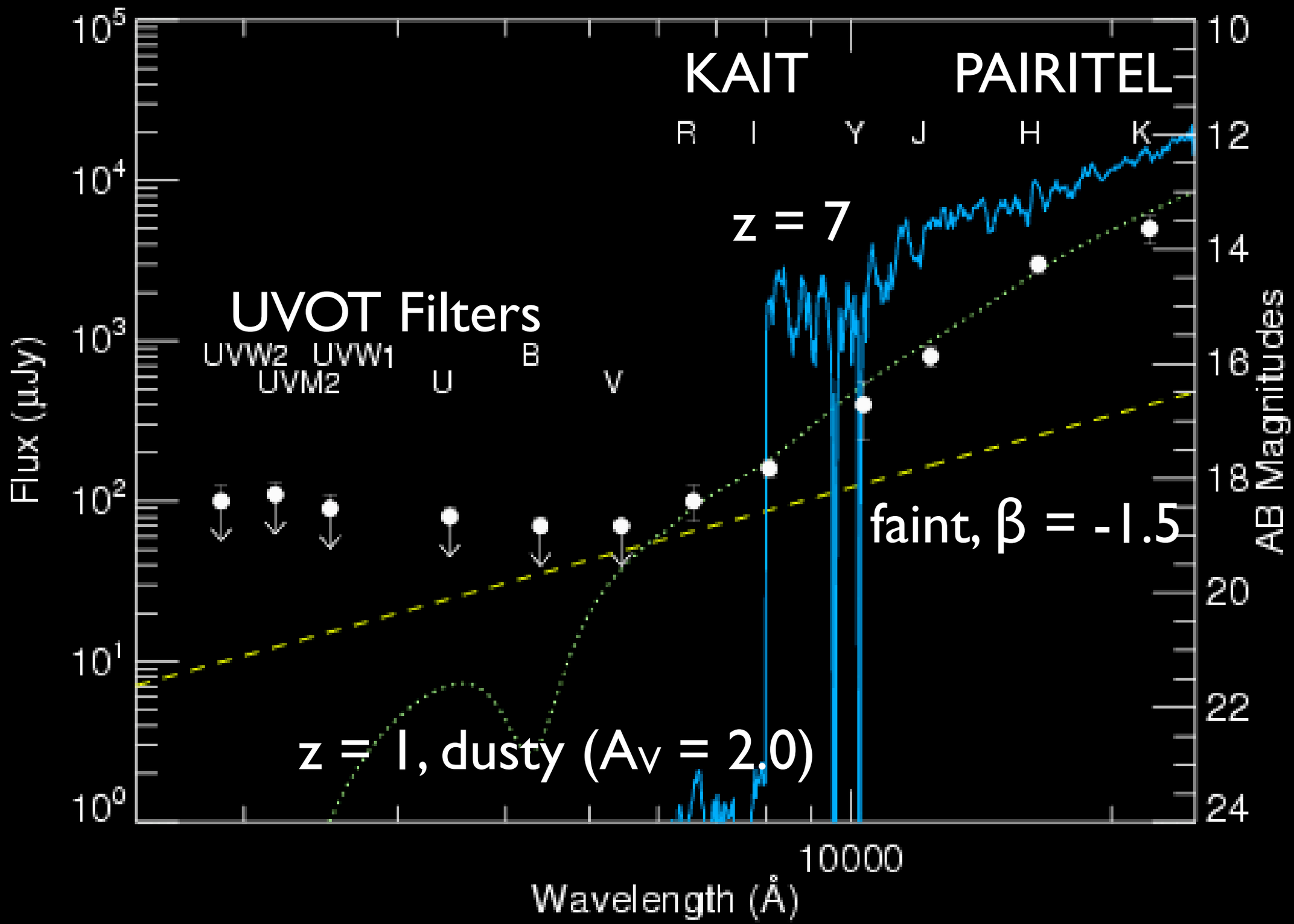
Special
Burst Alerts

Data Pipeline

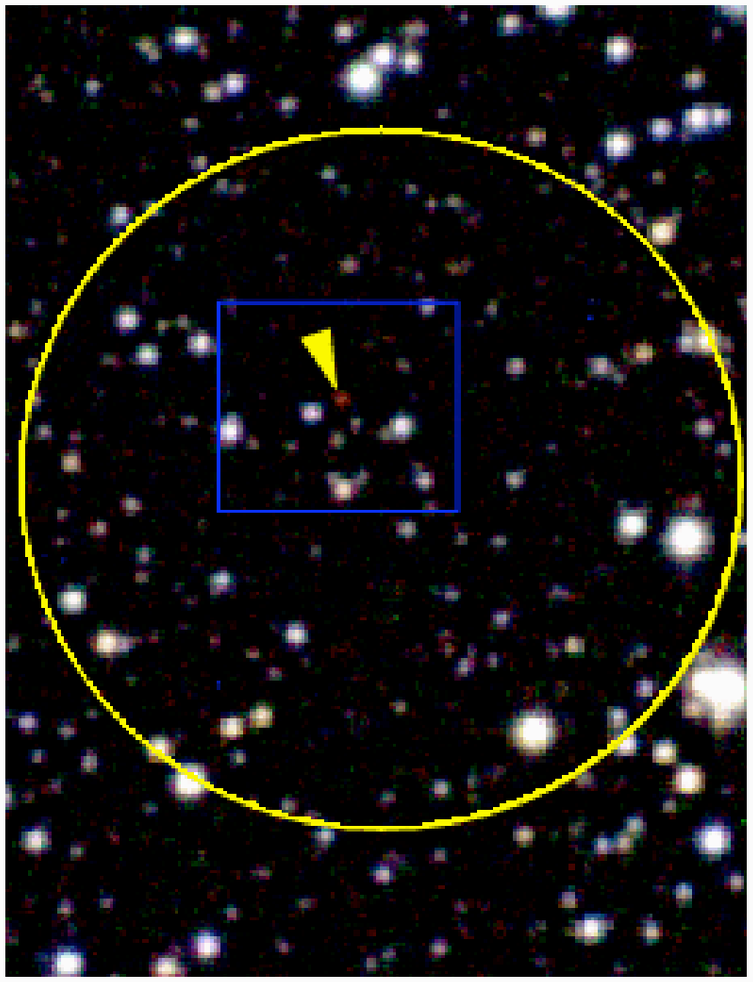
Data Archive

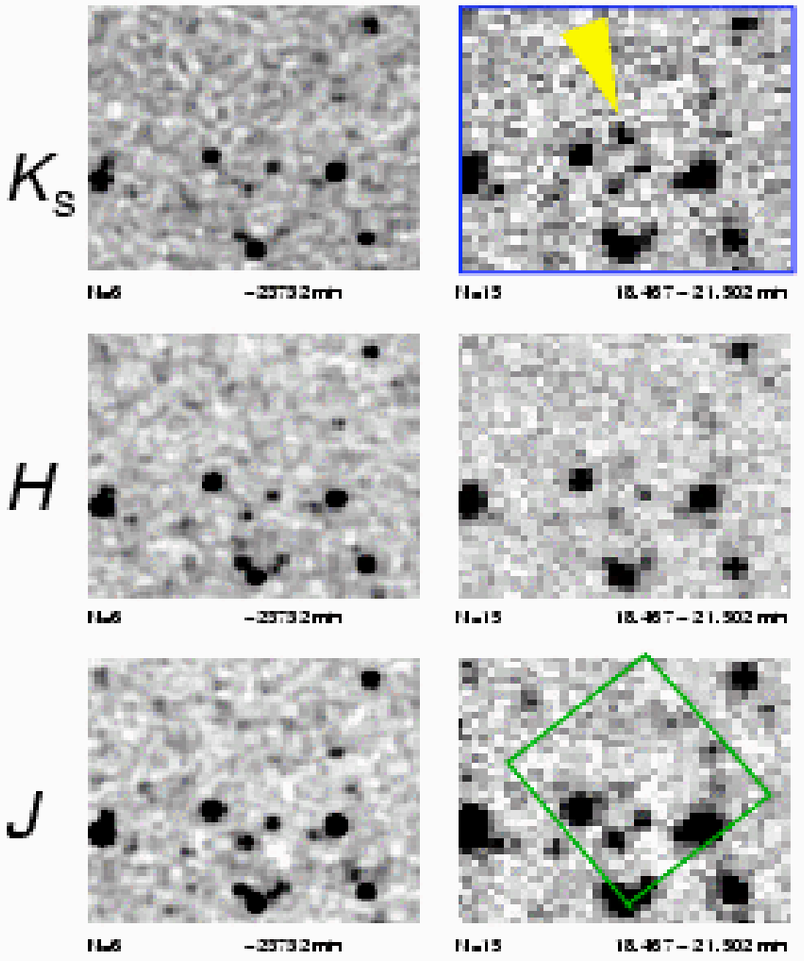
IR Finders
IR Photometry

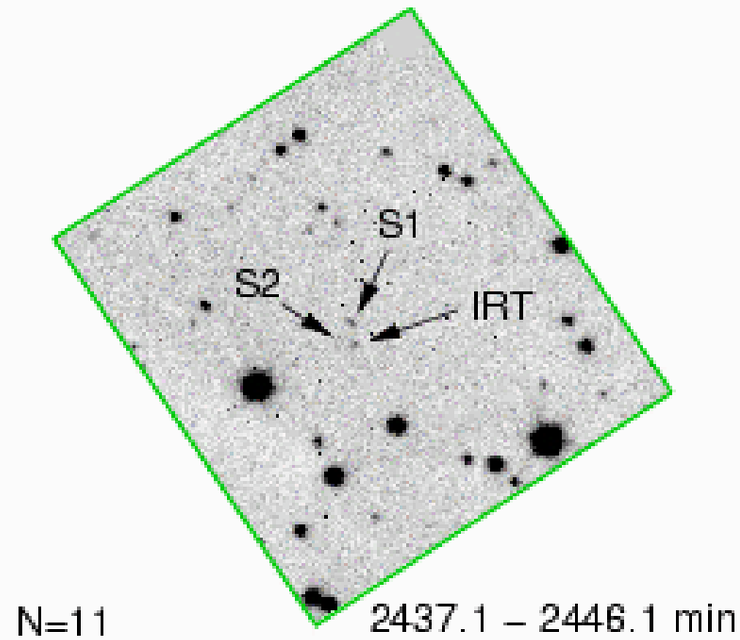
Now building RT photometric redshift estimator



