Content

- o Data Sharing, Data Grid
- o On-line Analysis
- o On-line Data Monitoring
- o Follow-up Analysis

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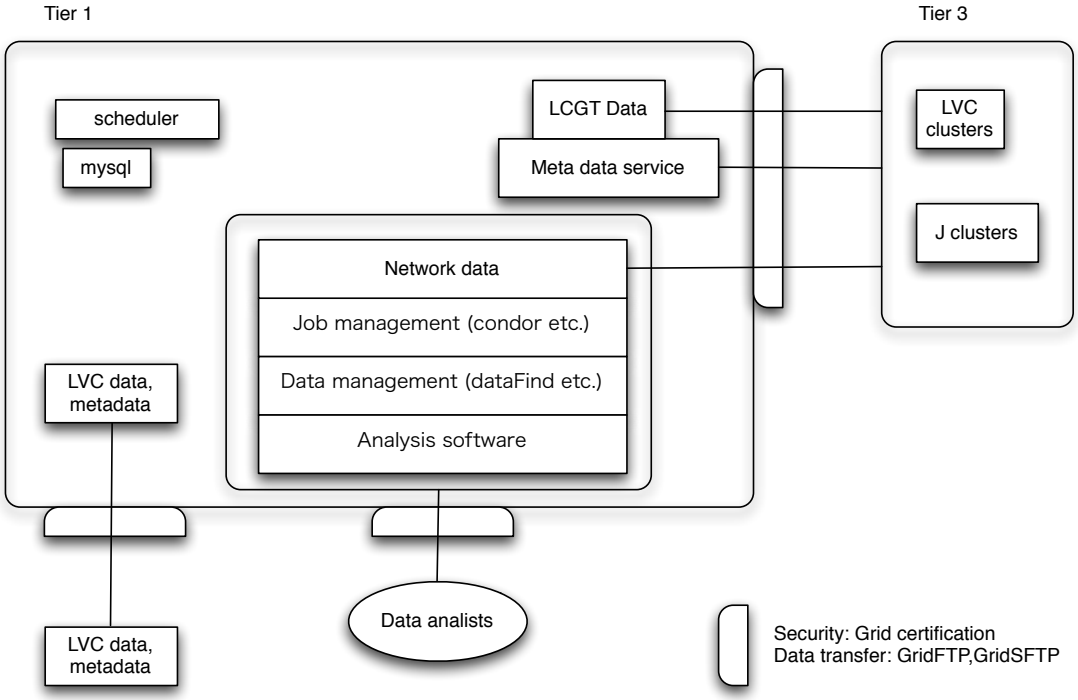
Procedure to data sharing from output of digital system

1. Saving output of digital system (GW channel, environmental channels etc.) in local storage.
   (ア) Assuming environmental channels are 10000, sampled at 1024Hz with float precision and the GW channel is sampled at 16384Hz with double precision, we store 2 weeks data in the local storage, required storage is (8*16384*3600*24 + 4*1024*3600*24*10000)*14=50TByte.
2. Calibration of GW channel and production of h-of-t.
   (ア) Current method takes 30~60[s] to produce h-of-t. This is too slow to perform real-time data analysis.
   (イ) This process should be in DMT.
3. Saving h-of-t, environmental channels in frame-formatted and transformation of the data to clusters.
   (ア) Frame: generation by Frame builder in DMT
   (イ) Data transfer: GridFTP in Globus
   (ウ) Required data transfer rate is (8*16384*24 + 4*1024*10000)*3600=159GByte/hour
   (エ) The cluster categorizes 4 groups: Tier1, Tier2, Tier3, Tier4. LVC data first transfer to Tier1. Tier1 replicate data to Tier2. Tier2 receives the replicated data and also transfer it to Tier3. The center in TAMA should play a role of Tier3 for LSC data and Tier1 for LCGT data.
4. The clusters contain a metadata server that maintains location of data and status of science modes etc.
5. Implementation of software for joining in data grid network (Globus).
6. Implementation of job management software (condor).

Data Sharing



Online analysis

1. h-of-t production

   Online analysis uses on-the-fly h-of-t which is produced from digital output directly and saves in the local storage in frame formatted file.

