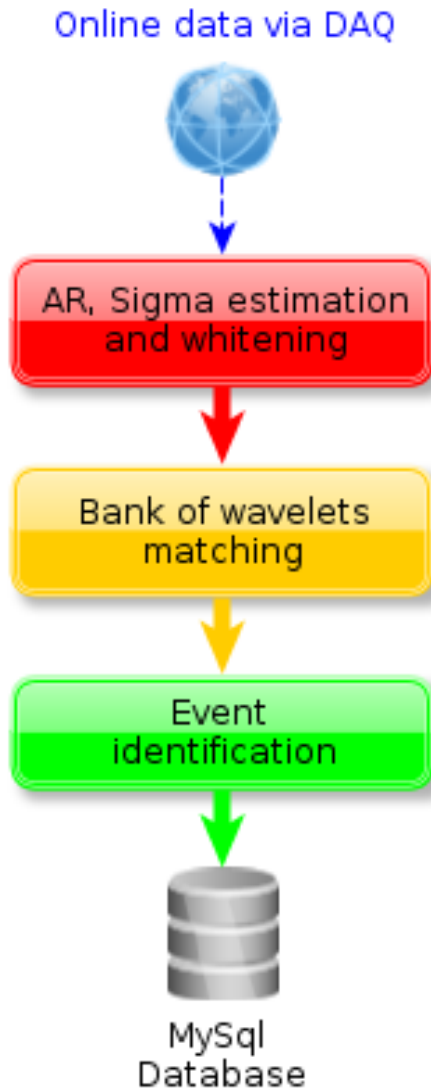




Transient events detector on **MySQL Database**

WDF - Wavelet Detection Filter case study

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WDF is an event triggers generator based on wavelet matching.

Event is defined by the following parameters

gpstime - Starting GPS time of the event

SNR - Reconstructed SNR

Duration - Afilter clustering (useful to disentangle transients by moving lines)

Cmax - maximum value of wavelet coefficient

Level - frequency

gpsmax - GPS time at SNR max

Wave - kind of triggering wavelet

NAP

WDF

NAP is a library written in C++ containing basic software for noise analysis and stochastic background

NAP routines have been embedded in python.

WDF running code are python scripts based on **NAP**

NAP is part of Virgo software and it is in cvs repository.

NAP documentation available on web.
https://wwwcascina.virgo.infn.it/DataAnalysis/Noise/nap_project.html

WDF

run **off-line** on file written on disks

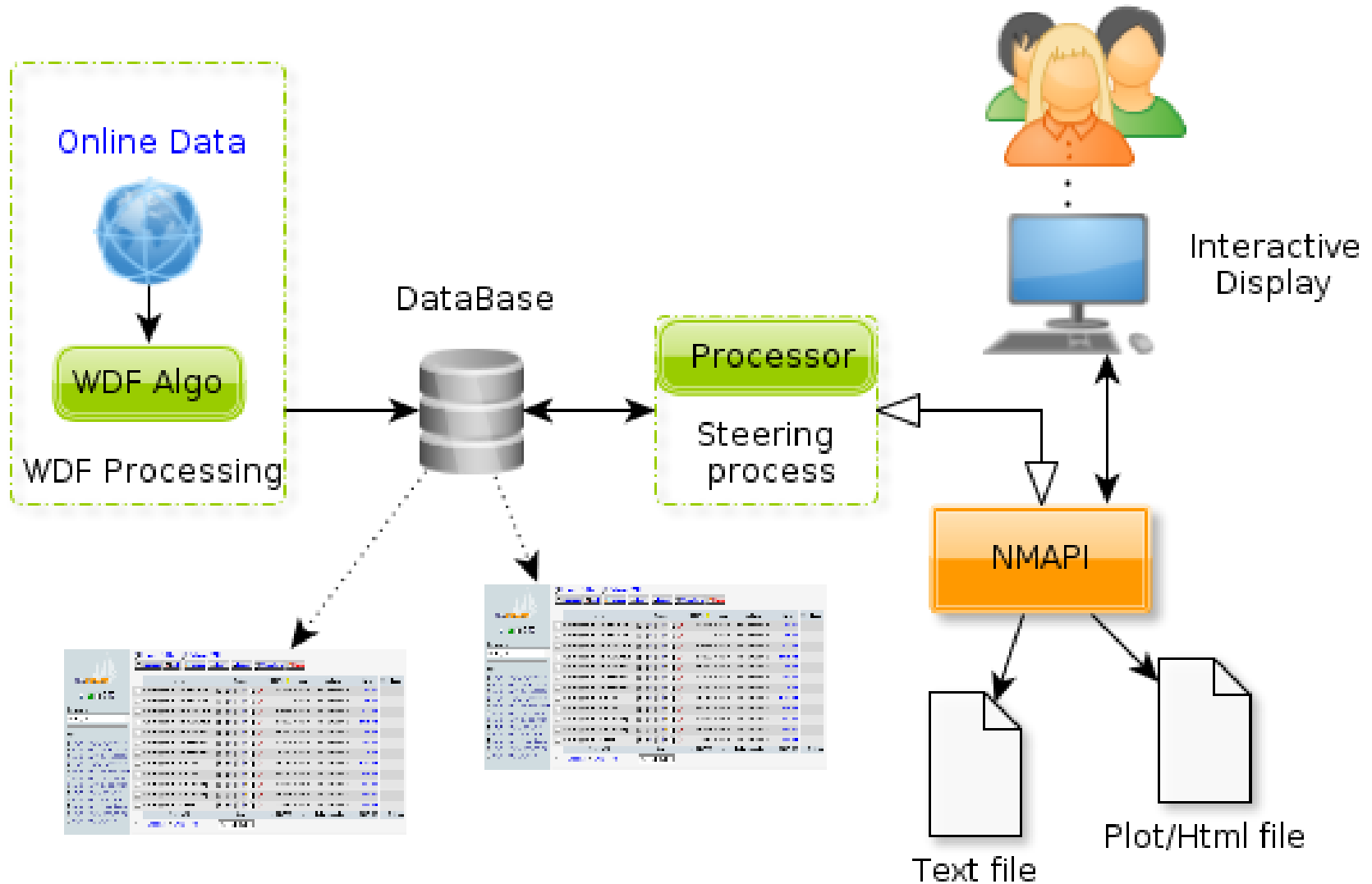
run **on-line** since it's linked to DAQ chain