Discovery of the First Swift Afterglow: GRB 041219a

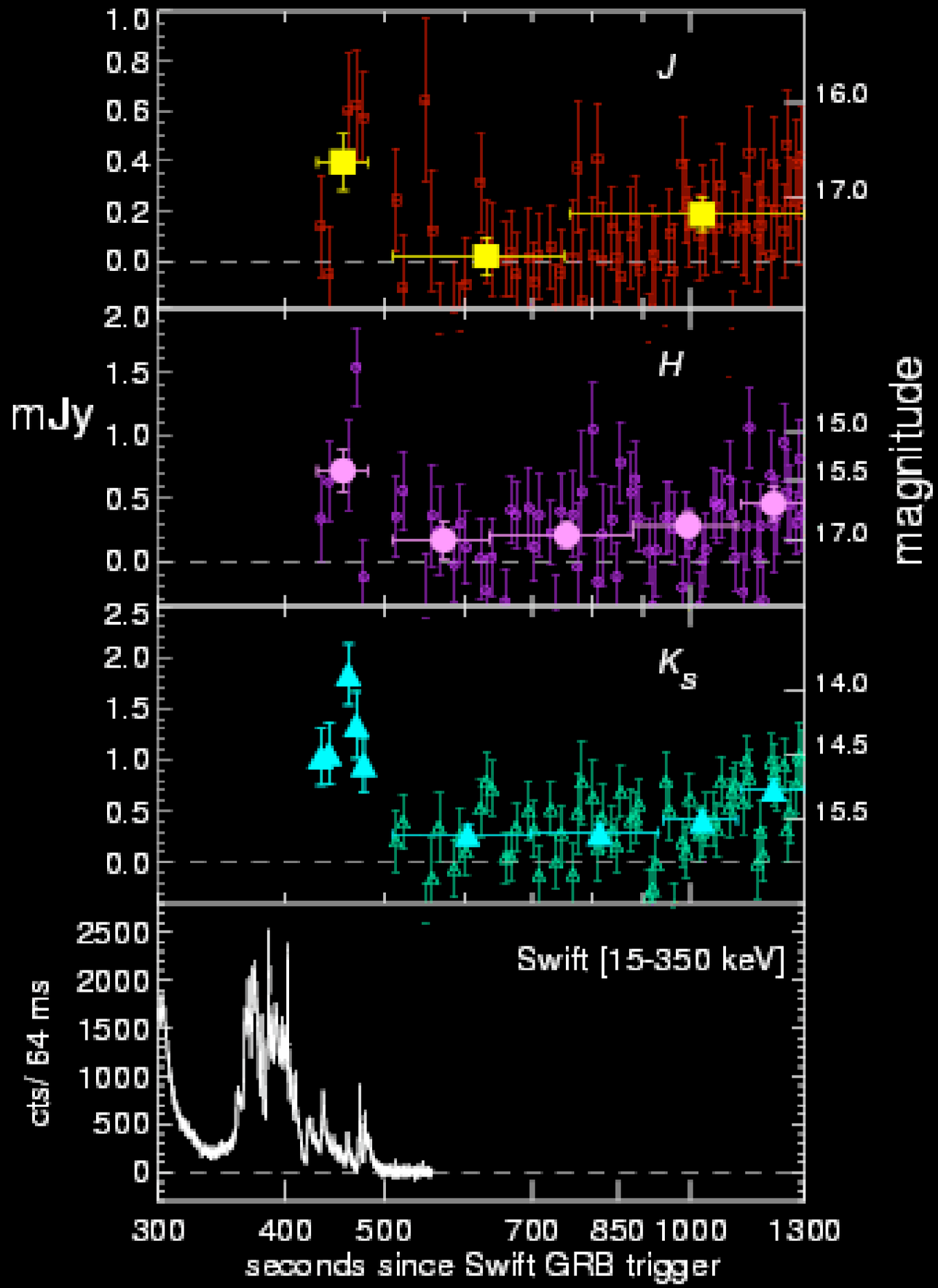






Location 0.2 deg off Galactic Plane: $A(V) \approx 5$ mag

Blake & Bloom 04



GRB 041219a:

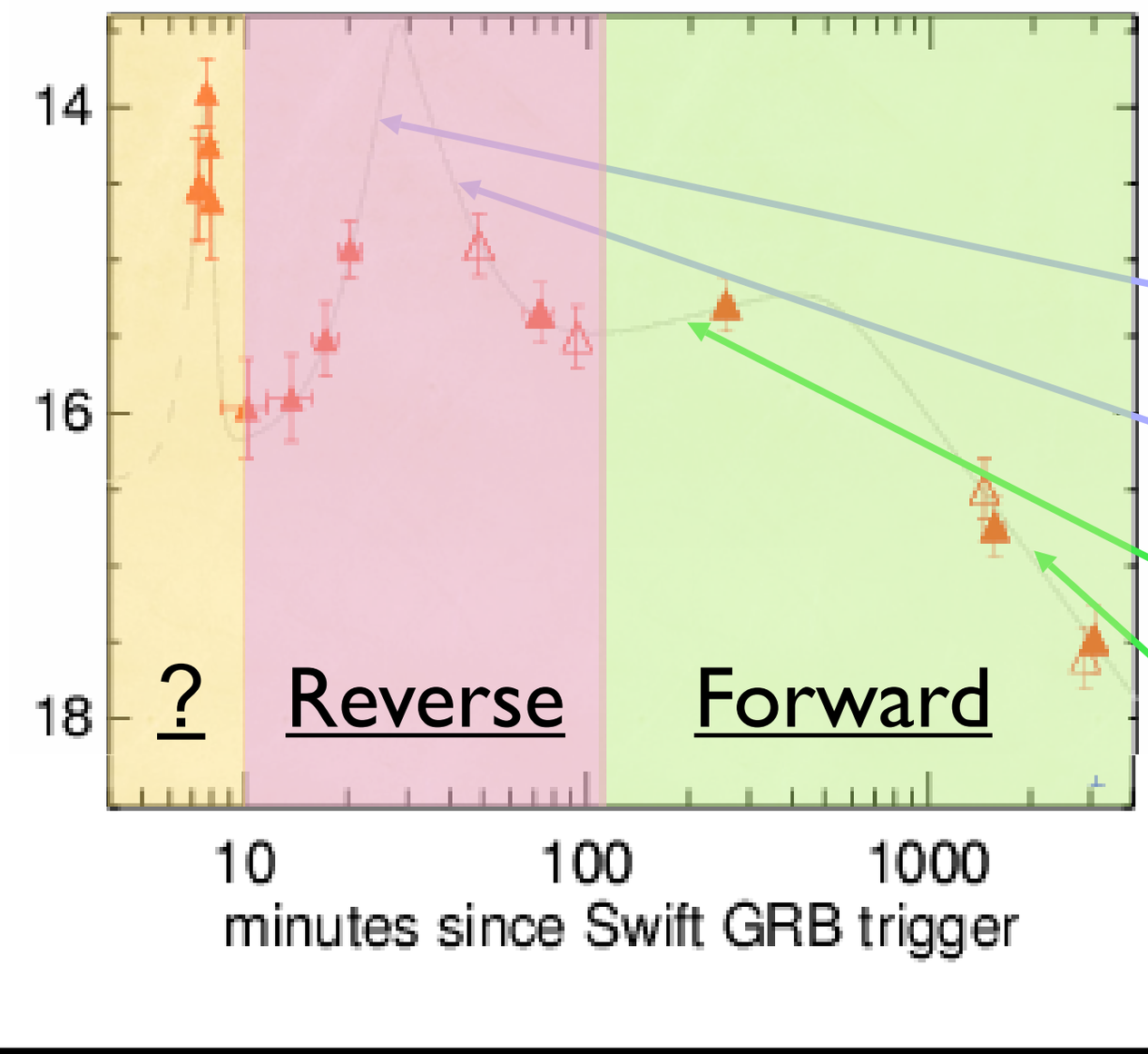
7.2 min after the burst trigger, while the burst was still occurring

