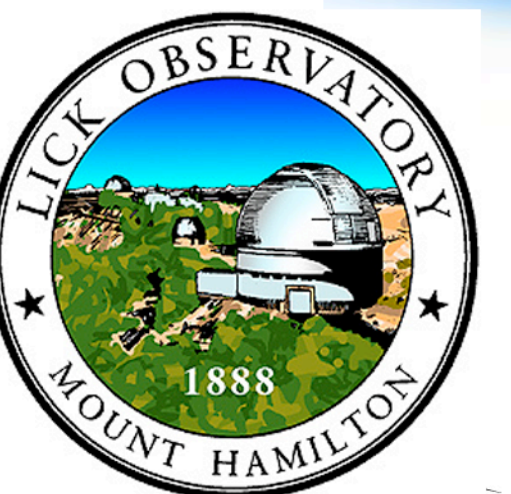# The VOEvent Alert Messaging System

A. Price (AAVSO), S.L. Allen (UCO/Lick Observatory), A. Fhima, J. Garcia (Gemini Observatory),
A. Mahabal (Caltech), R. Seaman (NOAO), R. Williams (Caltech), P. B. Warner (NOAO)

VOEvent is the emerging International Virtual Observatory standard for distributing transient celestial event notifications. The VOEvent specification provides a method for alerting subscribers to celestial phenomena in need of rapid, often automatic, observational follow-up. Both discovery and follow-up observations can be described using this semantically rich XML standard. We present a description of the standard and examples of implemented systems. The IVOA VOEvent working group is responsible for continuing to develop the specification and for motivating the development of conforming systems, interoperable with each other and with prior community resources. Much of the specific work presented in this poster was accomplished at the National Virtual Observatory Summer School II, supported by the National Science Foundation.
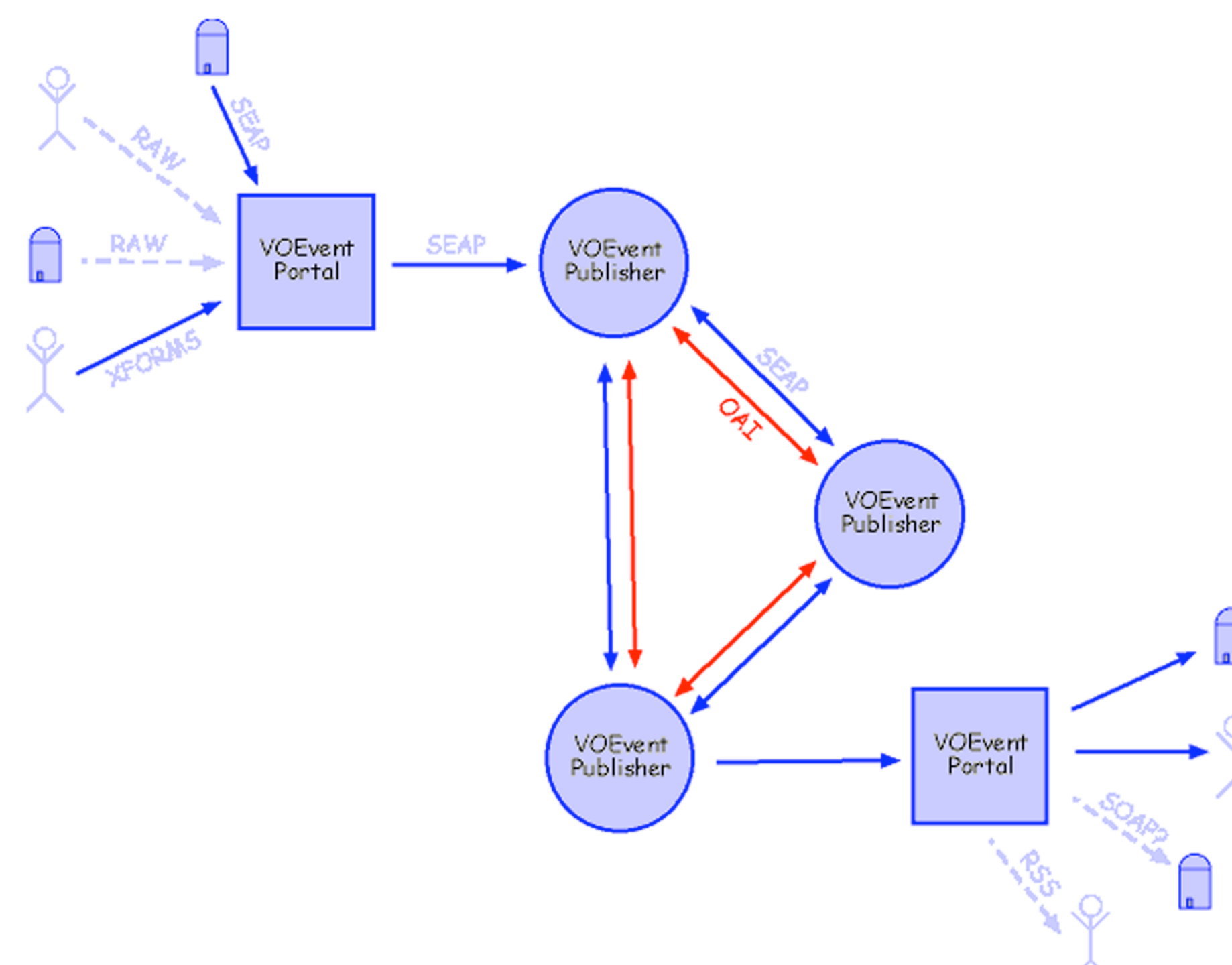
Description

