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Beijing Radionuclide Laboratory

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T4.1-O7

The Waveform Data Processing System Establishment Based on the Private Cloud Platform

CTBT Beijing National Data Center

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Contents

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1. Background
2. Structure of Automatic Processing System based on Private Cloud
3. Improvement of Processing system
4. Monitoring the Operation of System
5. DPRK2016 Events

Summary and Discussion

1. Background

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- In order to fulfill the obligation of the Treaty, the national data centre(NDC) was established in December, 2005.
- For the purpose of compliance with the CTBT
- Our duty
  - Data collecting and forwarding
  - Data request and transfer
  - Data analysis
  - Technical support
  - Capabilities development

1. Background

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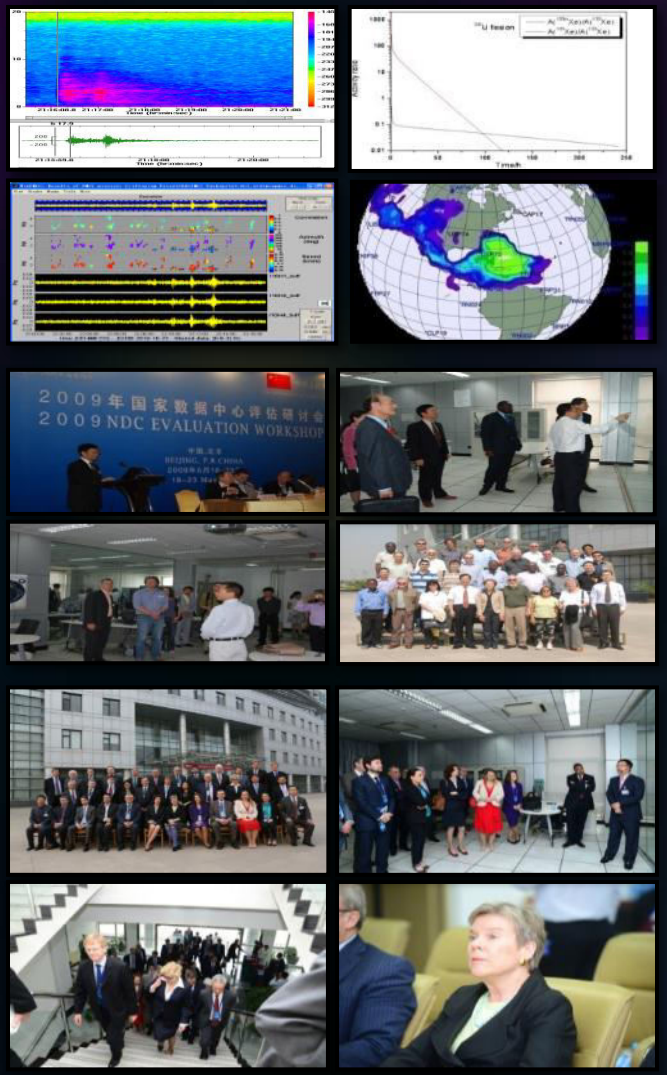
- Participated NPE08-10,NPE12 ,NPE13,NPE15
- Helped MFA hosted the NDC Workshop 2009 and East Asia Regional NDC Workshop (EARNW) 2016
- Visited by CTBT officers and others
- Helping inner IMS stations Certification and T&E
- Developing waveform data P&A technique



1. Background

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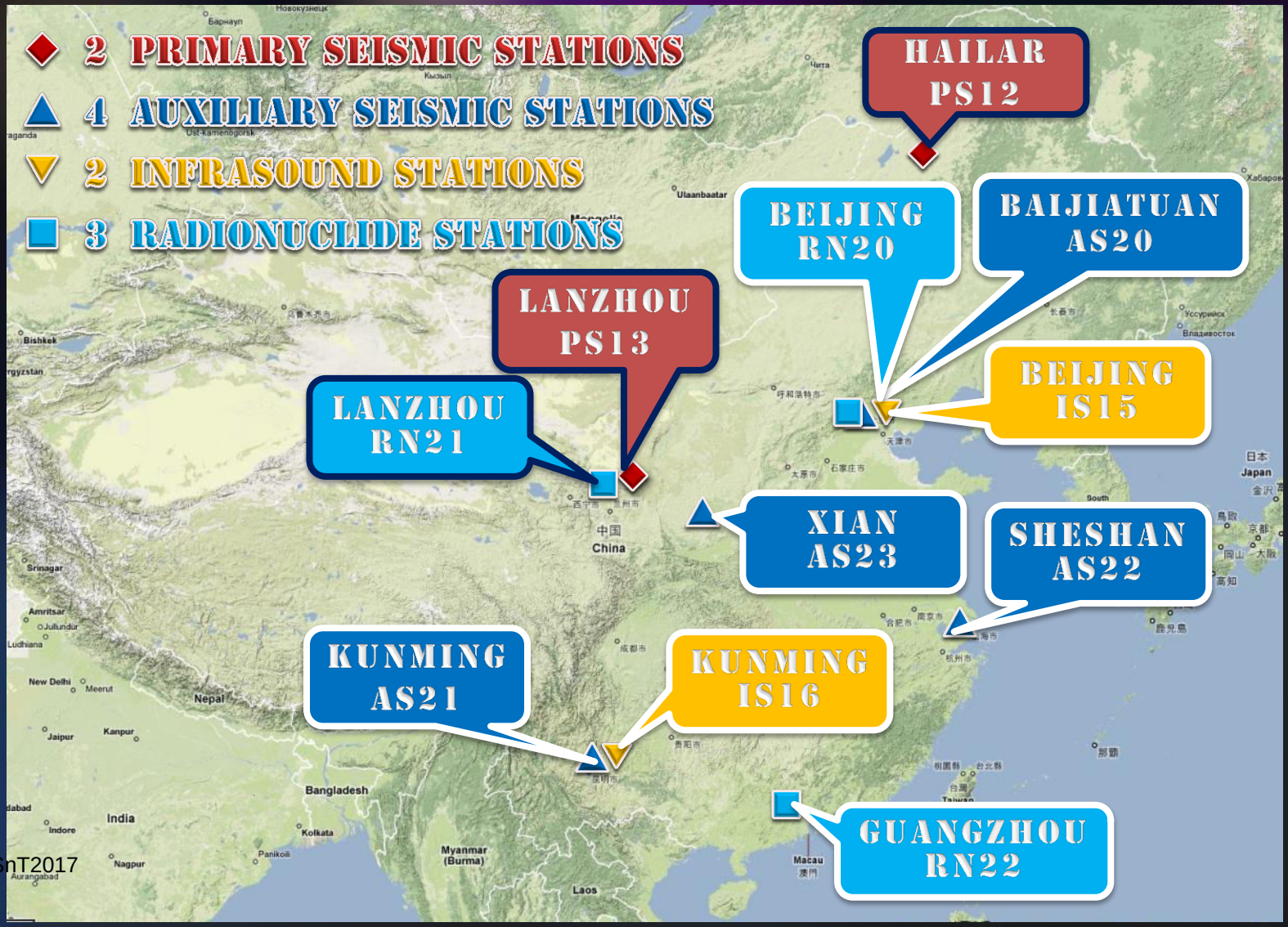


2. Structure of Automatic Processing System based on Private Cloud

Legacy System:

- China NDC data processing system is established in 2005.
- The architecture of data processing software is similar to IDCR3 software.
- The operation system is Solaris, hardware adopts the SPARC platform.