First contemporaneous IR transient

Only the 3rd burst that Swift had localized on-board

Blake et al. 2005 (Nature; in press)

Fitting 041219 Light Curve with Reverse/Forward Shocks



Consistent Value:
$p \approx 2.2$
(electron spectral index)

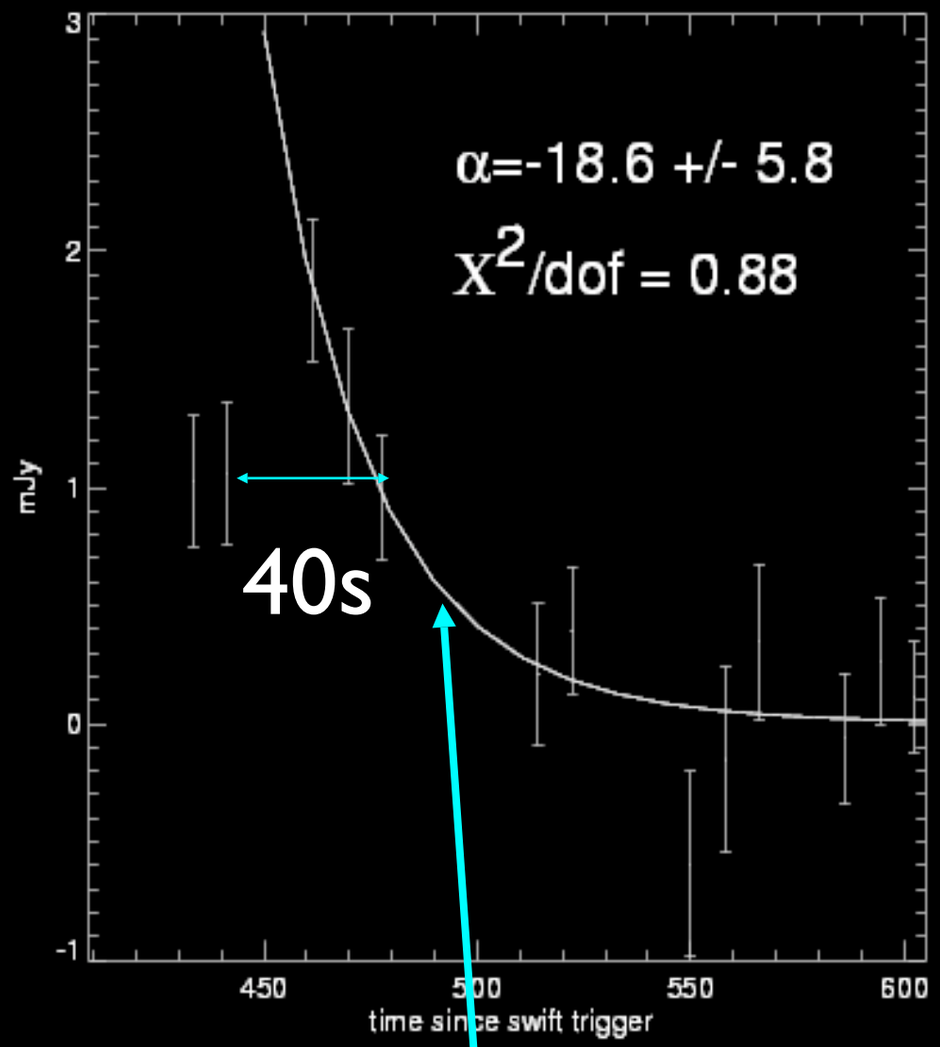
$\alpha = 6.1 \pm 2.9$

$\alpha = -3.4 \pm 2.8$

$\alpha = 0.3 \pm 0.1$

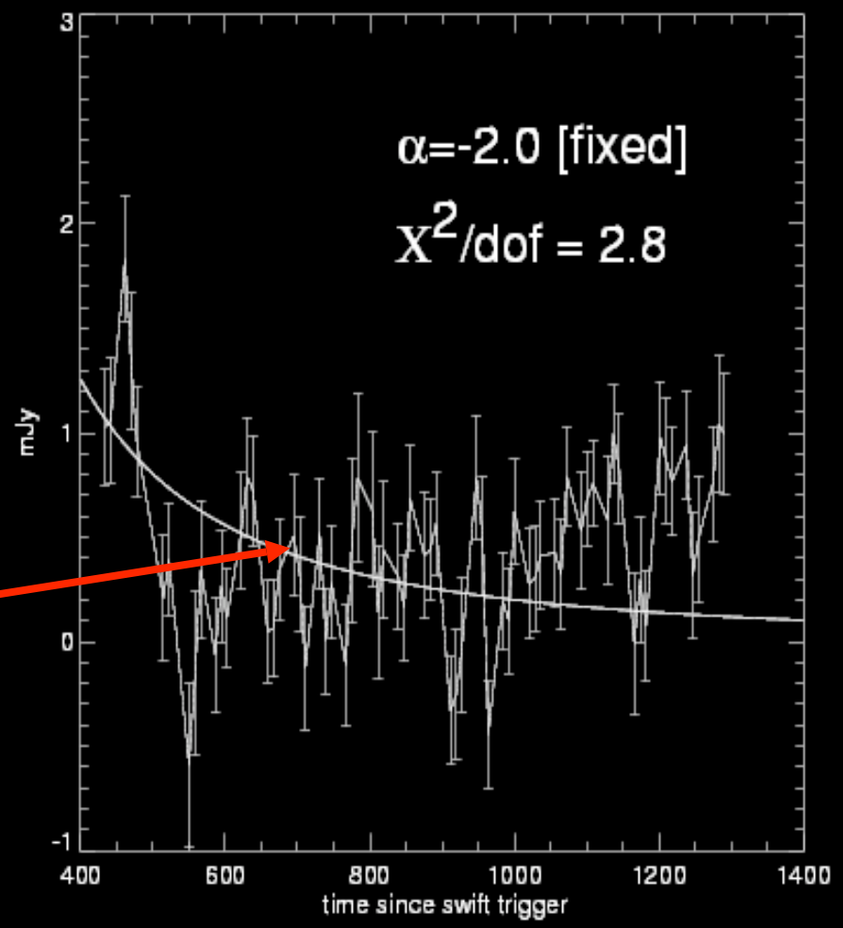
$\alpha = -1.2 \pm 0.1$

What is the origin of the IR Flash?