The VOEvent effort is an attempt to create a standard method for representing, transmitting, archiving, and publishing a discovery of an immediate event in the sky.

The objective is to drive robotic telescopes, to drive archive searches, to alert the community, and to build interoperable archives. The effort includes not just "photon" events, but also gravitational waves, neutrinos, air showers, etc.

Since automated systems will be used, structured data is used as opposed to natural language. The VOEvent packet uses XML to describe "Who, What, Where, When, How and Why" of the event. Subscribers get immediate notification of events, based on previously defined criteria.

The standard does not (yet) define a transport layer or the construction of registries, clients, etc.

```
<Who>        – Resource Metadata
<What>       – VOTable <Param> & <Group>
<WhereWhen>  – STC
<How>        – RTML
<Why>        – UCD, ontologies
<Citations>  – IVO Identifiers
<Description> – natural language
<Reference>  – everything else
```

RTML: Remote Telescope Markup Language
STC: Space-Time Coordinate Metadata Specification for VO
UCD: Universal Content Descriptor
VOTable: An XML format defined for the exchange of tabular data in the context of the virtual observatory.

Components of a Fully Functioning VOEvent System
(Note: An entity may have more than one role)
1. **Author** - Creator of a sky transient alert.
2. **Publisher** - Source of VOEvent Packets
3. **Subscriber** - Any entity that receives VOEvent packets
4. **Relay** - A subscriber to one or more input packet streams who emits one or more output streams. Stream filtering may occur here.
5. **Repository** - A storage place where packets may persist either permanently or temporarily.
6. **Broker** - Any combination of two or more of the three core components: publisher, repository or relay. (Subscription is mixed in as needed.) A broker may offer arbitrary applications-level functionality in addition to the VOEvent packet handling.
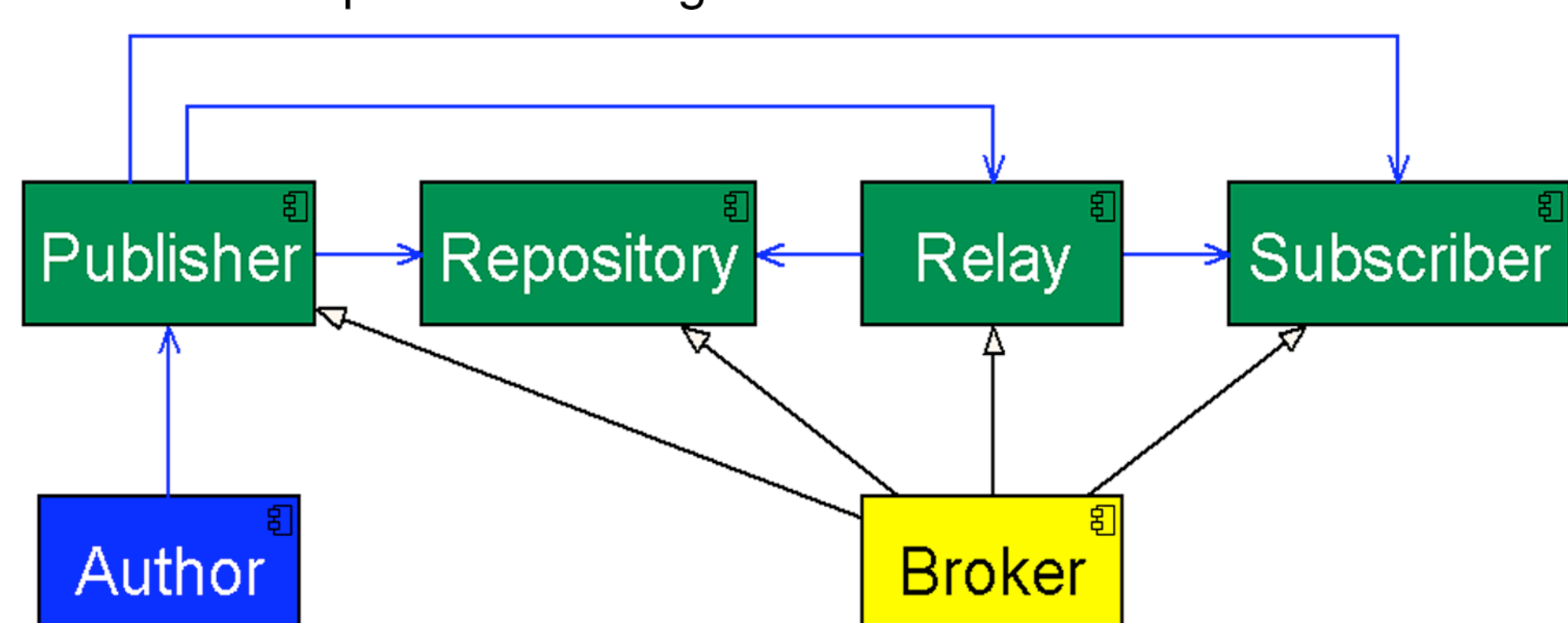