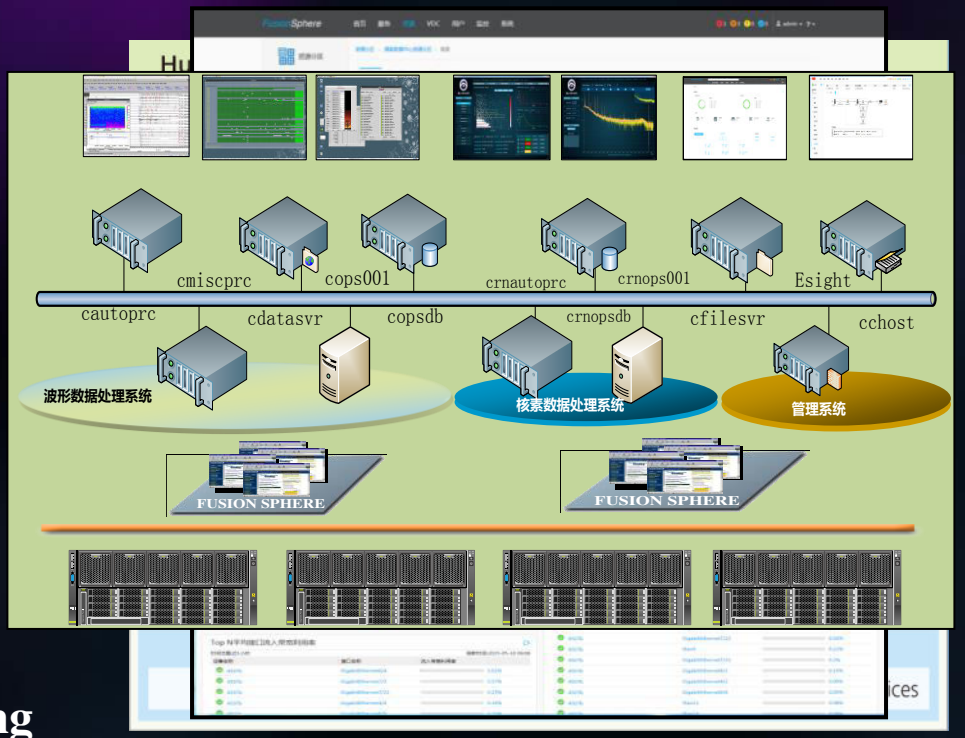
New System:

- Linux OS based on X86 architecture
- Huawei Technologies Co. Ltd. , FusionSphere cloud operating system
- Huawei RH5885 server, S5700 Switcher, OceanStor S5500

2. Structure of Automatic Processing System based on Private Cloud

Server Virtualization Platform:

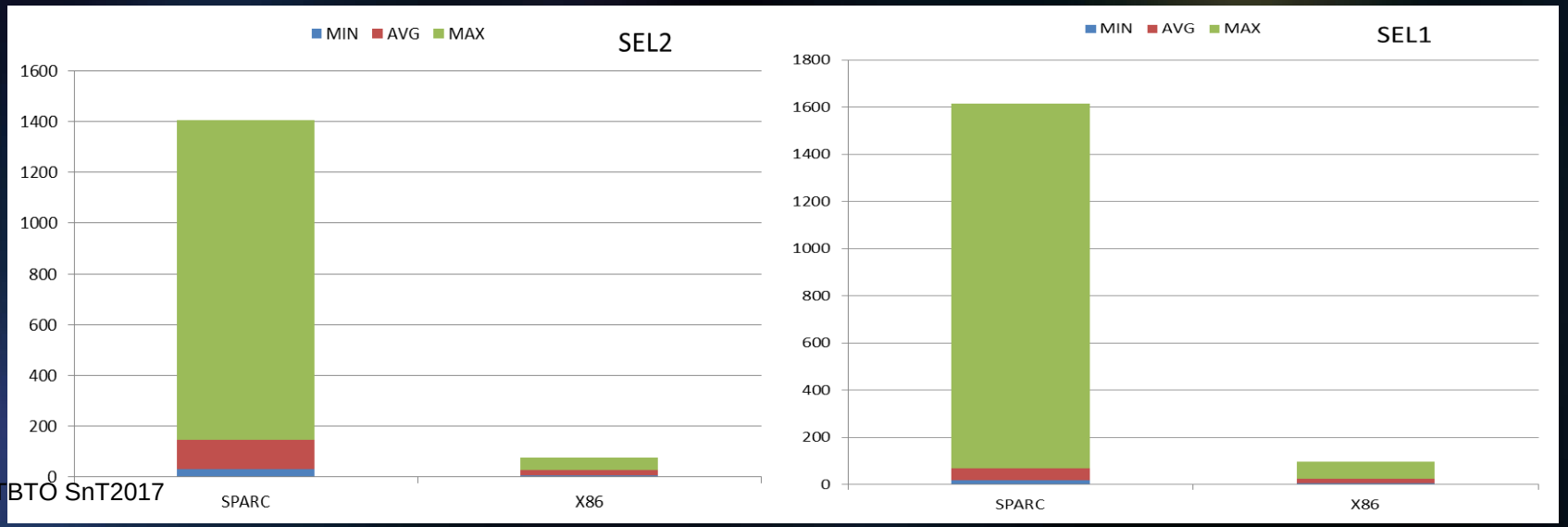
- Server Virtualization platform based on Huawei hardware and its Cloud OS software.
  - RH5885
  - S5500 Switcher
  - OceanStor
  - Fusion computer
  - Fusion Manager
  - Esight
- Benefits
  - Cost effective
  - Easy development and extending
  - Convenient O&M



2. Structure of Automatic Processing System based on Private Cloud

Data processing system based on Virtualization Platform :

- Virtualization Machine
  - Data receiving、Data processing、Interactive analyzing 、Task scheduling、LDAP、system management
  - HA type, HyperDP
- Taking Oracle RAC to improve the database reliability.
- Data processing system establishing and testing.



3. Improvement of Processing system

Tagerts:

The performance of data processing need to be improved to meet the requirements , to fulfill NDC duties better.

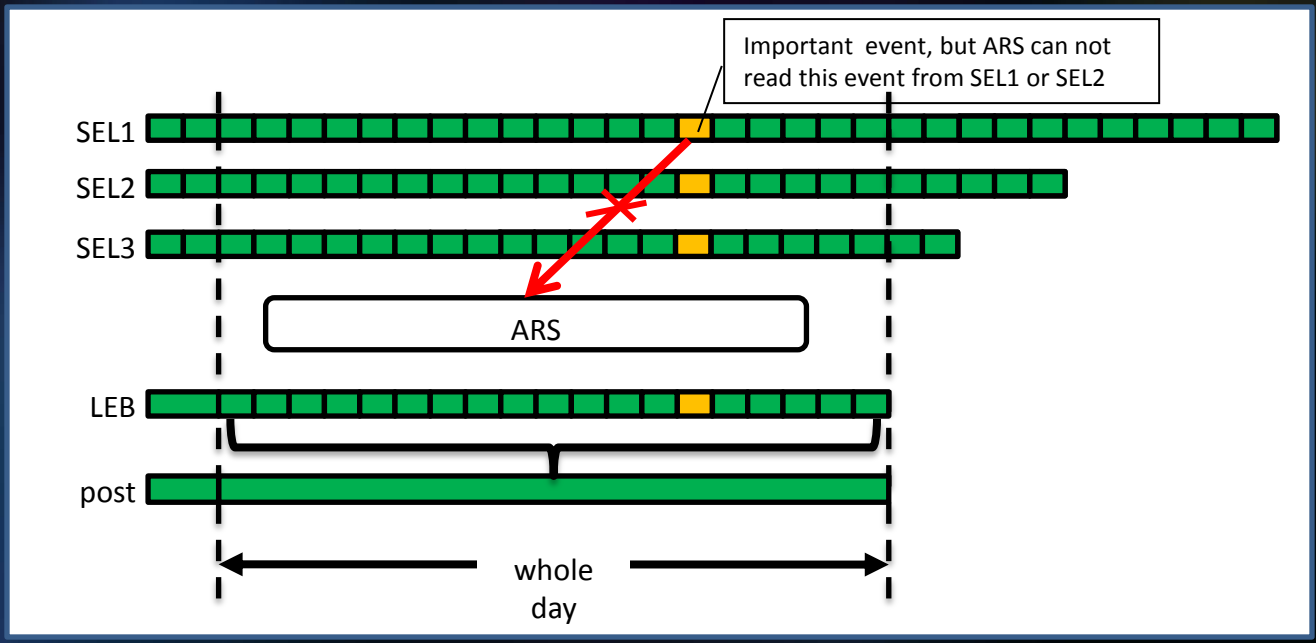
Requirements:

- Optimization of the processing pipeline
- New processing methods
- Data acquisition from different source
- ……