The on-line algorithm, which uses adaptive whitening, analyzed 1sec of data in 1sec of time.

Triggers are inserted in real time, as soon as they are produced.

NoiseWDF	<input checked="" type="checkbox"/>	unknown	GPS 1030958957 - Sep 06, 2012 (250) 11:29:04
Transmitters to WDF processes			
NoiseToWDF	<input type="checkbox"/>	unknown	raw Data transmitter to WDF
DQhToWDF	<input checked="" type="checkbox"/>	Active	Warning: no frame read since 866174 s
WDF processes			
WDF	<input type="checkbox"/>	unknown	WDF wavelet monitor on h
WDFMoni	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 0
WDFMoni1	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 1
WDFMoni2	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 2
WDFMoni3	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 3
WDFMoni4	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 4
WDFMoni5	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 5
WDFMoni6	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 6
WDFMoni7	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 7
WDFMoni8	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 8
WDFMoni9	<input type="checkbox"/>	unknown	WDFMoni wavelet monitor 9

WDF to database workflow



WDF Tables: example

Server: 127.0.0.1 Database: WDF

Structure SQL Search Query Export Operations Drop

Table	Action	Records	Type	Collation	Size	Overhead
<input type="checkbox"/> wdf_trigger_V1_Em_ACBDCE01		156,587	MyISAM	latin1_swedish_ci	8.8 MB	-
<input type="checkbox"/> wdf_trigger_V1_Em_ACDBCE01					1.0 KB	-
<input type="checkbox"/> wdf_trigger_V1_Em_MABDCE01					21.1 MB	-
<input type="checkbox"/> wdf_trigger_V1_Em_MABDNE01					195.8 MB	-
<input type="checkbox"/> wdf_trigger_V1_Em_MABDWE01					73.6 MB	-
<input type="checkbox"/> wdf_trigger_V1_Em_SEBDNE01					53.7 MB	-
<input type="checkbox"/> wdf_trigger_V1_Em_SEBDWE01					1.6 MB	-
<input type="checkbox"/> wdf_trigger_V1_Pr_B1_ACp					176.9 MB	-
<input type="checkbox"/> wdf_trigger_V1_Pr_B1_ACq					85.5 MB	-
<input type="checkbox"/> wdf_trigger_V1_Pr_B1_d2_ACp					64.2 MB	-
<input type="checkbox"/> wdf_trigger_V1_Pr_B1_d3_ACp					60.8 MB	-
<input type="checkbox"/> wdf_trigger_V1_h_4096Hz					52.7 MB	-
12 table(s)					794.5 MB	0 Bytes

Check All / Uncheck All With se

wdf_trigger_V1_Em_ACBDCE01

wdf_trigger_V1_Em_ACDBCE01

wdf_trigger_V1_Em_MABDCE01

wdf_trigger_V1_Em_MABDNE01

wdf_trigger_V1_Em_MABDWE01

wdf_trigger_V1_Em_SEBDNE01

wdf_trigger_V1_Em_SEBDWE01

wdf_trigger_V1_Pr_B1_ACp

wdf_trigger_V1_Pr_B1_ACq

wdf_trigger_V1_Pr_B1_d2_ACp

wdf_trigger_V1_Pr_B1_d3_ACp

wdf_trigger_V1_h_4096Hz

WDF MySQL Fields

Server: 127.0.0.1 Database: WDF_VSR2 Table: wdf_trigger_V1_Pr_B1_ACp

Showing rows 0 - 29 (6700582 total, Query took 0.0551 sec)