Blue lines are VOEvent packet flow. Lines with empty arrow heads indicate generalization, i.e., that a Broker is the combination of a Publisher, Repository, Relay, and Subscriber.


Coming Soon!

The IVOA VOEvent working group first met at Caltech in April 2005. Rapid progress was made to produce v1.0 of the VOEvent specification by early July. Initial prototypes of VOEvent publishers and subscribers were available around the same time. The second VOEvent workshop was held at NOAO in December and VOEvent remains a high priority project at several institutions.

Among the authors of this poster, Price will work on packet authoring software in perl. This will be available to the public via the VOEvent Wiki and the AAVSO web site. The code can be downloaded and customized for your use, or you may use the web form on the AAVSO web site to generate packets. Seaman will continue to labor on the VOEvent specification. In addition, Seaman and Warner received an NVO research grant to build authoring, brokering and subscription infrastructure in support of NOAO generated sky transient alerts, starting with Supernovae resulting from the NOAO ESSENCE and SuperMacho Surveys. The fruits of these labors will also be available to the community. Mahabal is active in the VOEventNET project. Allen's efforts on packet authentication are part of the development of VO security infrastructure. The Gemini Observatory will be building on the work of Fhima and Garcia to use VOEvent to support their rapid response queue.

All are welcome to join the VOEvent working group. Additional meetings are planned for mid 2006.
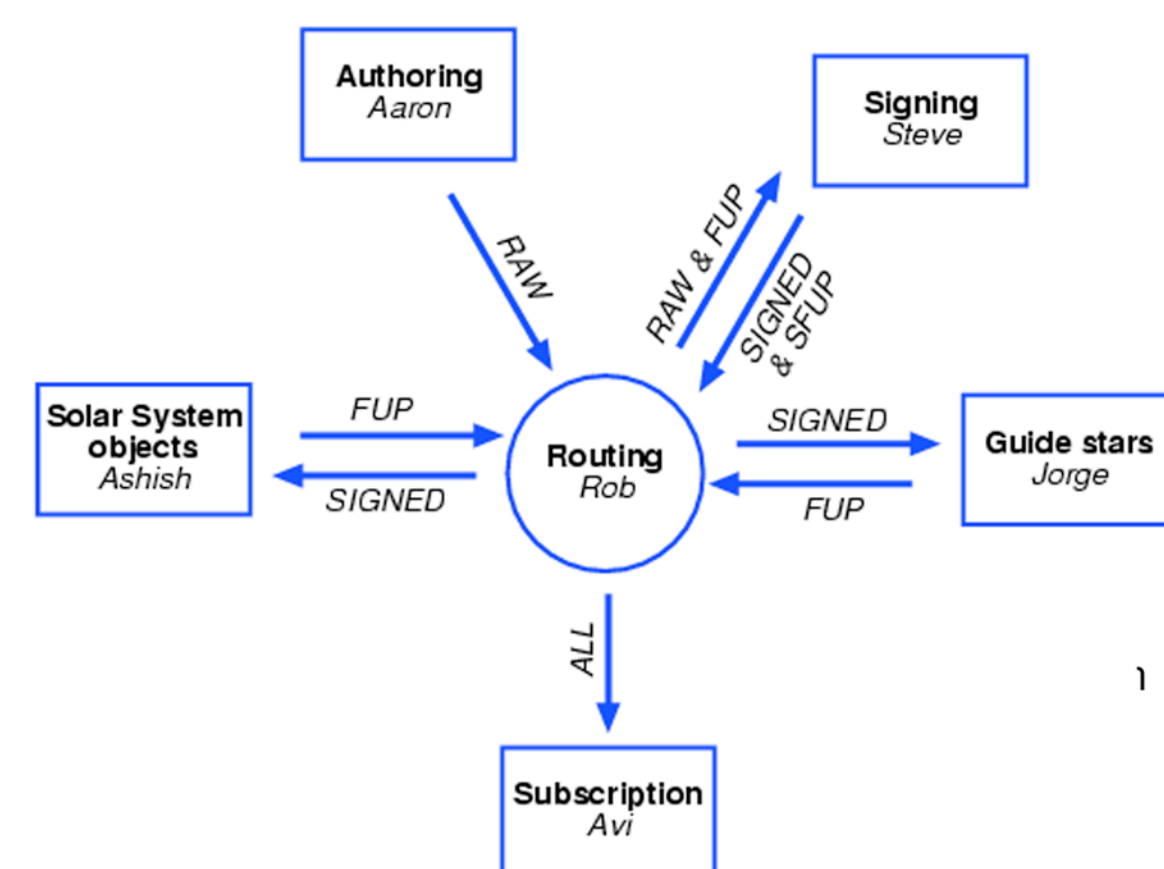
A Routing Diagram of the Sample Implementation
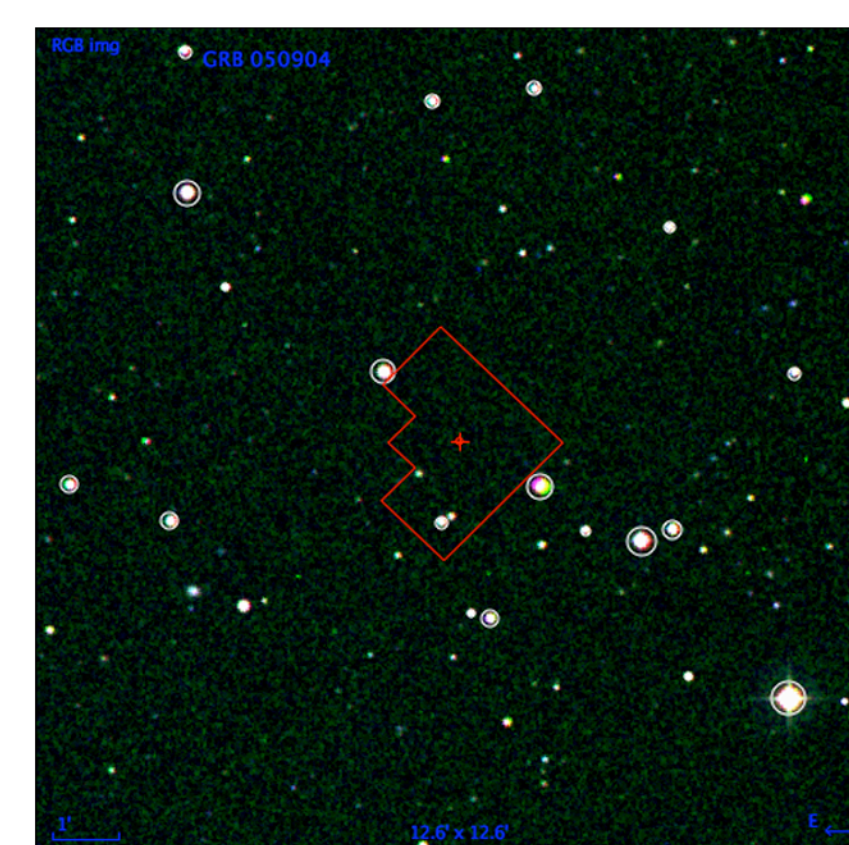
Guide Stars Chosen From VOEvent generated in Sample Implementation