3. Improvement of Processing system

The Fast Data Processing Flow

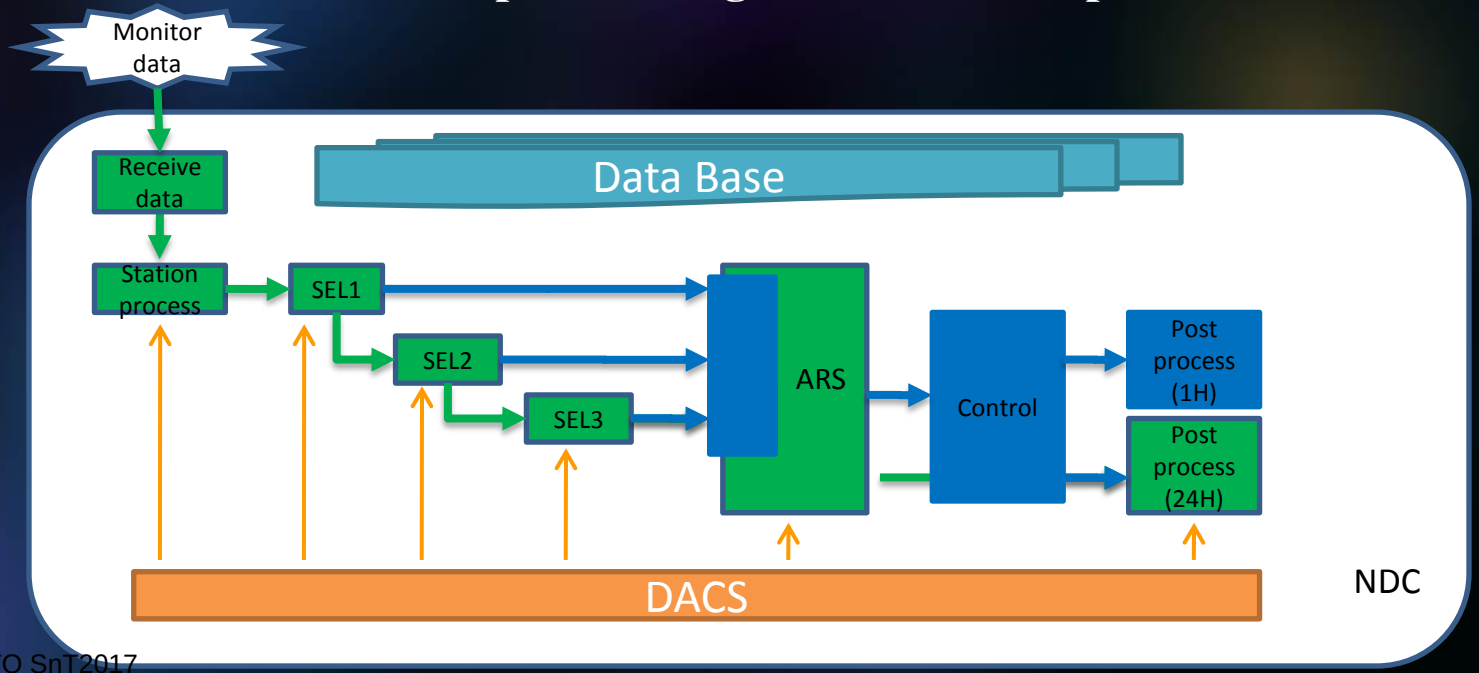
- Considering the signal propagation mechanism, the automatic bulletins (SEL1,2,3) have different latency.
- The analyst can't review automatic result in a timely manner.



3. Improvement of Processing system

The Fast Data Processing Flow

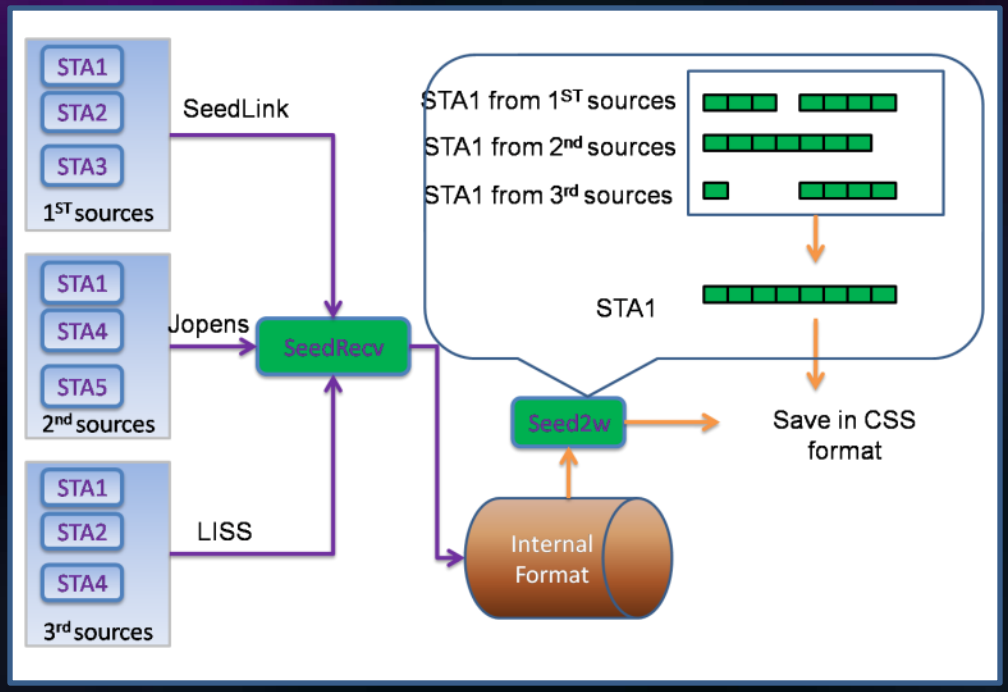
- The New Processing Flow Control realizes the analyst can interact with results at different network processing stage. And the post-processing also is executed immediately after the analyst reviews.
- The timeliness of the response to urgent events is improved.



3. Improvement of Processing system

Multiple Source Data Acquisition

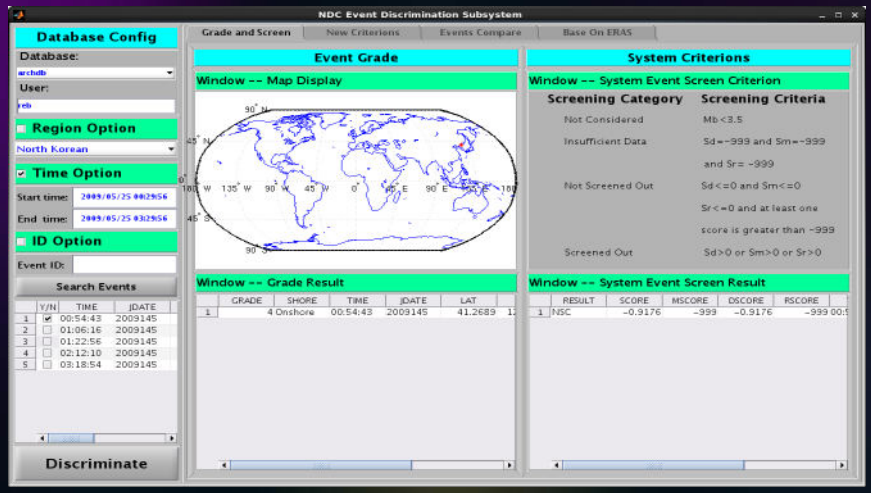
- The CD2Server
  CD → miniSEED
- SeedRecv and Seed2w
  miniSEED → CSS
- SeedRecv supports multiple data fetching methods, such as LISS, SeedLink and Jopens.
- Seed2w reads the formatted miniSEED files, drop the duplication data of each station, reorder data and convert them to CSS.

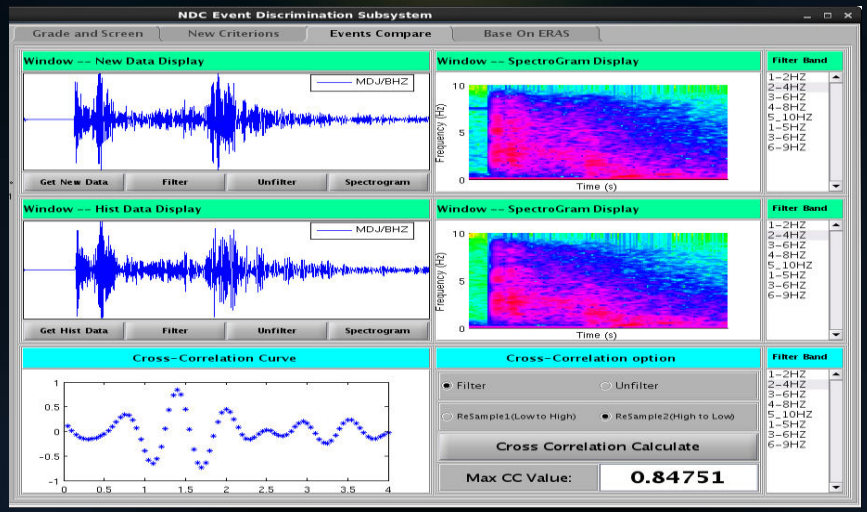


3. Improvement of Processing system

Event Screening Method

- Different spectrum characteristics of nature event and nuclear explosion
- New Event Screening criteria
  - Waveform Complexity
  - Signal Spectrum Ratio
  - Combined ratio
- New Event Screening Software