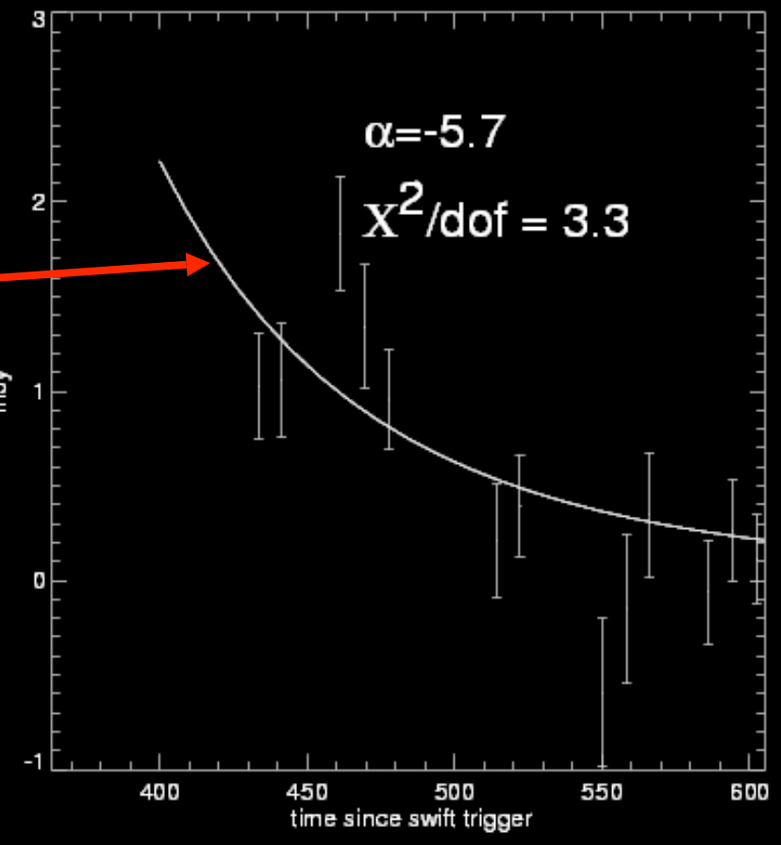


Very rapid rise and fall, FWHM ~ 40 sec

Simple reverse shock does not fit (wind ISM yields t-3)



Single power-law is not a good fit



PAIRITEL is Transient Target Starved:

I want to trigger off of non-GRBs

I do not want to add triggers by hand

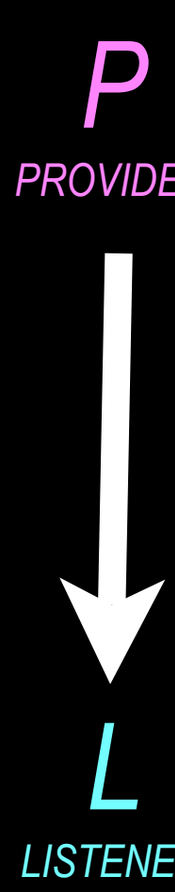
I do not want to write new code to add every new type of trigger

I want VOEvent Providers and I want to broadcast to the

VOEvents Network

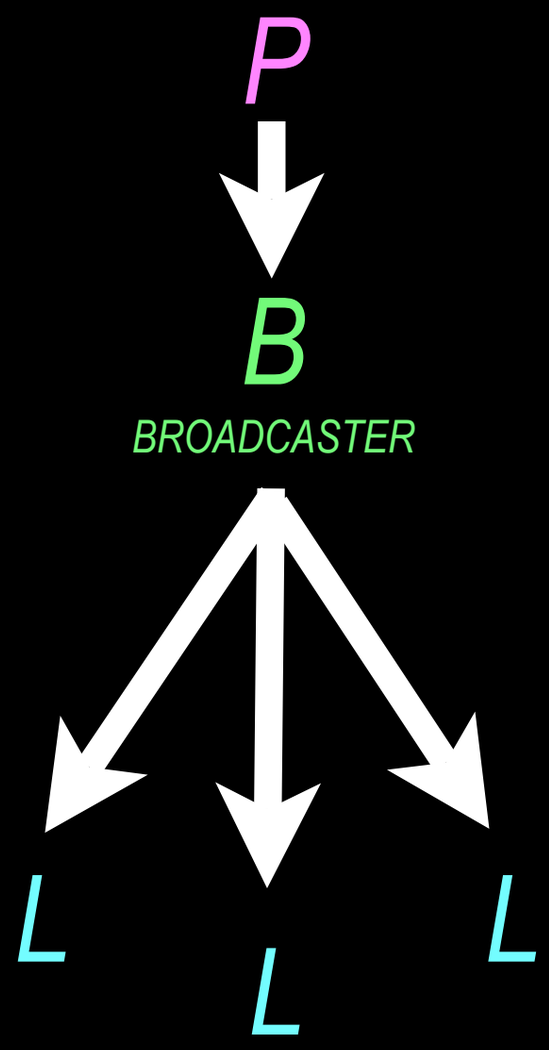
Existing Networks:
Building Blocks of VOEvent Networks

Peer-to-Peer



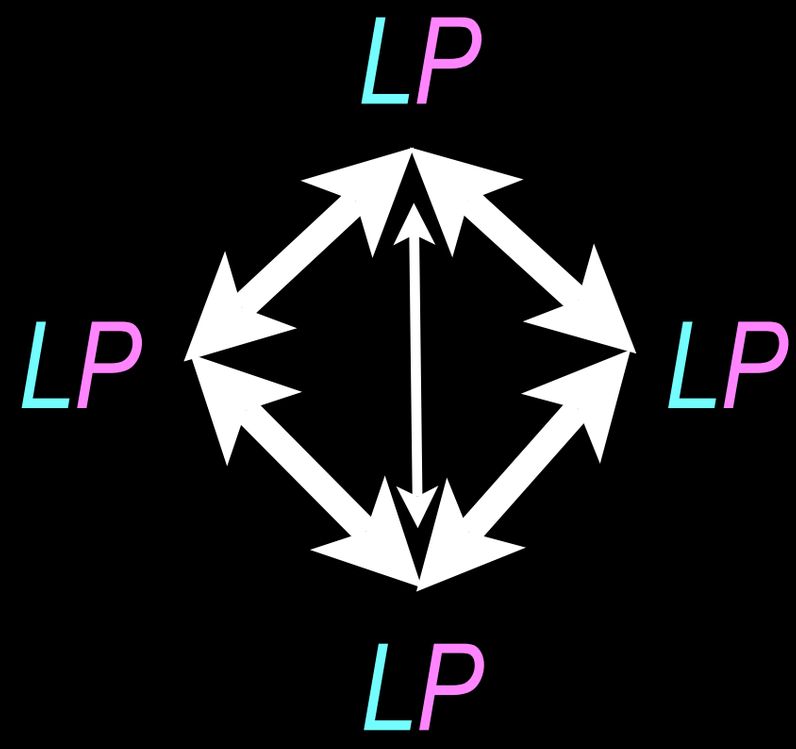
QUEST SNe

Broadcast



GCN, SNEWS

Intranets



RAPTOR

Properties of a VOEvent Network

Real-Time

all central nodes (B) **must** receive, process, transmit *rapidly*
ideally, all end-points (P, L) **should** create & act rapidly

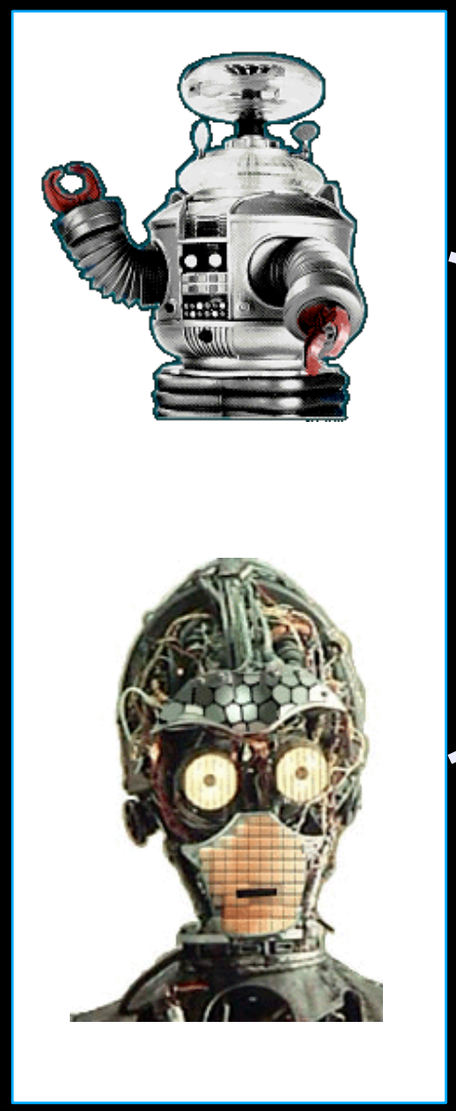
Human-free Feedback

Ls - Ps should react/respond using B intermediaries

Robust Against Single-point Failures

Ls should reply on > 1 set of P to generate targets
B intermediaries

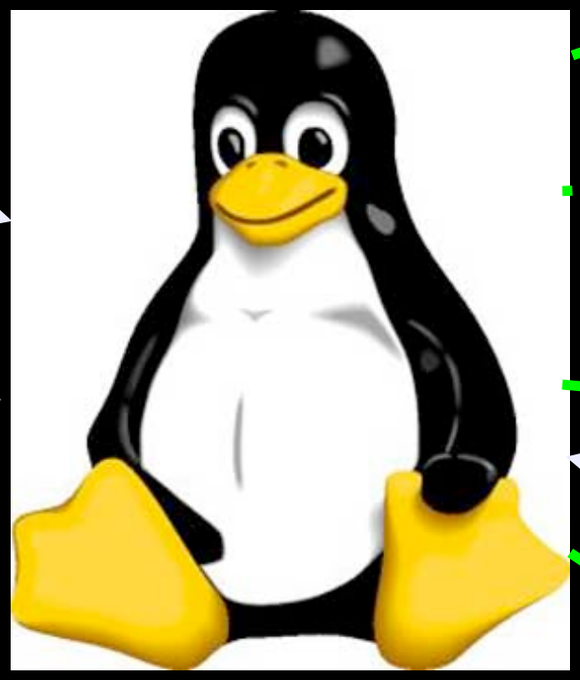
Architecture of a Simple VOEvents Network