SQL query:
SELECT *
 FROM `wdf_trigger_V1_Pr_B1_ACp`
 LIMIT 0, 30

gpstime

snr

duration

cmax

level

gpsmax

wave

	gpstime	snr	duration	cmax	level	gpsmax	wave
	926680627.05115	115.475041341915	2.92069935798645	3.89380618546841e-07	2617.1875	926680626.15345	Db20
	926680627.1023	43.2338823575001	0	2.917344476213e-07	4237.28125	926680627.1023	Db20
	926680627.3069	5.11704361878138	0	3.6496393072e-07	9.1875	926680627.3069	Db20
	926680627.46						
	926680627.56						
	926680627.7161	7.00093512723707	0	4.26533564071475e-07	9267.578125	926680627.7161	Db20
	926680628.05115	6.36856210769945	0	3.91668050115172e-07	410.15625	926680628.05115	Db20
	926680628.2046	7.61410166941493	0	5.02146930466806e-07	419.921875	926680628.2046	Db20
	926680628.46035	5.99168935337012	0	3.73926353080504e-07	8964.84375	926680628.46035	Db20
	926680630.46035	9.12942678731162	0	2.43416325609533e-07	3300.78125	926680630.46035	Db20
	926680631.2046	6.94398878935213	0	5.05094188728467e-07	410.15625	926680631.2046	Db20
	926680631.35805	15.5672887184192	0.255749821662903	8.99619043586775e-07	419.921875	926680631.5115	DCT
	926680632.5115	5.86777726602655	0	2.37349409753854e-07	1845.703125	926680632.5115	DCT

WDF run on-line and fill a MySQL database since VSR2. It ran on main GW channel and (for testing) on some auxiliary channels.

Database storage example for VSR2. Estimation for 30 channels.

	Current situation		Future expectations (approximate)	
	Records	Space used (KB)	Records	Space used (KB)
wdf_triggers_Pr_B1_ACp	6700583	345000	850000/month	100000/month

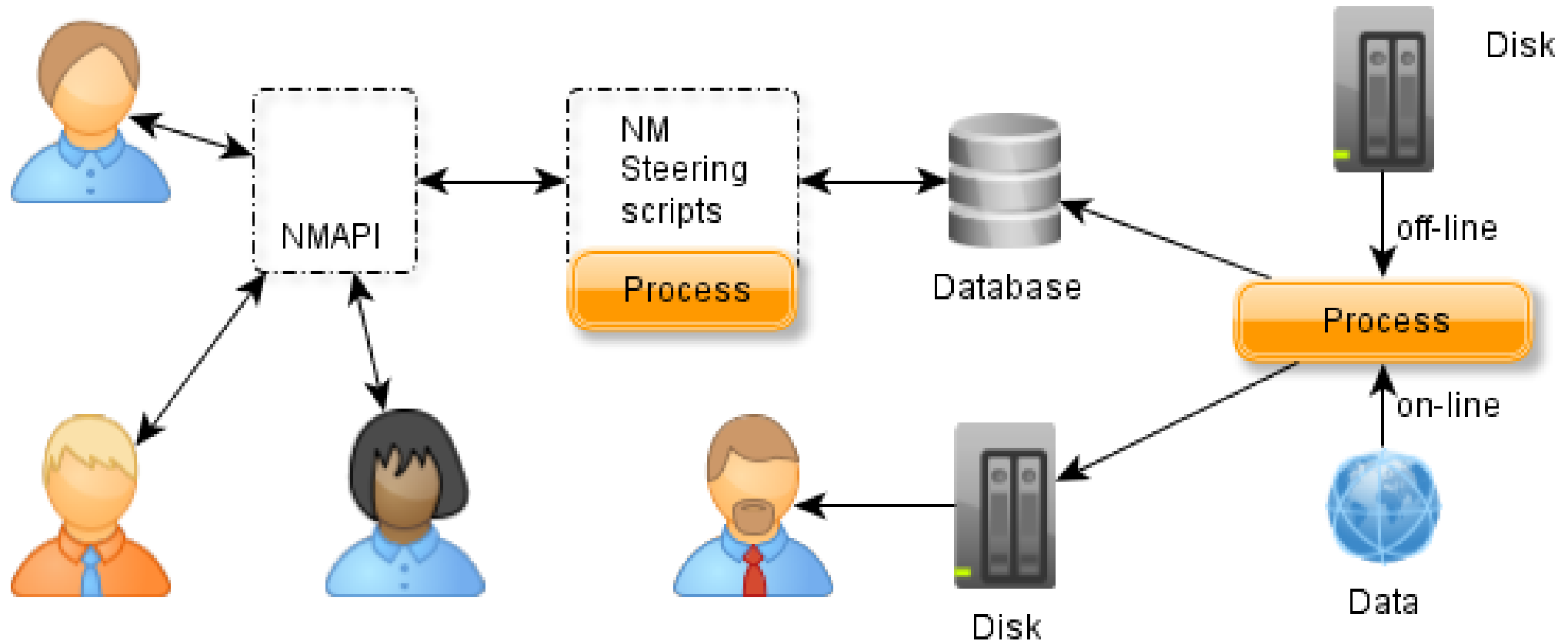
Never ran on all the auxiliary channels, since DQ group used KW or Omega.