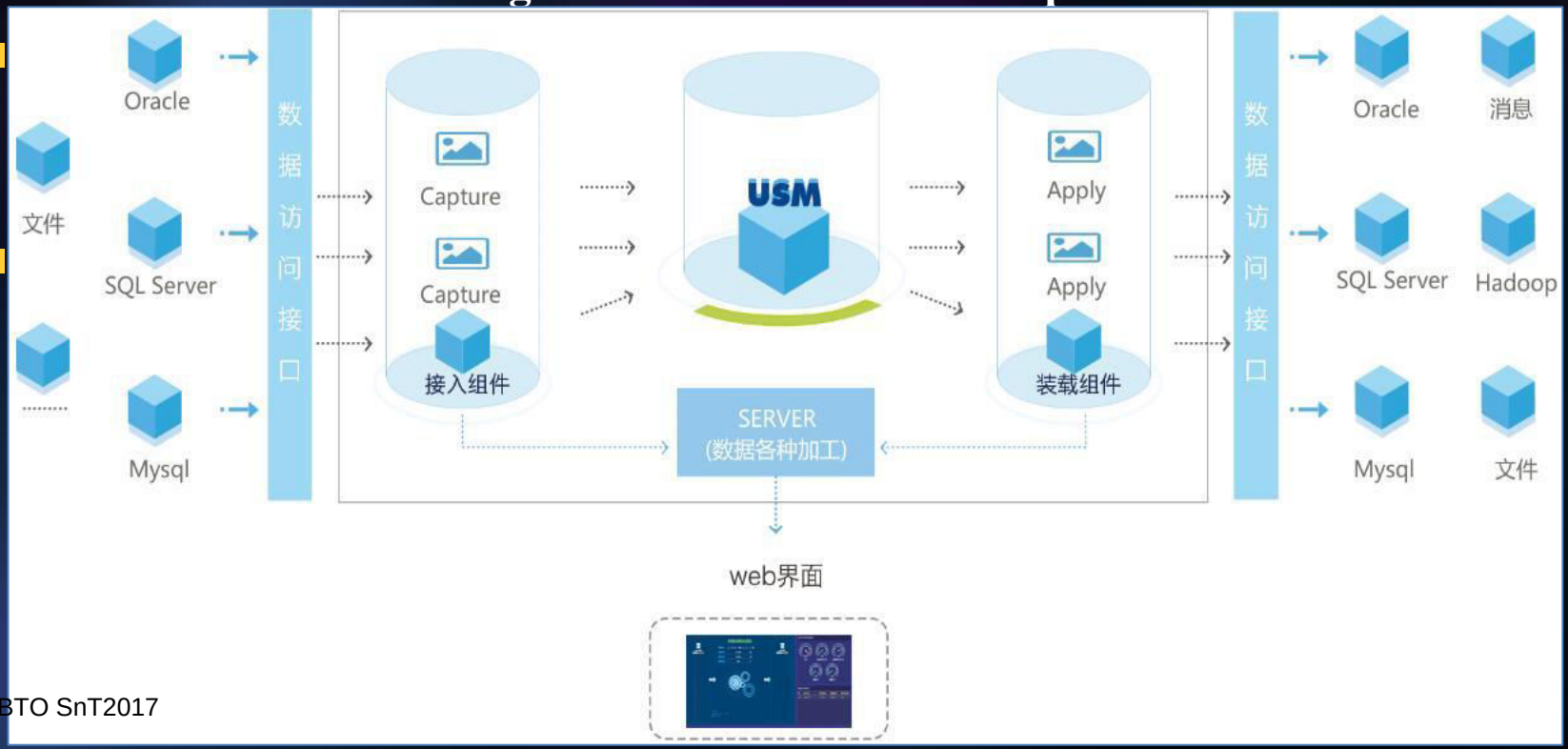




3. Improvement of Processing system

Database Synchronization and Products Archiving

- R7 DIP
  - Log-based changed Data Capture
  - Real-Time Data Integration & Transactional Replication



4. Monitoring the Operation of System

Tagerts:

Develop an integrated tool to monitor the status of whole system to

-find any faults of the processing pipeline on time

-reduce the pressure of system maintenance

Requirements:

Centralizing monitoring …

- stations status
- communication system status
- IT equipment's status
- autoprocessing procedure status
- results status
- future needs: monitoring capability status, etc.

4. Monitoring the Operation of System

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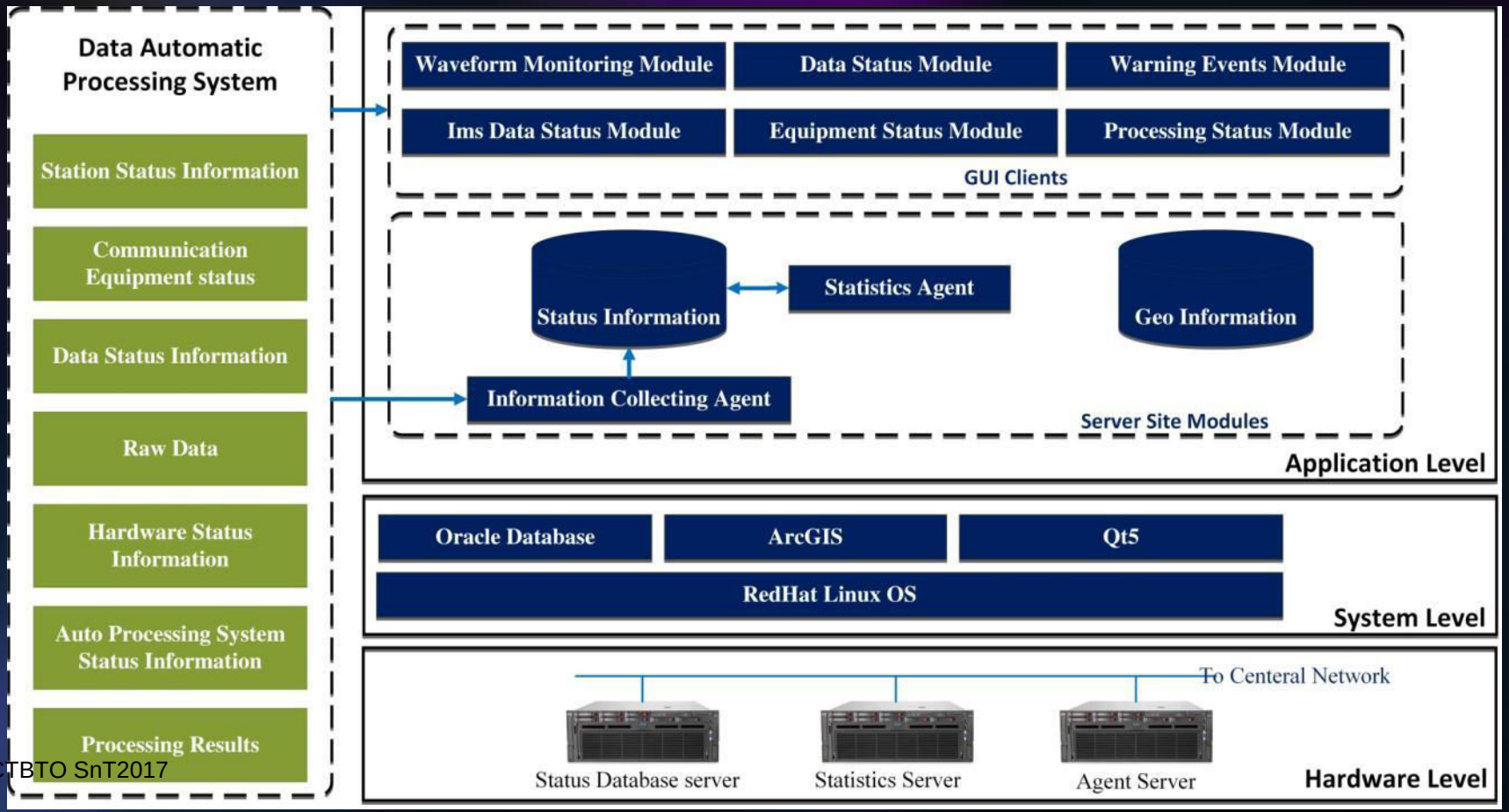
OMMS:

Operation Management and Maintenance Software



4. Monitoring the Operation of System

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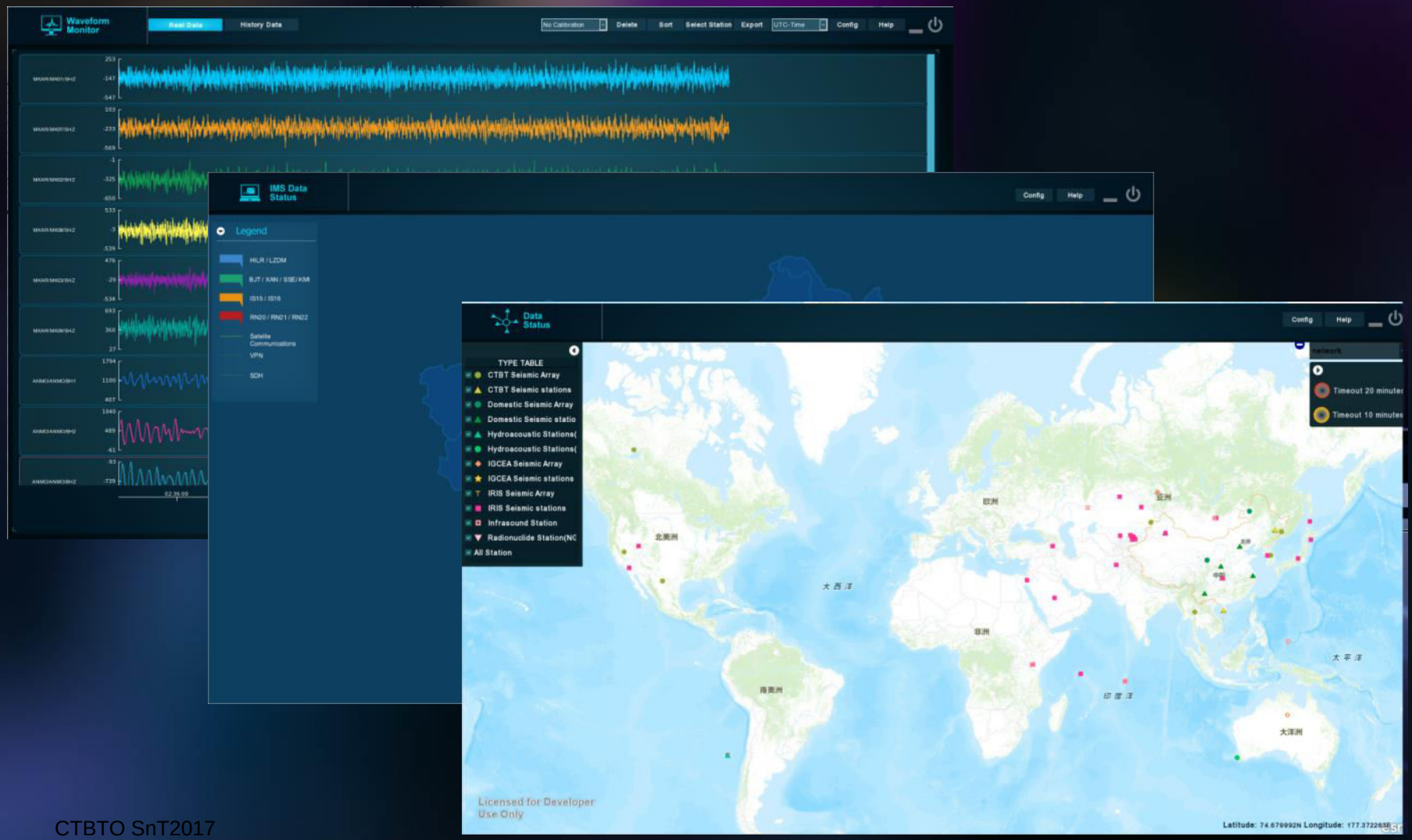

4. Monitoring the Operation of System

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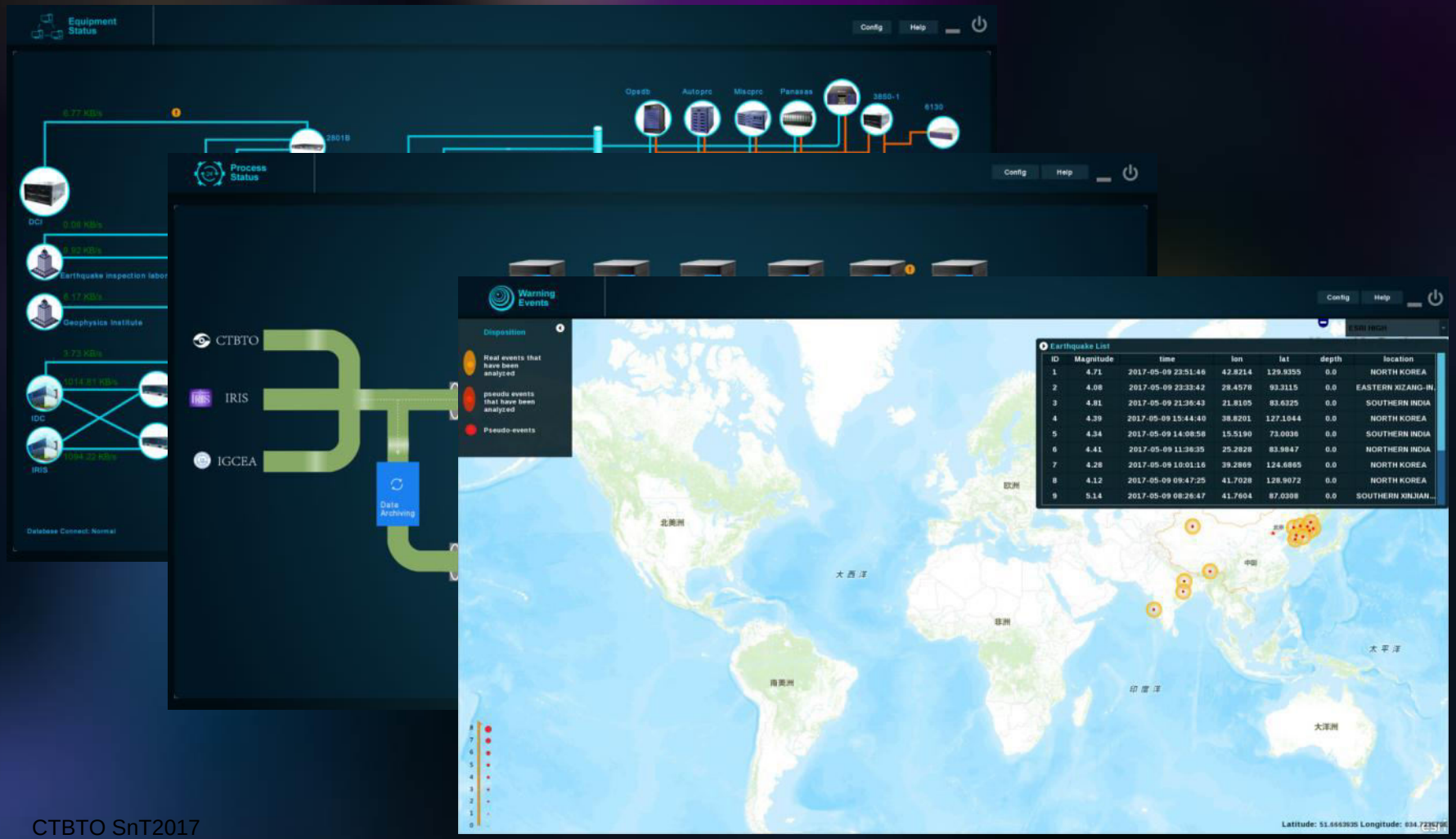