VOEvent Providers

DISCOVERY

DISCOVERY



"Transient Service Node"

Broadcaster

DISCOVERY

CITATION

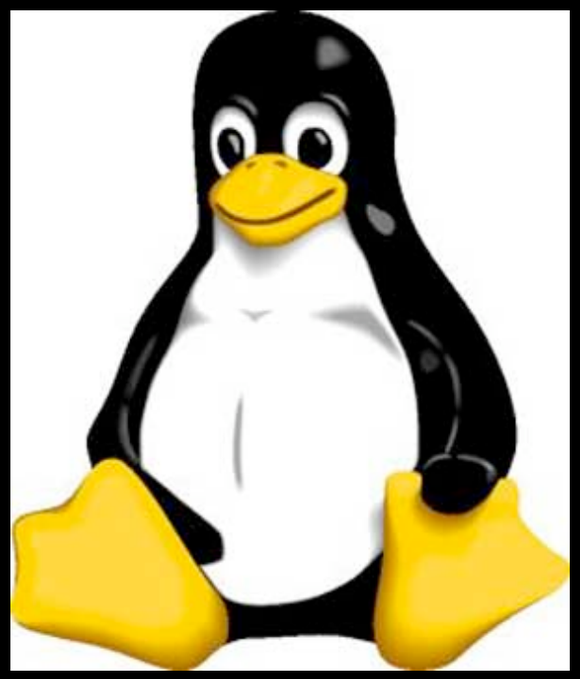
P

"Follow-up Agents"

Listeners

Broadcasters → Aggregators/Harvester

Pushers, Pullers & Enablers of Poly-Directional flow



"Transient Service Node"

Reliability

- Maintain database of VOEvents that pass through
- Enforce validation against current schema
- High duty cycle up-time

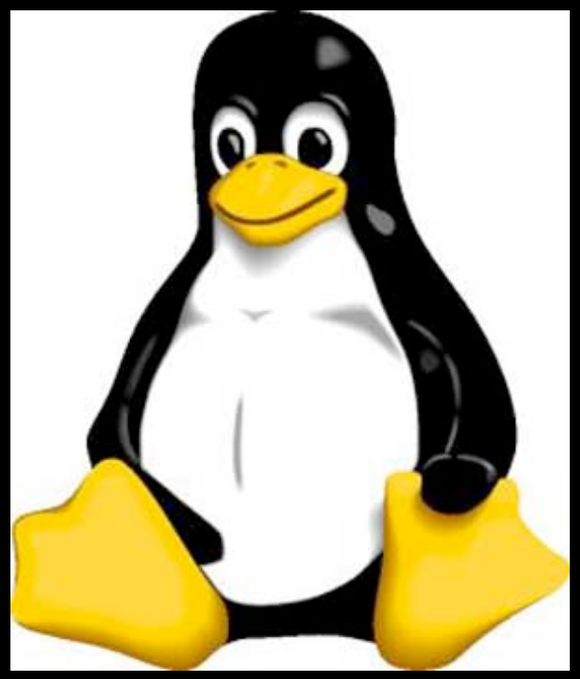
Persistence

(as the VOEvent Schema change):

- Provide Transparent Translations between Schema version

Broadcasters → Aggregators/Harvester

Pushers, Pullers & Enablers of Poly-Directional flow



"Transient Service Node"

Usability

Subscription

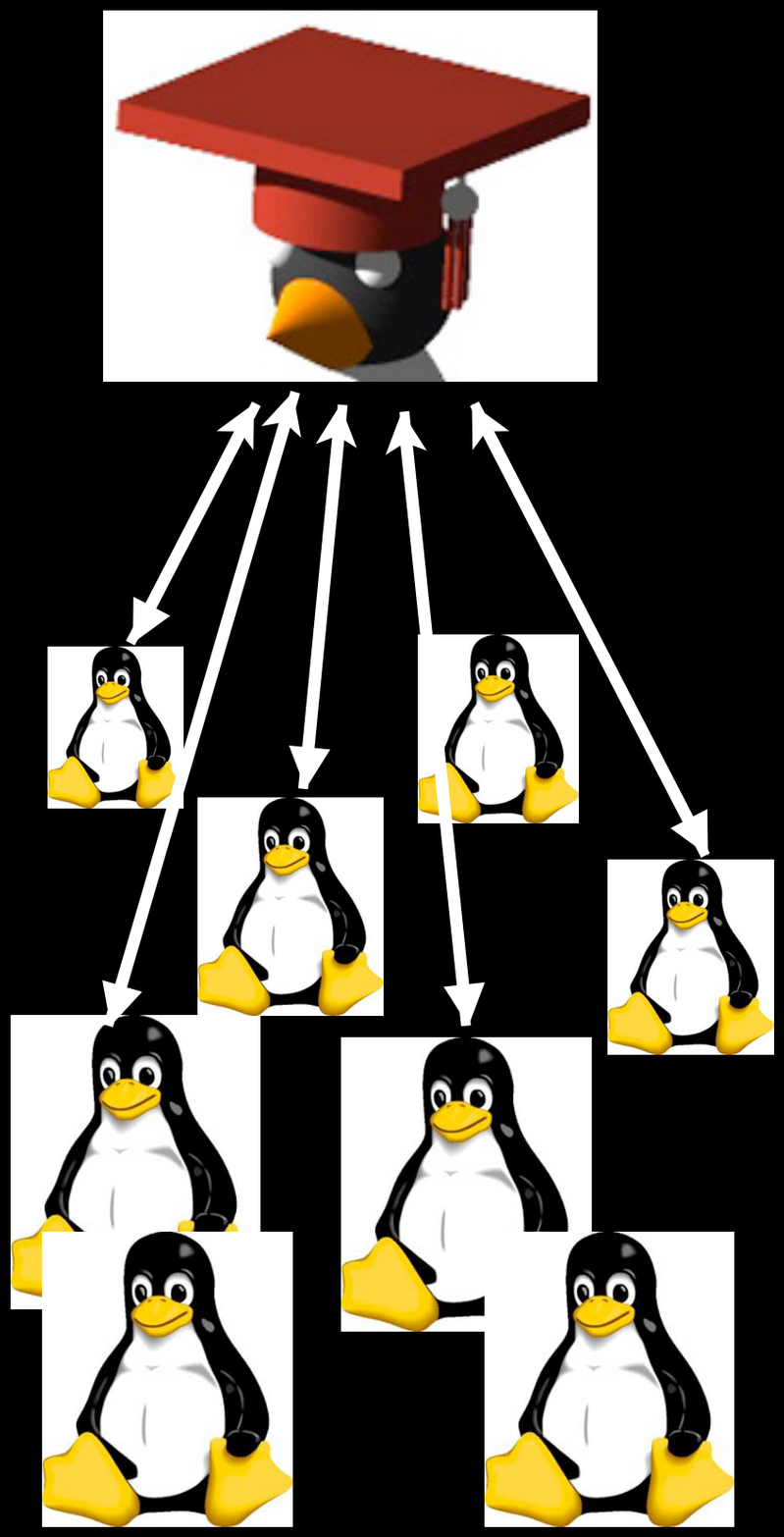
- Keep persistent (ADQL) queries for subscribed follow-up agents & push out (e.g., SOAP TCP/IP) new transients based on those queries

Open Interfaces

- (Pull) Web- & batch-based queries
  e.g., target starved grad student @ telescope

- (Push) RSS feeds, TCP/IP broadcasts, etc.