2. Partial detector characterization

   multi-channel monitoring (noise floor, non-stationarity)

   DQ flag LIGO used through S6

   (ア) DMT flag

   Produced by DMT monitor

   (イ) UPV flag (used percent veto)

   Associated to channels coincident with gw glitches more than 50% of the time

   (ウ) DCH flag (Detector CHaracterization) --offline

   Resulting from detector characterization investigations

   (エ) SCI flag -- offline

   Resulting from scimon

3. Online Burst search

   I. Analyzing network data, getting event candidates. Estimate sky locations and GPS times of them.

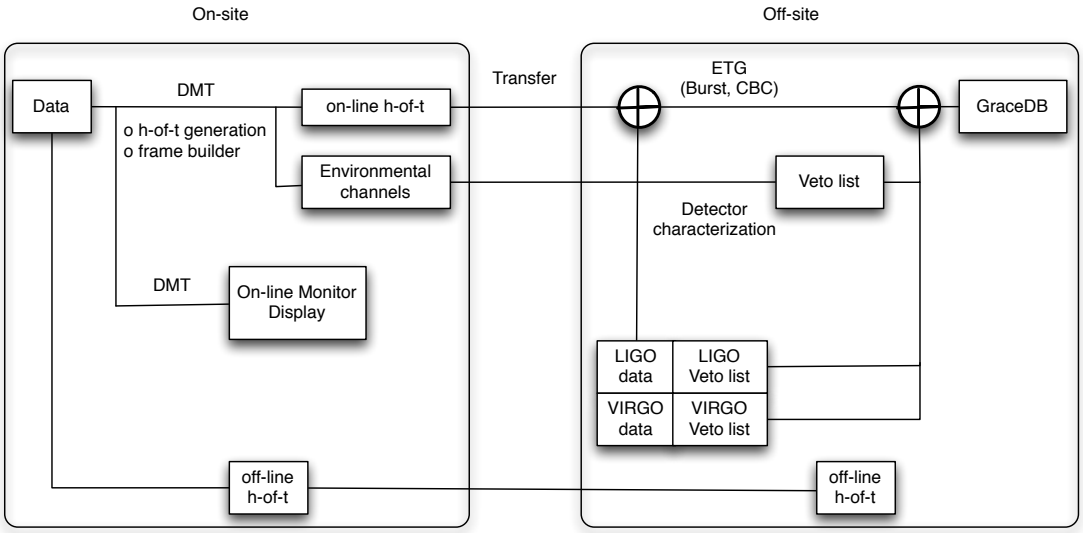
   II. Sending information of the triggered events to a database, which stores the event candidates, in JVO.

   III. Sending results to follow-up analysis and offline analysis.

4. Online CBC search

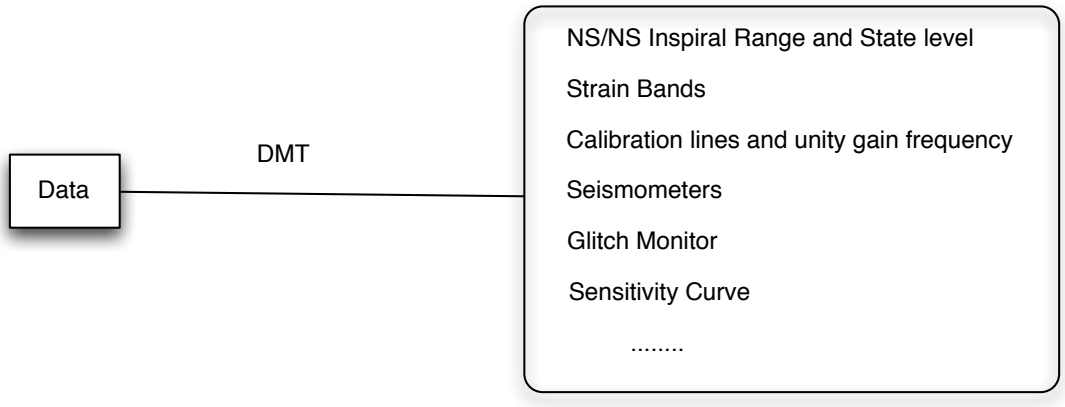
   Sending results to follow-up analysis and offline analysis.