5. DPRK2016 Events

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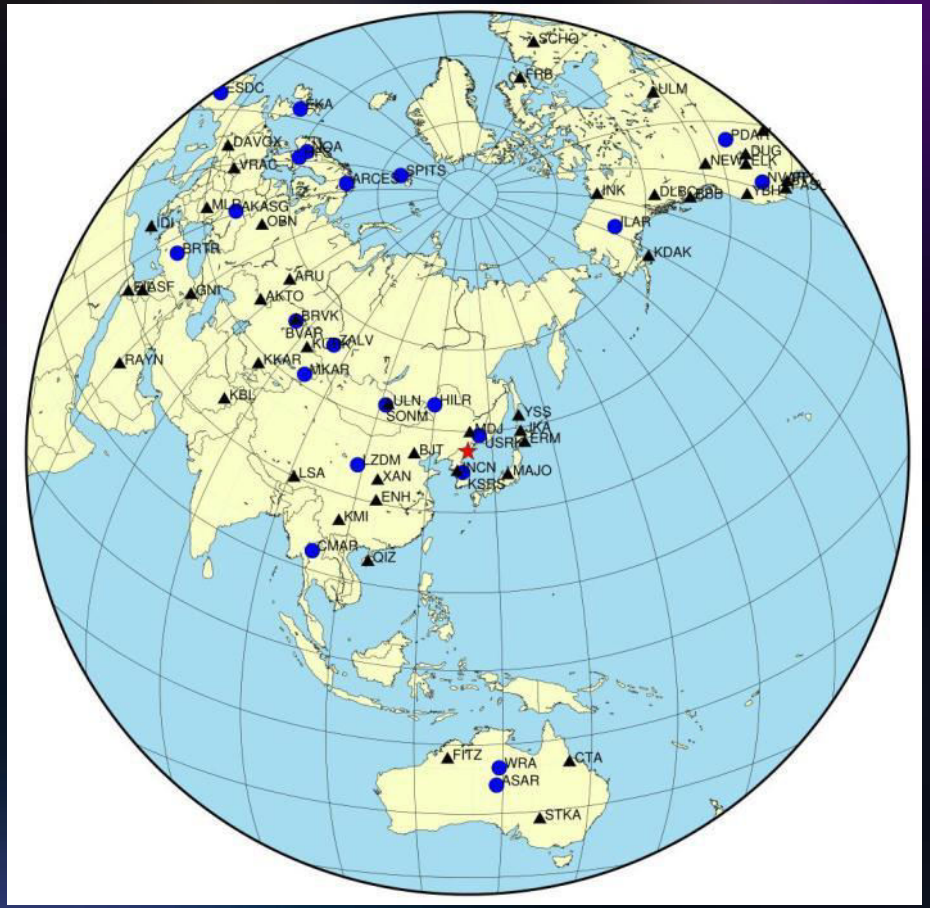

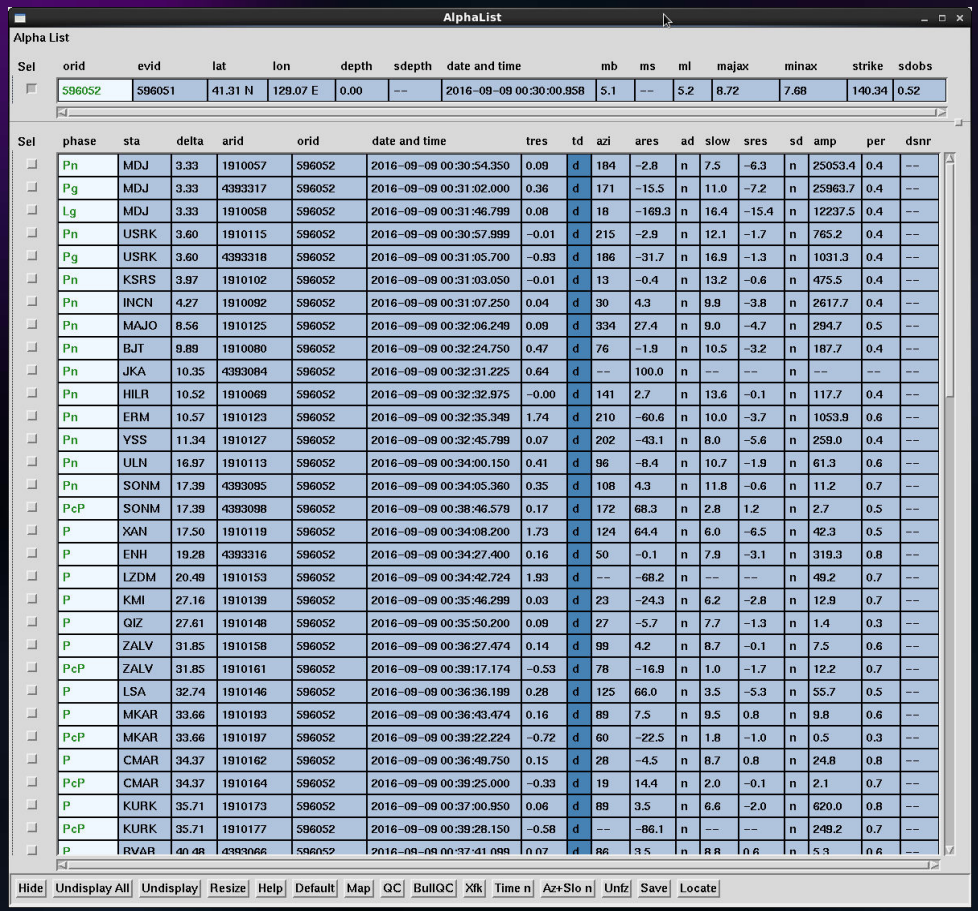

There are 72 seismic stations used for DPRK 20160909 event analysis, most of Stations from IMS, others from IRIS and CDSN.

5. DPRK2016 Events

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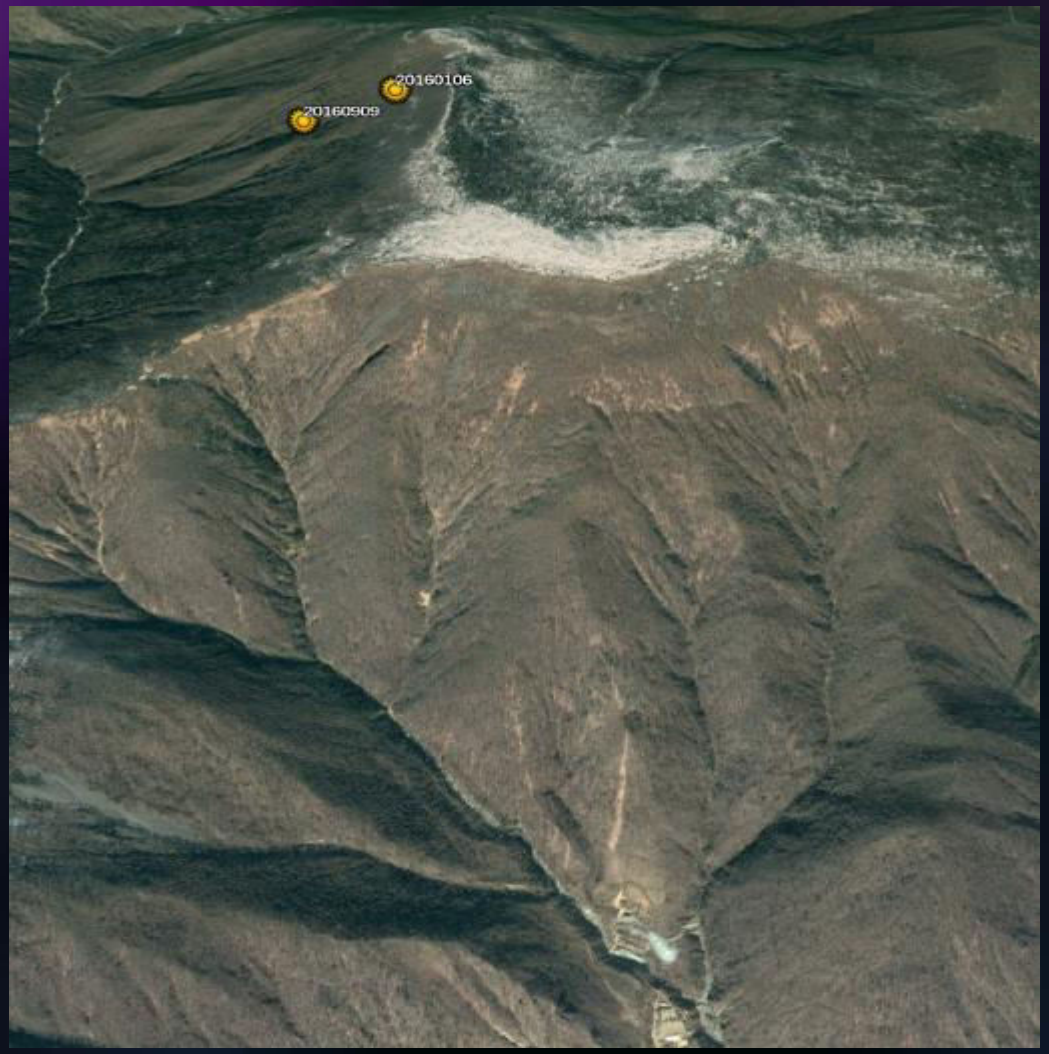
Magnitude Arrivals