Until now it is used just to test the pipeline Online Triggers Generator → Database, and give indication on triggers rate

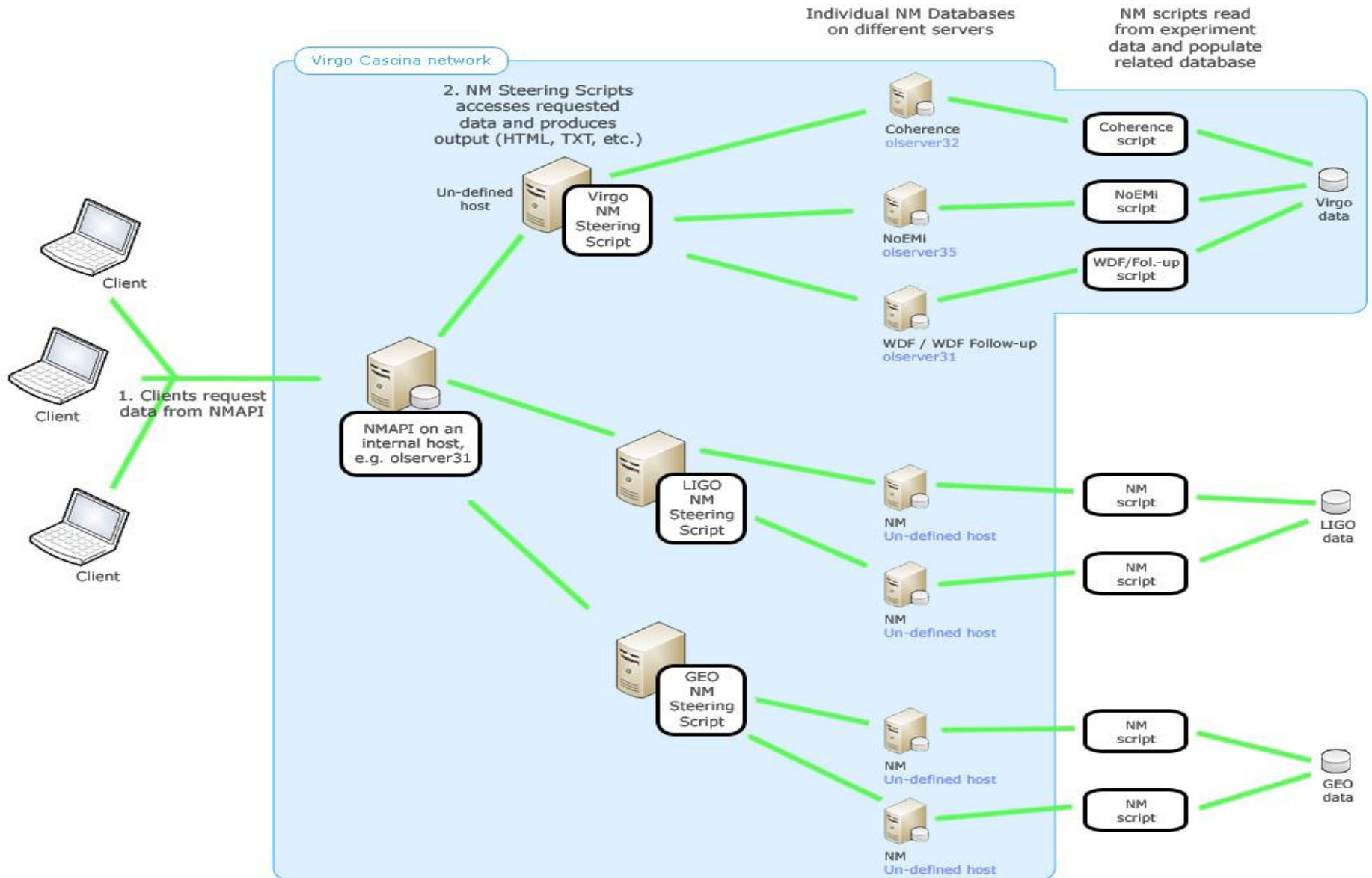
How users can access the
Database triggers?