Role of Meta-Aggregators of VOEvents

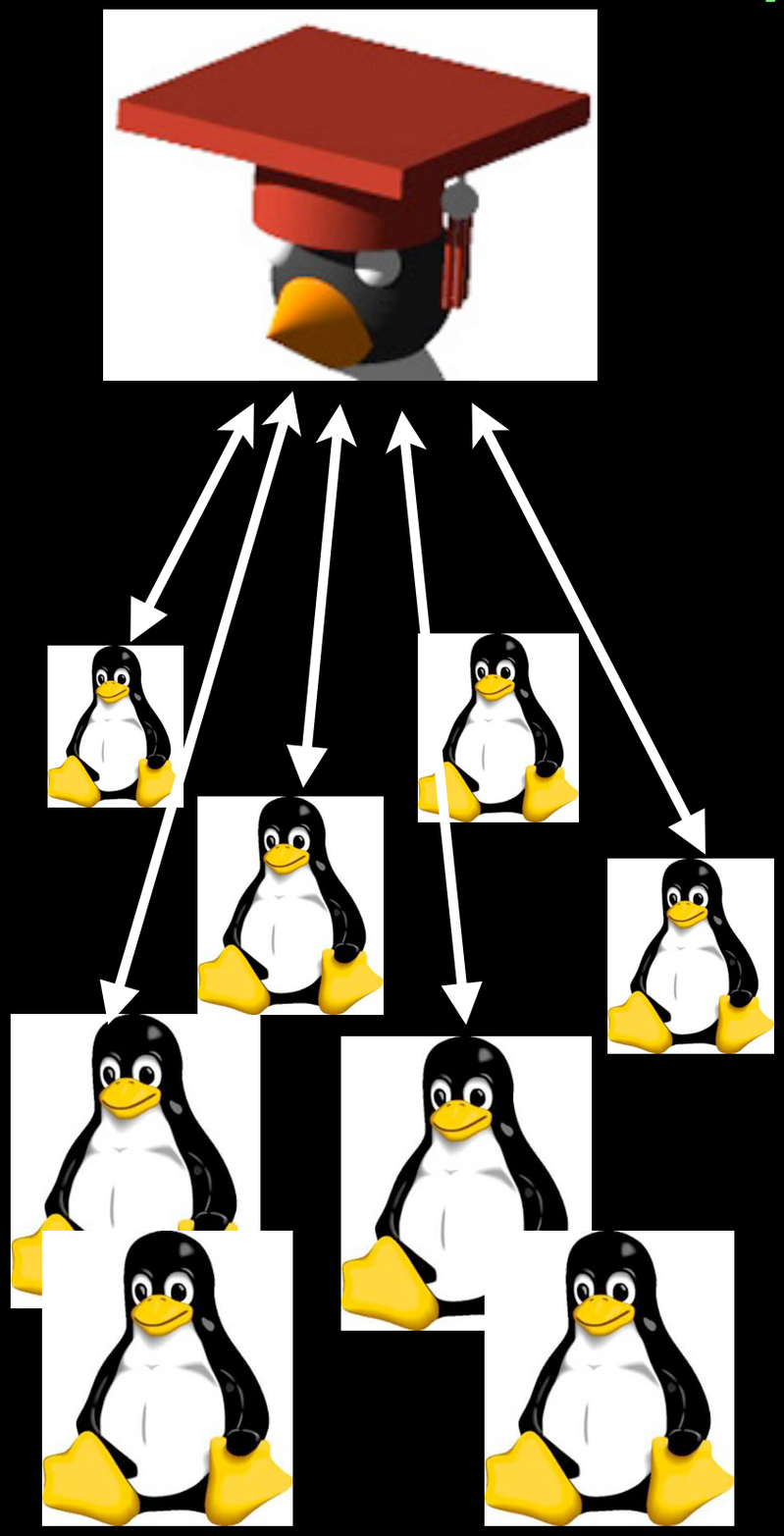


Maintain superset of VOEvents
from child aggregators

Provide the Same Interfacing
as a simple aggregator
→ structured/nested networking

Provide Probabilistic Estimates
for potential subscribers

e.g., with query such-and-such
you will be expected to receive
1250 alerts per night