Station Magnitudes

Td	M/A	D/N	D/E	Station	Phase	Amptype	Delta	S	F	R	mb_av	mlppn
			D	XAN	P	A5/2	17.50	5.28	5.25	3.85	0.19	--
			D	ENH	P	A5/2	19.28	5.68	5.66	4.02	0.59	--
			D	KMI	P	A5/2	27.16	4.92	4.90	4.28	-0.17	--
			D	QIZ	P	A5/2	27.62	4.36	4.34	5.40	-0.73	--
			D	ZALV	P	A5/2	31.85	4.78	4.77	4.56	-0.30	--
			D	LSA	P	A5/2	32.74	5.67	5.65	5.78	0.58	--
			D	MKAR	P	A5/2	33.66	4.86	4.85	4.76	-0.22	--
			D	CMAR	P	A5/2	34.37	5.14	5.12	4.20	0.05	--
			D	KURK	P	A5/2	35.65	6.54	6.52	3.96	1.46	--
			D	BVAR	P	A5/2	40.48	4.60	4.58	5.49	-0.49	--
			D	BRVK	P	A5/2	40.54	6.06	6.04	6.07	0.97	--
			D	KKAR	P	A5/2	42.65	4.12	4.10	0.48	-0.97	--
			D	ARU	P	A5/2	46.65	5.10	5.08	5.35	0.01	--
			D	KBL	P	A5/2	47.01	4.64	4.62	5.05	-0.45	--
			D	AKTO	P	A5/2	48.55	4.84	4.82	4.39	-0.25	--
			D	ILAR	P	A5/2	51.12	5.26	5.26	2.57	0.19	--
			D	SPITS	P	A5/2	54.30	4.73	4.71	4.89	-0.36	--
			D	INK	P	A5/2	54.95	5.13	5.11	5.24	0.04	--
			D	DLBC	P	A5/2	61.03	4.79	4.77	3.97	-0.30	--
			D	WRA	P	A5/2	61.13	5.24	5.22	4.55	0.15	--
			D	GNI	P	A5/2	61.35	4.99	4.97	4.66	-0.10	--
			D	ASAR	P	A5/2	64.80	5.03	5.01	4.45	-0.05	--
			D	AKASG	P	A5/2	64.81	5.50	5.48	4.47	0.41	--
			D	BBB	P	A5/2	65.46	4.77	4.75	4.72	-0.32	--
			D	HFS	P	A5/2	65.93	5.29	5.27	3.90	0.20	--
			D	NOA	P	A5/2	66.22	5.20	5.18	4.72	0.11	--
			D	BRTR	P	A5/2	68.67	4.92	4.90	5.20	-0.17	--
			D	MLR	P	A5/2	69.69	5.10	5.08	4.62	0.01	--
			D	RAYN	P	A5/2	70.22	5.94	5.92	4.43	0.85	--
			D	VRAC	P	A5/2	72.02	5.50	5.48	5.10	0.41	--
			D	NEW	P	A5/2	73.38	4.83	4.82	4.59	-0.25	--
			D	STKA	P	A5/2	73.73	5.00	4.98	4.63	-0.09	--
			D	EIL	P	A5/2	73.93	4.26	4.26	5.22	-0.80	--
			D	FRB	P	A5/2	74.36	5.69	5.67	6.39	0.60	--
			D	EKA	P	A5/2	75.50	5.31	5.29	3.72	0.22	--
			D	IDI	P	A5/2	76.86	5.31	5.29	3.66	0.22	--

Sort by: Magtype / Delta

Hide Help



5. DPRK2016 Events

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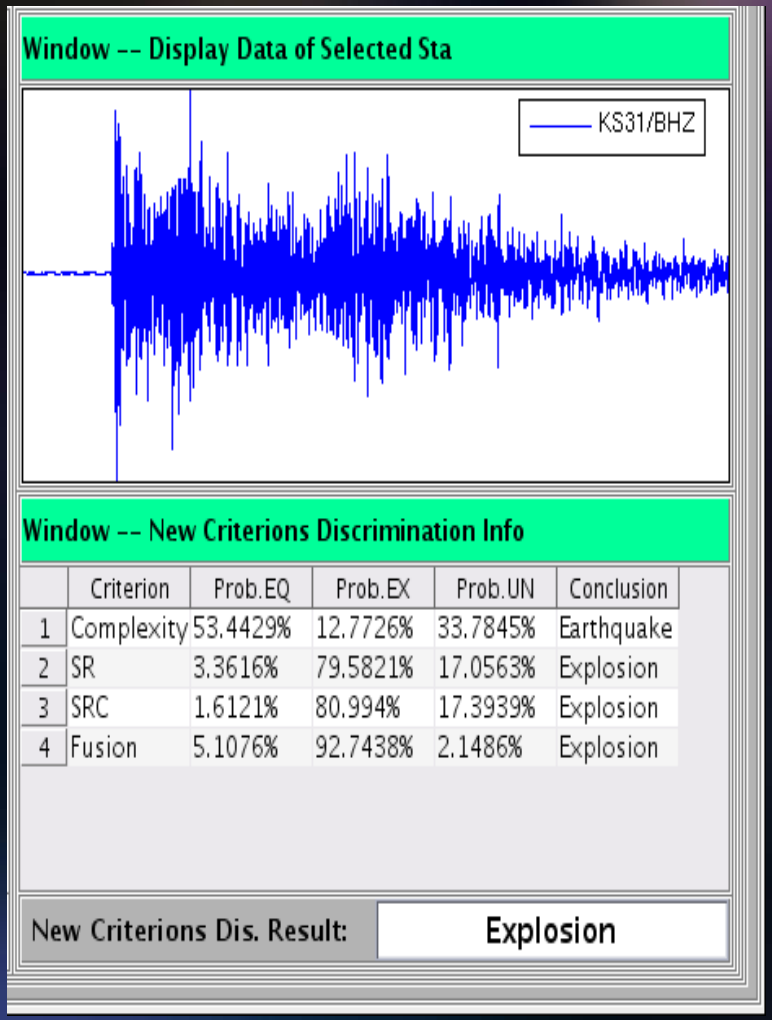