WDF is part of Noise Monitor API, and a Web interface to perform queries to the database is available to users

General Noise Monitors structure: NMAPI and D-NMAPI

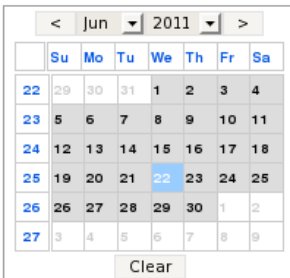


Distributed-NMAPI



NMAPI - WDF - Summary WDF

Logged in as cuoco > LOG-OUT



Channel V1:Pr_B1_ACp

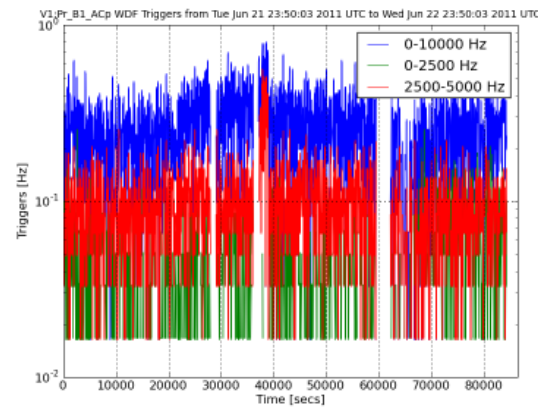
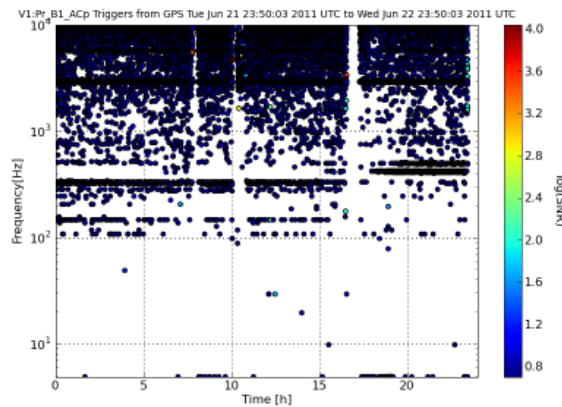
CHOB

- View summary pages
- Launch script
- Add/Edit a Noise Monitor
- Debugging: ON - OFF

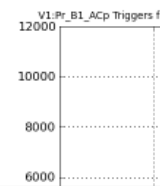
Wavelet Detection Filter (WDF) finds triggers due to transient signals in the data, using wavelet decomposition of whitened data and looking for excess of signal over background noise, which usually is contained in few wavelet coefficients

V1:Pr_B1_ACp, Triggers in the period GPS 992731818 - 992818218

Frequency-Time-SNR map --- Triggers rate per second



SNR-Frequency --- SNR-time



NoEMi is integrate in NMAPI, for example

WDF

NMAPI - WDF - Launch script WDF

Logged in as cuoco > LOG-OUT

CHDB

View summary pages

Launch script

Add/Edit a Noise Monitor

Debugging: ON - OFF

■ Enter required WDF script launch criteria

To obtain a list of triggers produced by WDF, you can launch the script selecting the output format as TXT, if you want an ascii files or HTML format if you want to see plots of triggers features. you have to select a channel from the list, the starting time, the duration in seconds

Channel

V1:Em_ACBDC01

CHDB

Output format

TXT

GPS start ?

length ?

3600

sampling ?

20000

> CLEAR CRITERIA

> LAUNCH SCRIPT

For example a query to the data base to produce a summary page for 1235342 secs (878488 triggers) last <5min

NMAPI - WDF - Launch script WDF Logged in as cuoco > LOG-OUT

CHOB

View summary pages

Launch script

Add/Edit a Noise Monitor

Debugging: ON - OFF

> RETURN TO SCRIPT LAUNCH

The script was launched using the following criteria:

Channels: V1:h_4096Hz
Output formats: TXT
GPS start: 997056015
length: 3600
sampling: 4096

List of WDF Triggers for channel V1:h_4096Hz from GPS Thu Aug 11 01:00:00 2011 UTC to Thu Aug 11 02:00:00 2011 UTC