On-line Analysis



Online Data Monitoring

On-line Monitor Display



Main software package: DMT(Data Monitoring Tool), DTT(Diagnostics Test Tool)

Monitor	Summary
BicoMon	
BitTest	Checks for stuck bits and repeated words in the raw data
CorrMon	Measure interchannel correlations and optionally estimate linear response functions
DEnvCorr	Measure and remove cross correlations between a signal channel and one or more environment channels.
DTracker	Multitaper line tracker.
DuoTone	Measures LSC timing stability using RAMP and Dual-Tone sinusoids.
GainMon	This monitor tracks the unity gain frequency for the DARM loop
HistCompr	Make histograms of [filtered] data [trigger on

	differences from reference].
IRIG-B	Measure timing stability relative to IRIG-B signals.
InspiralMon	Monitor online compact binary inspiral search
LIGOLwMon	A monitor for displaying time series data derived from LIGO LW XML files.
LineMonitor	Monitoring of amplitude, frequency and phase of narrow resonances.
Listen	Send a specified channel to the audio device of your workstation.
LockLoss	Watch for acquisition and loss of lock.
LscMonitor	
MTLineMon	Use multitaper spectral methods to identify and remove spectral lines.
MultiVolt	Monitor power line frequency, RMS and harmonic content
NoiseFloorMon	
PSLmon	Generic monitor program (Spectra, Glitches and Bands) for PSL and others
PTmon	Glitch monitor using peak-trough (peak-to-peak) time series.
PhotonCal	Measures LSC calibration using the photon calibrators.
PlaneMon	Monitors microphone channels for airplane signals and records airplane events.
PulsarMon	A Periodic Source Sensitivity Monitor for the DMT
RayleighMonitor	Real-time display of Raleigh statistic (a measure of noise gaussianity)
SegGener	Construct arbitrary segment table entries from OSC conditions.
SenseMonitor	A Binary-Inspiral Sensitivity Monitor for the DMT
ServoMon	Watch for servo instabilities.
ShapeMon	Monitor spectral shape stability

Slice2	Look for improper time ordering of data slices.
SpecMon	
SpectrumArchiver	
SpectrumFold	Diagnose excess power in bins at multiples of a fixed frequency (in particular 0.25 Hz)
Station	
StochMon	A Stochastic Sensitivity Monitor for the DMT
StrainbandsMon	A monitor to keep track of the strain within certain frequency bands.
TimeMon	Monitor timing card stability using ramp signals
TrigDsply	Display raw or filtered data associated with a list of triggers
TrigSpec	
WaveMon	Monitoring of glitches using wavelet time-frequency analysis
absGlitch	Glitch monitor using fixed trigger thresholds.
blrms_monitor	Apply a bank of IIR bandpass filters to timeseries data
burstMon	
eqMon	An earthquake monitor.
fastGlitch	Tool to plot filtered time series around given trigger times.
glitchMon	Generate a trigger when the signal exceeds threshold.
kleineWelle	
magGlitch	glitchMon optimized for magnetometer data.
sigma	Utility to display data graphically as time, frequency series and histogram.
suspensionMon	