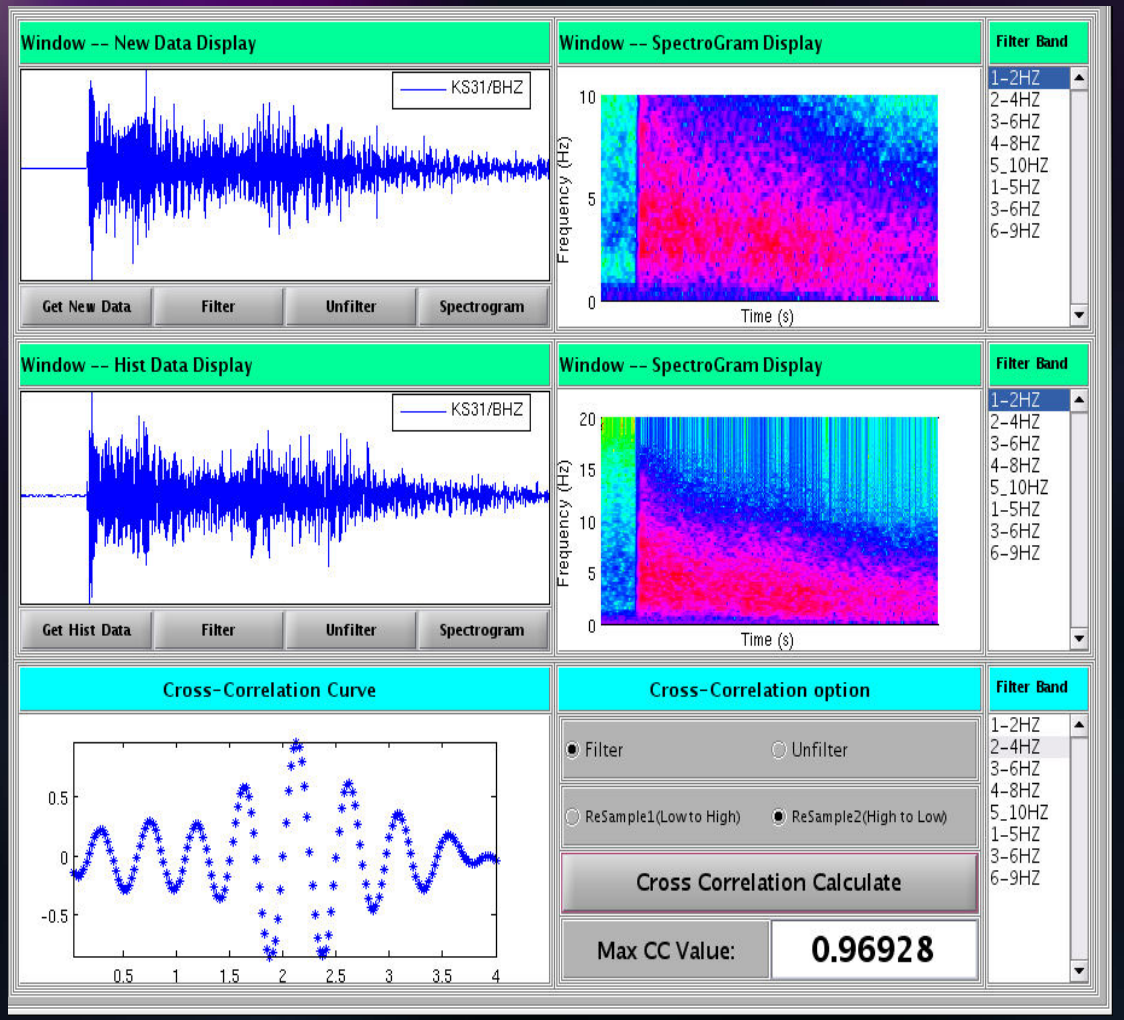

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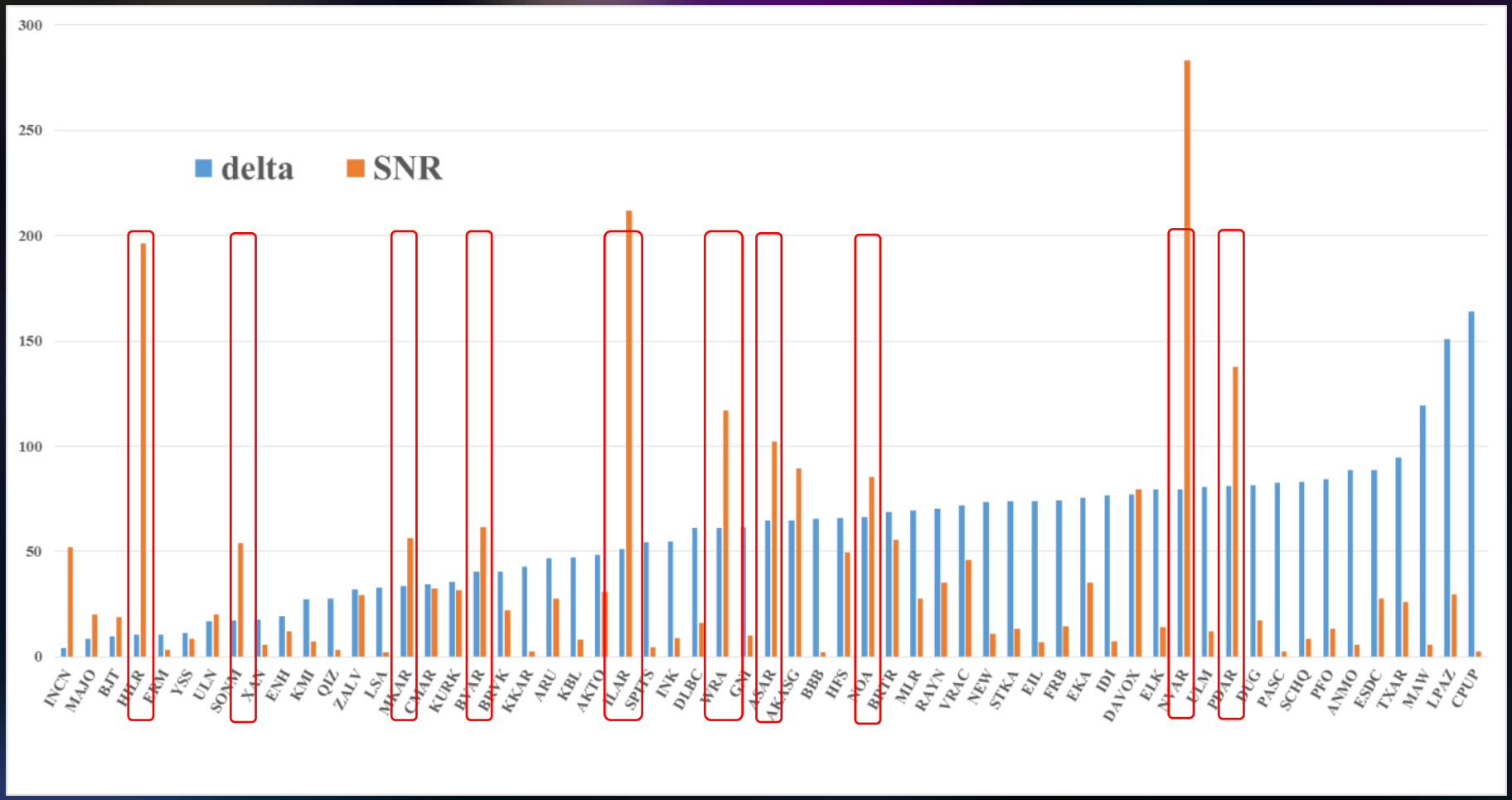

Distribution of delta and SNR of stations associated by DPRK 20160909 event

5. DPRK2016 Events

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Amplitude Ratio between 2016-2 and 2013

sta	phase	amp of 2013	amp of 2016-2	ratio of amp	ratio of energy
ASAR	P	12.69	15.40	1.21	1.29
BRTR	P	3.00	8.13	2.71	3.77
BRVK	P	147.94	191.70	1.30	1.41
CMAR	P	23.88	24.80	1.04	1.05
DUG	P	4.23	6.85	1.62	1.90
HILR	Pn	72.62	117.70	1.62	1.90
ILAR	P	15.73	26.87	1.71	2.04
KMI	P	9.50	12.91	1.36	1.50
KSRS	Pn	393.35	475.54	1.21	1.29
MKAR	P	7.15	9.83	1.38	1.53
NVAR	P	25.88	40.47	1.56	1.81
PDAR	P	9.77	13.84	1.42	1.59
TXAR	P	2.16	3.28	1.52	1.75
USRK	Pn	520.31	765.18	1.47	1.67
XAN	P	29.59	42.28	1.43	1.61
ZALV	P	4.77	7.54	1.58	1.84
AVERAGE					1.75
STD					0.58

Amplitude Ratio between 2016-2 and 2016-1

sta	phase	amp of 2016-1	amp of 2016-2	ratio of amp	ratio of energy
BRTR	P	4.68	8.13	1.74	2.09
BRVK	P	87.51	191.70	2.19	2.84
CMAR	P	14.98	24.80	1.66	1.96
DUG	P	3.80	6.85	1.81	2.19
HILR	Pn	63.93	117.70	1.84	2.25
ILAR	P	14.22	26.87	1.89	2.33
KMI	P	6.97	12.91	1.85	2.27
KSRS	Pn	353.24	475.54	1.35	1.49
MKAR	P	5.43	9.83	1.81	2.20
NVAR	P	24.13	40.47	1.68	1.99
PDAR	P	7.92	13.84	1.75	2.10
TXAR	P	1.90	3.28	1.73	2.07
USRK	Pn	565.20	765.18	1.35	1.50
USRK	Pg	455.61	840.25	1.84	2.26
XAN	P	27.19	42.28	1.55	1.80
ZALV	P	3.63	7.54	2.08	2.65
AVERAGE					2.12
STD					0.34

Summary and Discussion

- Based on X86 architecture and Huawei ICT hardware, includes servers, switches and storages, integrated Private Cloud solution is satisfied with our data processing requests.
- Migrated our system to Linux, and made some improvements to data processing system.
- Adopted the C/S architecture and QT tools based on GIS system, we developed OMMS software, which realized real-time monitoring the whole system, include stations, communications, servers, storages, processing procedures and results.
- Based on the data from IMS, IRIS and CDSN, analyzed the 2016 DPRK events, the two events located in the same mountain and are not far away, the field of the last one is almost twice of the 2016.01, and 1.75 times of the 2013, and all of them should be manmade explosions.

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Thanks for your attention!

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