GPS_starting	SNR	Duration	Frequency	GPS_SNRmax
997056073.403076	6.936050	0.000000	48.000000	997056073.403076
997056142.496094	5.356923	0.000000	416.000000	997056142.496094
997056146.682129	5.045801	0.000000	192.000000	997056146.682129
997056155.961182	5.212014	0.000000	176.000000	997056155.961182
997056212.806152	5.714859	0.000000	32.000000	997056212.806152
997056316.248047	5.046307	0.000000	1840.000000	997056316.248047
997056448.279053	5.135286	0.000000	496.000000	997056448.279053
997056535.806152	5.003205	0.000000	224.000000	997056535.806152
997056901.248047	5.888900	0.000000	48.000000	997056901.248047
997056915.465088	5.157628	0.000000	80.000000	997056915.465088
997056916.403076	5.383911	0.000000	416.000000	997056916.403076
997056960.279053	5.069510	0.000000	800.000000	997056960.279053
997056983.341064	5.745866	0.000000	1744.000000	997056983.341064
997057004.961182	6.518016	0.000000	224.000000	997057004.961182
997057202.961182	6.053799	0.000000	160.000000	997057202.961182
997057255.527100	5.497162	0.000000	608.000000	997057255.527100
997057330.186035	7.922667	0.000000	48.000000	997057330.186035
997057396.744141	5.213679	0.000000	416.000000	997057396.744141
997057608.930176	7.700688	0.031006	608.000000	997057608.930176
997057783.589111	30.718479	0.031006	16.000000	997057783.589111
997057945.589111	21.036876	0.000000	48.000000	997057945.589111
997057980.248047	5.989057	0.000000	80.000000	997057980.248047
997058163.403076	6.634454	0.000000	128.000000	997058163.403076
997058262.744141	5.469289	0.000000	816.000000	997058262.744141
997058460.248047	9.497461	0.031006	80.000000	997058460.248047
997058628.961182	5.176842	0.000000	1984.000000	997058628.961182
997058630.434082	5.677049	0.000000	800.000000	997058630.434082
997058672.775146	6.295677	0.000000	1920.000000	997058672.775146

Glitches
Lines
Stationarity
Coherence

WDF Follow Up

NMAPI - WDFfollowUp - Summary WDFfollowUp
username [LOG-IN](#)

< Jul 2011 >

	Su	Mo	Tu	We	Th	Fr	Sa
26	26	27	28	29	30	1	2
27	3	4	5	6	7	8	9
28	10	11	12	13	14	15	16
29	17	18	19	20	21	22	23
30	24	25	26	27	28	29	30
31	31	1	2	3	4	5	6

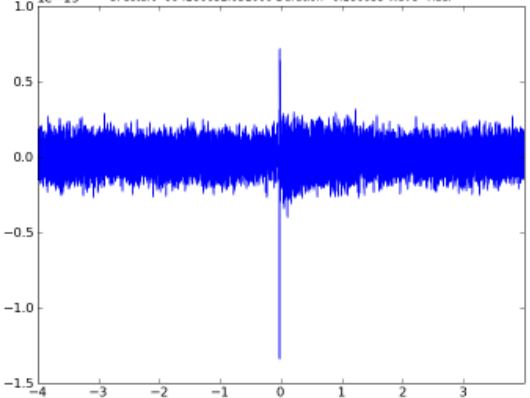
The tool select the five most energetic events in the last hours and plot the corresponding whitened data in time-domain and time frequency domain.

WDF: 5 highest SNR events at time 2011-07-09--23:58

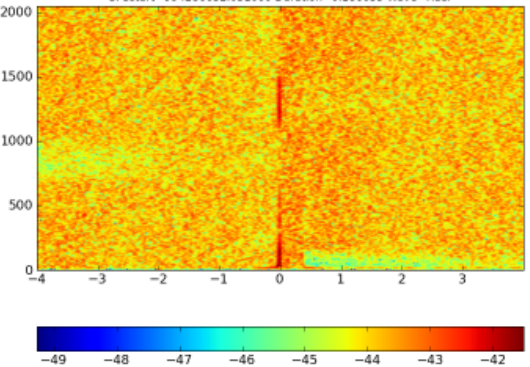
Channel: V1:h_4096Hz

Event at GPS=994286632.093000 secs SNR=98.2362 Freq=80 GPSstart=994286632.031000 Duration=0.186035 secs Wave=Haar

Event at GPS=994286632.093000 secs SNR=98.2362 secs Freq=80
GPSstart=994286632.031000 Duration=0.186035 Wave=Haar



Whitened Specgram: Event at GPS=994286632.093000 secs SNR=98.2362 secs Freq=80
GPSstart=994286632.031000 Duration=0.186035 Wave=Haar



Channel
V1:h_4096Hz

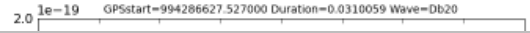
CHDB

View summary pages


Channel: V1:h_4096Hz

Event at GPS=994286627.527000 secs SNR=92.5984 Freq=864 GPSstart=994286627.527000 Duration=0.0310059 secs Wave=Db20

Event at GPS=994286627.527000 secs SNR=92.5984 secs Freq=864
GPSstart=994286627.527000 Duration=0.0310059 Wave=Db20