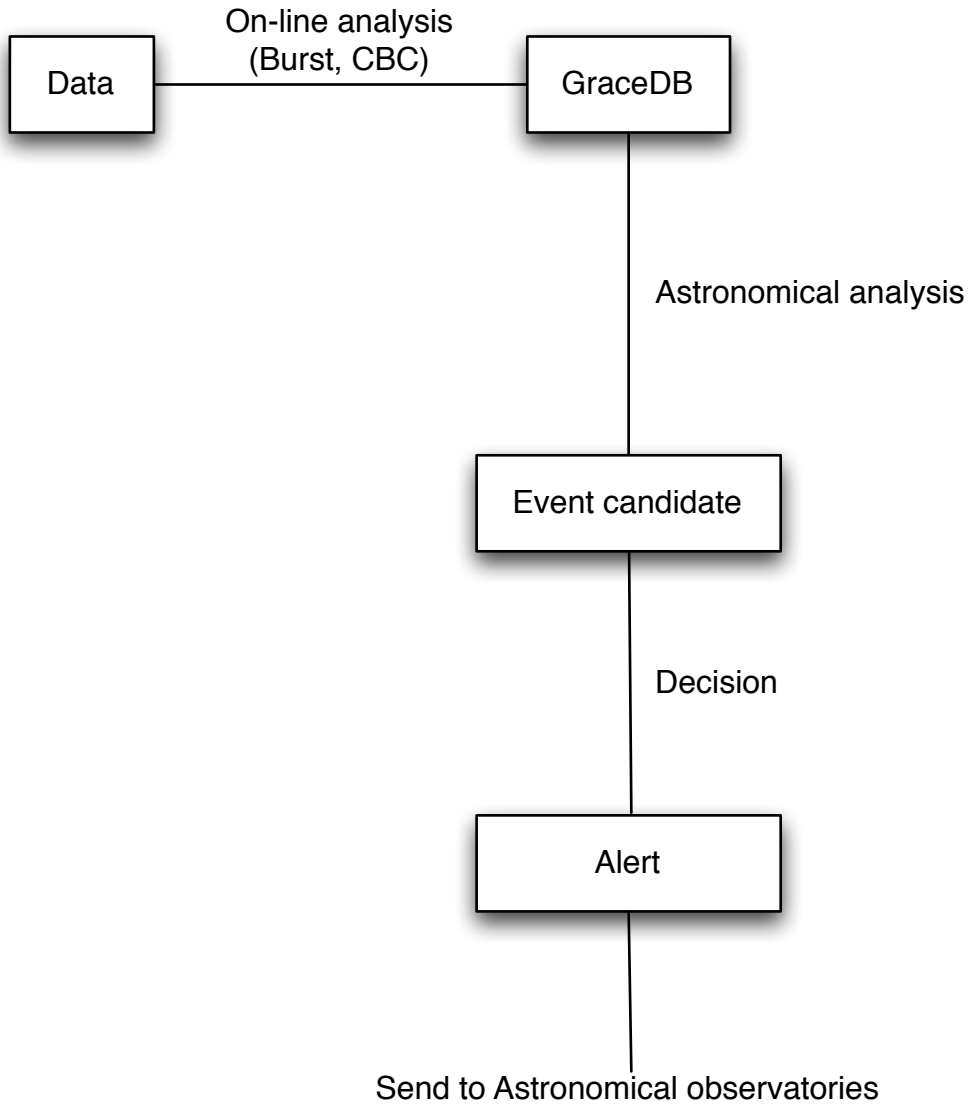
Procedure of EM follow-up observation

1. Data calibration and transfer data from multiple detector sites.
2. Event Trigger Generator
   (ア) Identification of significant events in multiple sites.
   (イ) Evaluation of background.
   (ウ) Application of data quality criteria.
   (エ) Estimation of sky positions of the events.
   (オ) Saving of the event candidates to JVO.
3. Observing Plan
   (ア) Tiling of the error region of the estimated sky positions.
   (イ) Which astronomical telescopes should be used.
4. Human monitor. – 5-10 minutes
   (ア) Check that the event is not near the beginning or end of a data segment
   (イ) Check the data quality around the time of the event
   (ウ) Check the detector glitch rates around the time of the event
   (エ) Discuss each detector's performance with the on-site scientists
   (オ) Vetting

Sending observation request to EM-telescopes. Totally 45-60minites

5. Astronomical analysis
   (ア) Image analysis
   (イ) …

Follow-up Analysis



Supplement

LSC channels by subsystem

o H1 - LHO 4 km detector

H1:ASC - H1 alignment sensing and control

H1:DAQ - H1 data acquisition

H1:GDS - H1 global diagnostics

H1:IOO - H1 input/output optics

H1:ISI - H1 internal seismic isolation

H1:LSC - H1 length sensing and control

H1:PSL - H1 pre-stabilized laser

H1:SEI - H1 seismic isolation

H1:SUS - H1 suspension

H1:TCS - H1 thermal compensation

o H0 - LHO facility

H0:GDS - LHO global diagnostics

H0:PEM - LHO physical environment