More Information
IVOA VOEvent Wiki http://www.ivoa.net/twiki/bin/view/IVOA/IvoaVOEvent
VOEvent Demo http://chart.stsci.edu/twiki/bin/view/Main/VoEventDemo
VOevent Spec v1.0 http://www.ivoa.net/internal/IVOA/IvoaVOEvent/VOEvent-v1.0.html
Mailing List http://www.ivoa.net/forum/voevent/
NVO Summer School 2 http://chart.stsci.edu/twiki/bin/view/Main/SummerSchool2
VO Event II Meeting http://ivoa.net/twiki/bin/view/IVOA/

Sample Implementation at the 2nd NVO Summer School

At the 2nd NVO Summer School the authors of the poster worked on a two-day project to create a working VOEvent system. The goal was to demonstrate working portions of the system and to determine areas in need of future development. The demonstration consisted of:

1. **Authoring (Price):** A perl script and HTML interface was written to create the XML packets based on a recent real event.
2. **Signing (Allen):** A digital signature was assigned to the XML packet using an x509 certificate with the W3C XML signature schema.
3. **Routing (Seaman):** The shareware routing system Elvin was used to distribute the packets. Open source alternatives to Elvin include Apache Pubscribe, ICE, JMS, Mule and Jabber.
4. **Subscription (Fhima):** PHP was used to read and translate VOEvent packets into human readable form and make them available via a fun schematic published via RSS.
5. **Consuming VOEvents: Solar System Objects and Variable Stars (Mahabal):** A perl script parses the VOEvent packets and creates a list of possible VOEvent contaminants (e.g. known asteroids and known variable stars).
6. **Consuming VOEvents: Guide Stars (Garcia):** An Aladin script is used to select the best selected guide stars, detailing instrument configurations and field of view. Also, a VOTable of the selected stars is created and they are dynamically displayed in the default web browser.

Tongue-in-cheek color codes used with the RSS feed in our sample presentation.

HTML Interface to XML-Generating Perl Script

Required Fields

Field	Value	
Event Name:	TT ARI	
Event Value:	11.516	
Value Units:	B Mag	
Time of Event:	2005-09-11T10:21:51	UTC
VO Event Identifier:	aavso.newsflash.#12345	

Send VOEvent

Optional

What & When		
RA:	31.721	J2000
Decl.:	15.295	J2000
Coordinates Type:	Degrees	
What Description:	TT Ari is beginning a fading event for the first time since 1984.	
What Reference:	http://www.aavso.org/cgi-bin/quickquick.pl?star=ttk20ari	
Event Value Error:	0.035	
Time Error:	1	UTC
What UCD:	phot.mag;em.opt.B	

Why		
Importance:	0.6	0-1
Expires:	2005-09-18T10:21:51	
Concept:	Possibly first fading event since 1984. Time series and spectra ne	
Inference:	Associated	
Inference Name:	VY Scl type novalikes	

How		
How Name:	TT ARI	
Description String:	CCD B observation submitted to the AAVSO.	
RTML URI:	N/A	
Position Error Angle:	0	
Position Error Angle Reference:	North	N-S-E-W
Position Error:	0 0	
Equinox:	J2000.0	
Space Name:	Equatorial	
Naxes:	2	
Time Name:	Time	
Time Scale:	UTC	

Who		
Event Observation Location:	Bennet, CO, USA	
Publisher ID:	ivo://vo.aavso.org	
Role:	observation	
Name:	Aaron Price	
Institution:	AAVSO	
Address:	Clinton B. Ford Astronomical Data & Research Center 25 Birch St	
Phone:	1-617-354-0484	
E-mail:	aavso@aavso.org	
Principle Contact?:	True	
Version:	1.0	

Citations		
Citation Description:	AAVSO MyNewsFlash System	
Citation ID:	http://www.aavso.org/publications/newsflash	
Citation Cue:	Source	

VOEvent WhereWhens: Nearby Solar System Objects and Variable Stars

Page made at NVOSS II by Ashish Mahabal <aam@astro.caltech.edu>

Databases used:
skybot from IMCCE for Solar System objects, and
GCVS for Variable Stars
Future

VOEvent id	IMCCE VOTable	GCVS stars
ivo://raptor.lanl/VOEvent#23573	Solar System	Variable Stars
ivo://raptor.lanl/VOEvent#23572	Solar System	Variable Stars
ivo://raptor.lanl/VOEvent#23567	Solar System	Variable Stars
ivo://raptor.lanl/VOEvent#23567	Solar System	Variable Stars
ivo://raptor.lanl/VOEvent#23567	Solar System	Variable Stars
aavso.newsflash.#12345	Solar System	Variable Stars
aavso.newsflash.#12345	Solar System	Variable Stars