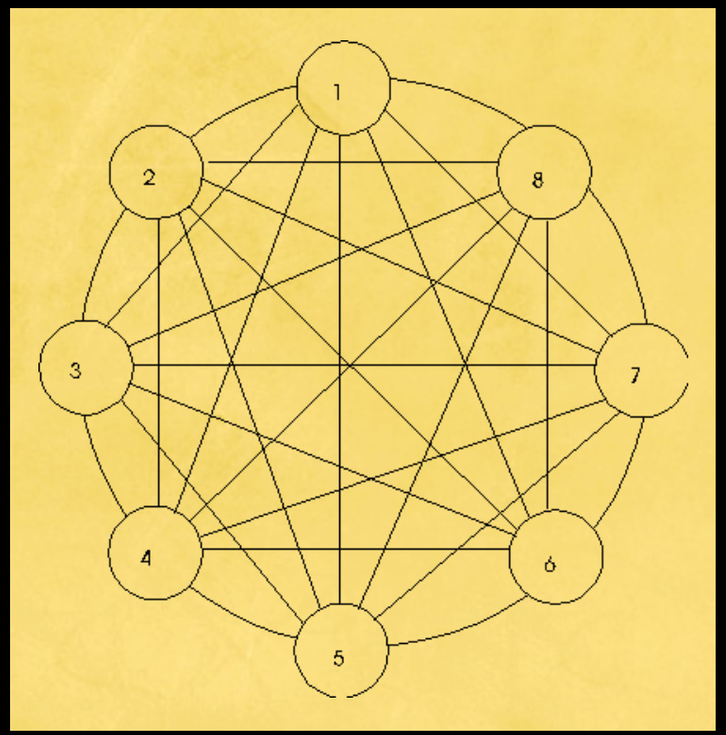


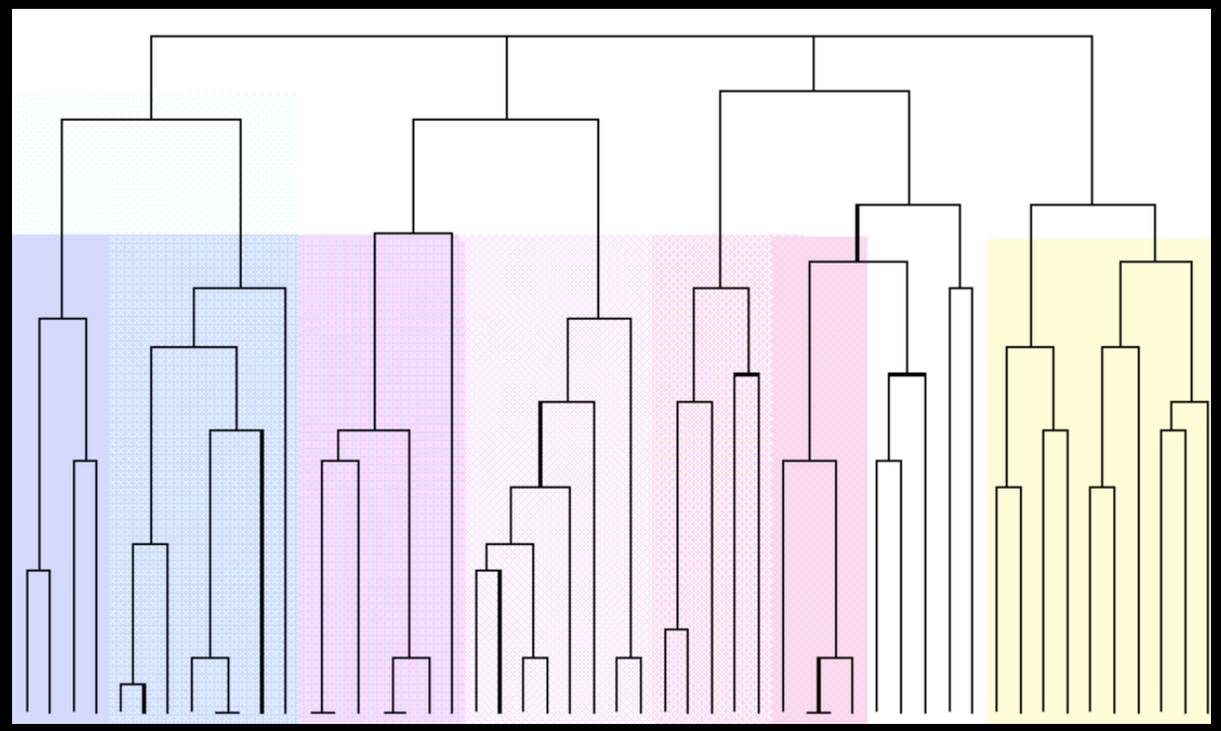
Types of Meta-Aggregators of VOEvents

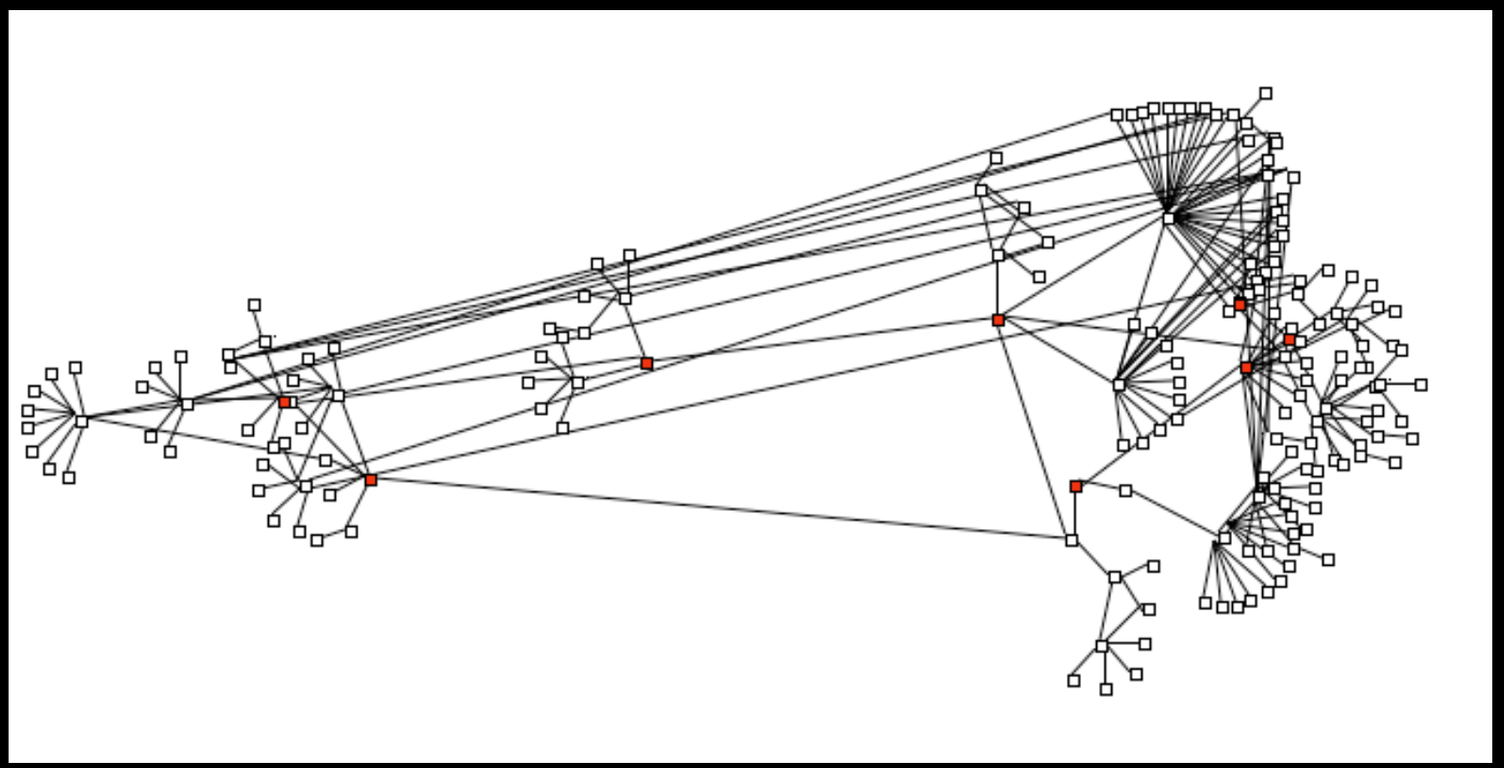
* Simple Logic:
  determining
  ivo_1 == ivo_2
  (e.g., XRB050406 == VelaX-1)
  "DNS" for VOEvents
* Complex Logic:
  providing prioritized &
  probability weighted target lists
  e.g. Bill's Fantabulous Supernova List
  "Aggregator of World's Top SN Providers"
* External Source Parsers:
  Archive comparators
  X-correlate with all ApJ papers

Value-added with meta perspective

Topology of VOEvents Network







Self-organization refers to a process in which the internal organization of a system, normally an open system, increases automatically without being guided or managed by an outside source. Self-organizing systems typically (though not always) display emergent properties.

http://en.wikipedia.org/wiki/Self-organisation

Self-Organization:

* Enabled by Meta-aggregators

* Events (+associated data) that are *important will persist, almost by definition*

* Events that are crap or hypotheses that are *wrong will be corrected*

^-*self*

At 11:20 one morning not too long ago, an anonymous user replaced the entire Islam entry with a single scatological word. At 11:22, a user named Solitude reverted the entry. At 11:25, the anonymous user struck again, this time replacing the article with the phrase "u stink!" By 11:26, another user, reverted that change - and the vandal disappeared....Cases of mass deletions, a common form of vandalism, were corrected in a median time of 2.8 minutes. When an obscenity accompanied the mass deletion, the median time dropped to 1.7 minutes.

It turns out that Wikipedia has an innate capacity to heal itself. As a result, woefully outnumbered vandals often give up and leave.

Wired. March 2005

Emergence:

There will be unforeseen uses (and abuses?) of the system, which we should embrace

Foreseen Science MO with the Network

Silent Follow-on

Near-Earth asteroid study

Event driven

Ad-hoc (*Galactic supernovae*)

Organized (*GRBs*)

Organized Campaigns

World-wide transient surveys

Do we need a new message PlannedCampaign?

Not expecting substantially different science agendas

Success will Depend on Agent Participation

Listener-only or Broadcast-only Network is useless

Multiple Providers w/ Redundancy
robustness against errors & weather
for Listeners

Listeners Must Feedback

Agents Working Outside the Spirit of the Network

Event Teasters

People/groups/robotic Provide basic VOEvents, getting others to observe, but do not broadcast all the data that

Moochers

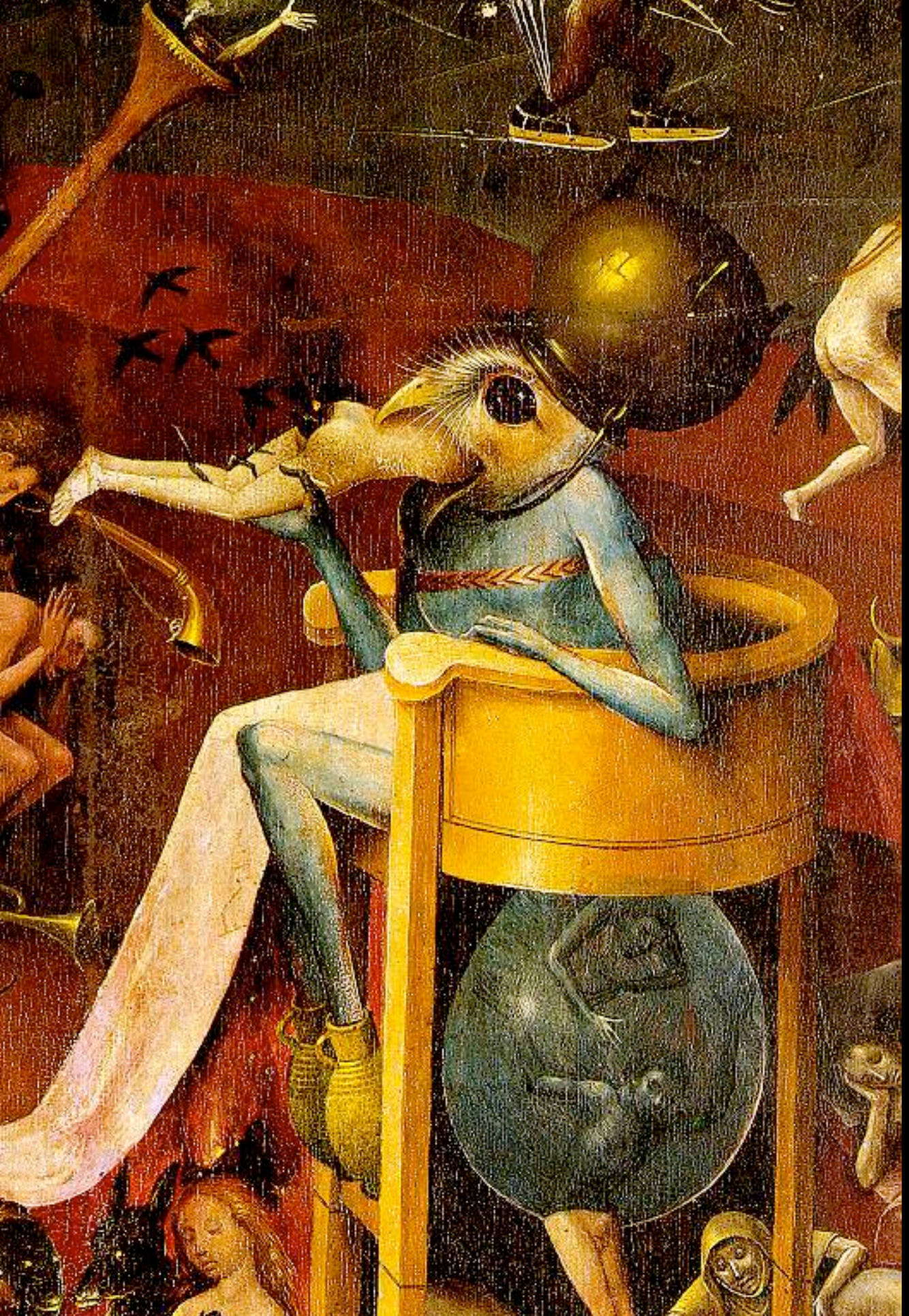
People/groups/robotic which Listen by never Provide