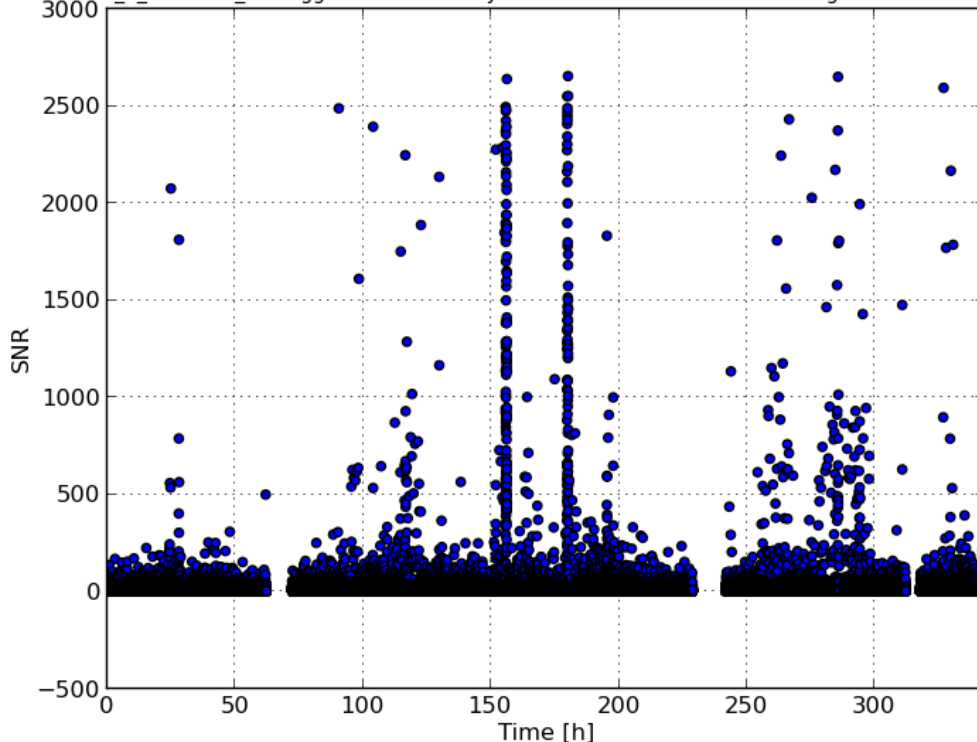


Whitened Specgram: Event at GPS=994286627.527000 secs SNR=92.5984 secs Freq=864
GPSstart=994286627.527000 Duration=0.0310059 Wave=Db20