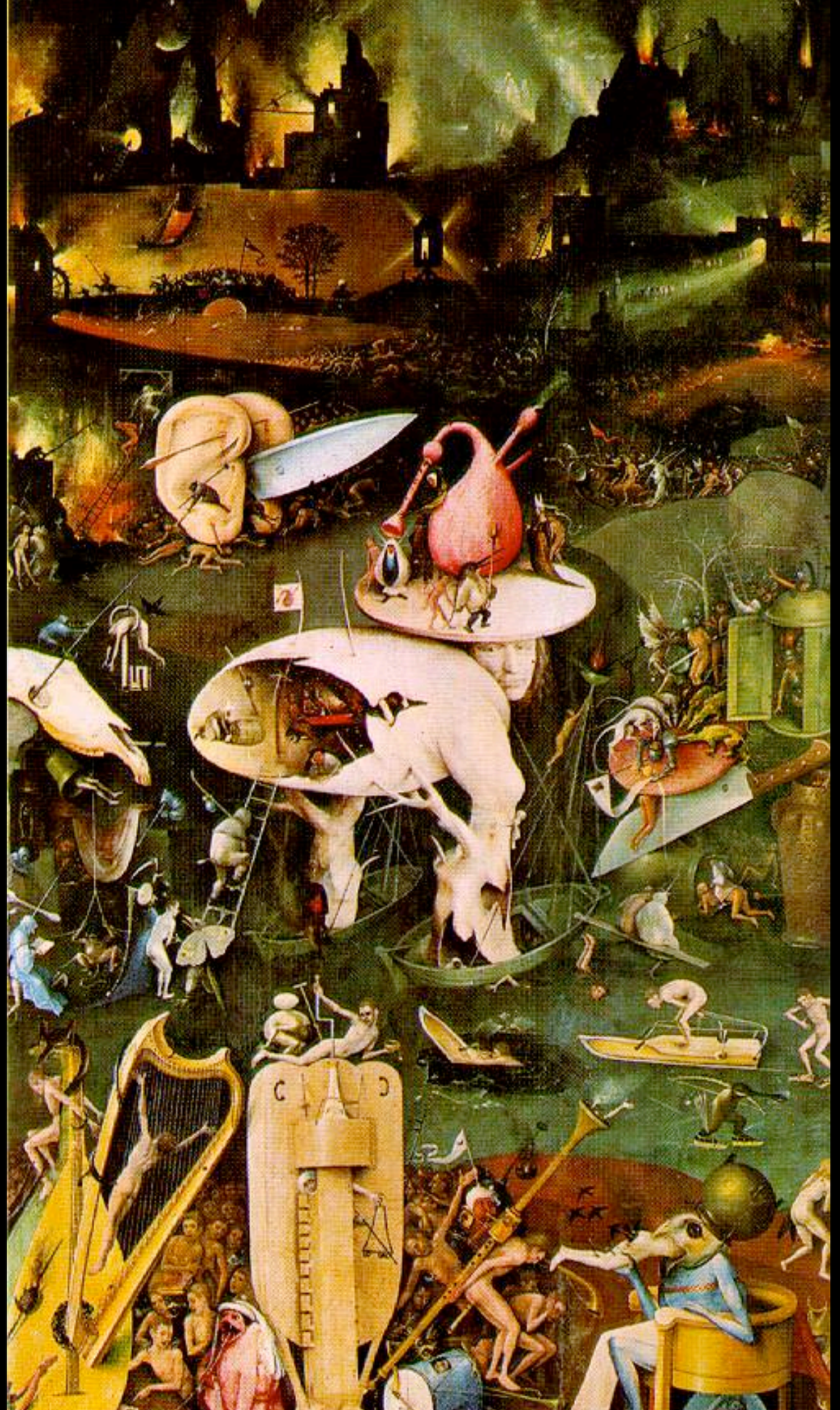
Private Networks

Evil shadow networks with Providers, Listeners, & Aggregators

dont publish events, only papers

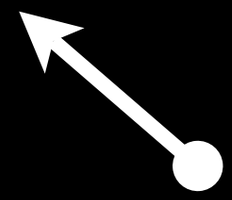
} Embrace them!





Proposed Benchmarks

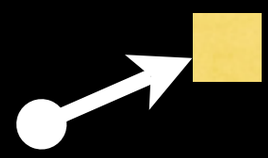
in parallel with systematic schema blessings



Simplistic Uni-directional Transport

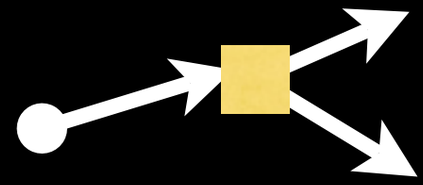
Provider supplies VOEvent to Listener who then reacts

two physical sites, two un-connected groups



Basic Aggregation of Single Provider

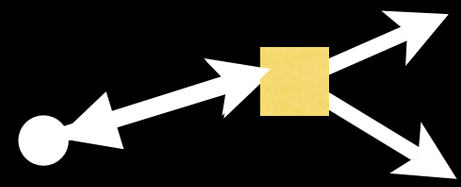
DB, web-interface with ADQL, implement a push technology



First Simple Network

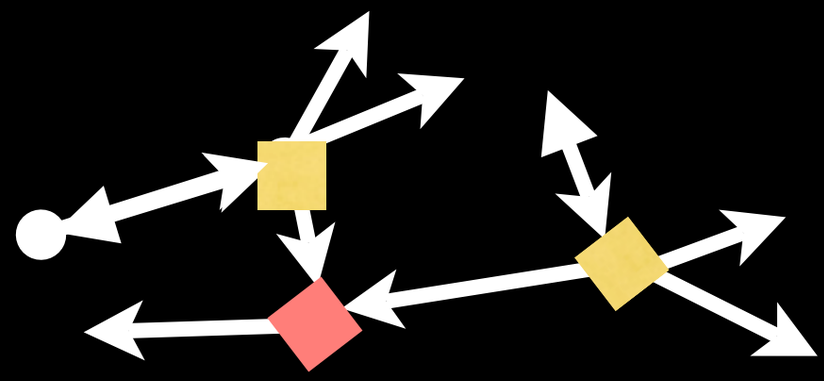
>= 1 Provider, 1 Aggregator, >1 Listeners

2005



Simple Network with Feedback

1 Provider, 1 Provider-Listener, 1 Aggregator, >1 Listeners



Complex Network

>2 Provider, >1 Provider-Listener, 2 Aggregator,

Meta-Aggregator, >2 Listeners,

1 Listener to only a Meta-Aggregator

Barriers to Entry are Too High that we MUST Implement Basic Nodes & Services

This is different philosophy than VO at large

Identify Transport Protocols
SOAP, TCP/IP, RSS2.0?

Determine DB representation of VOEvent Messages
eXist, postgresl?

Write Plug n' Play APIs and convince someone not in this room to use it


I WANT YOU