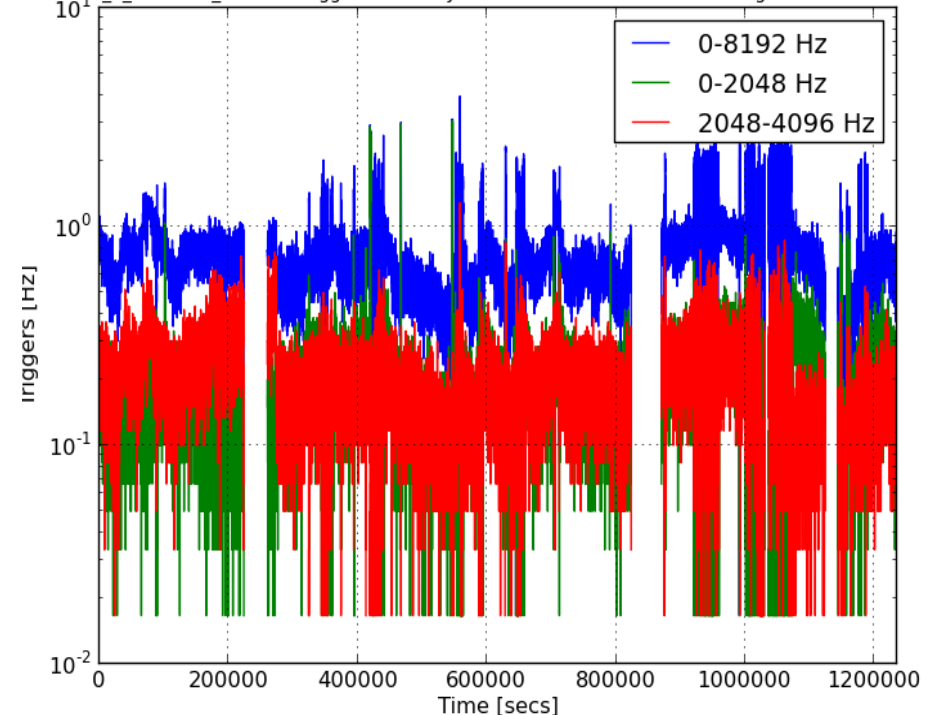


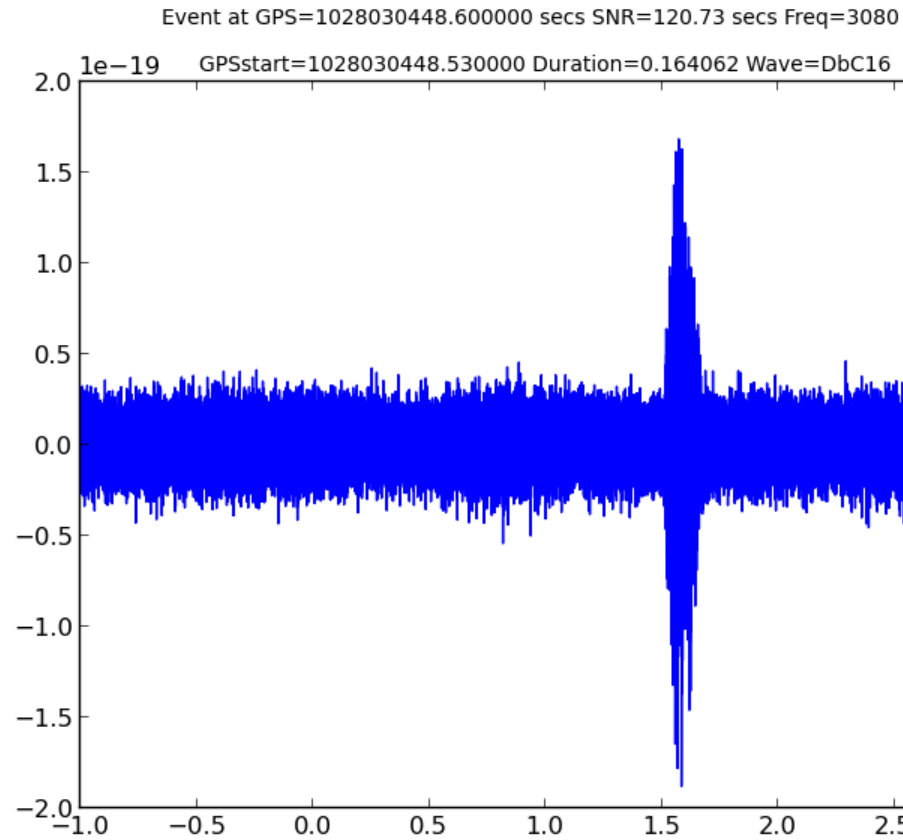
- o WDF ran on line on Virgo h(t) ER2 data.
- o Code to be update to insert DQ segments (to be done)

V1:FAKE_h_16384Hz_4R Triggers from GPS Fri Jul 20 09:20:30 2012 UTC to Fri Aug 3 16:29:32 2012 UTC

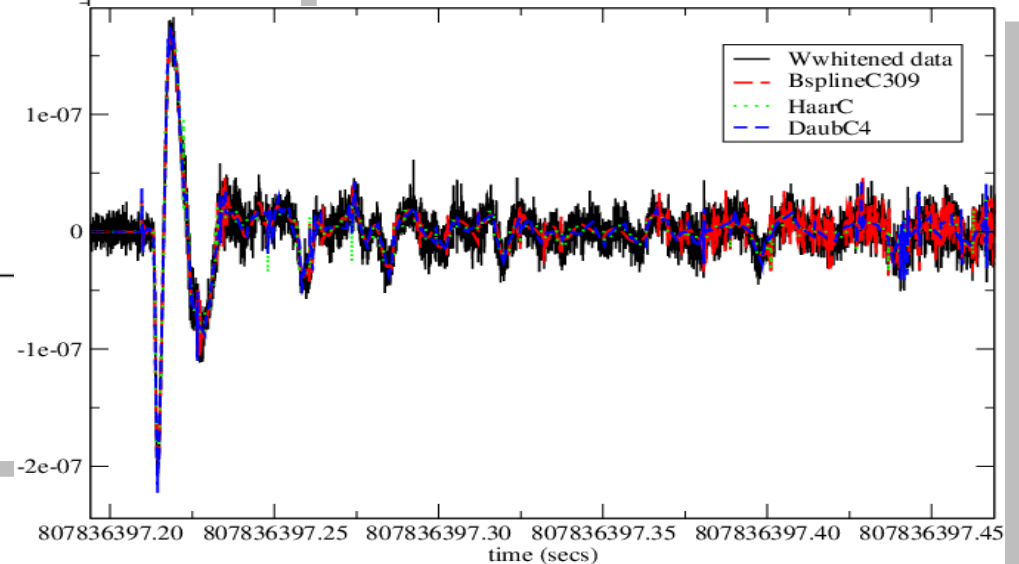


V1:FAKE_h_16384Hz_4R WDF Triggers from Fri Jul 20 09:20:30 2012 UTC to Fri Aug 3 16:29:32 2012 UTC





The idea is to have a
Catalogue of time-domain Waveforms
(saved in few wavelet coefficients, for example)



ER2:tests on Injected Signals to check Event Reconstructions

Use the Wavelet denoising algorithms to build Time-Domain Waveforms, and save the coefficients in a database

Test the Use of WDF→Database on massive number of channels to understand the performance of the architecture