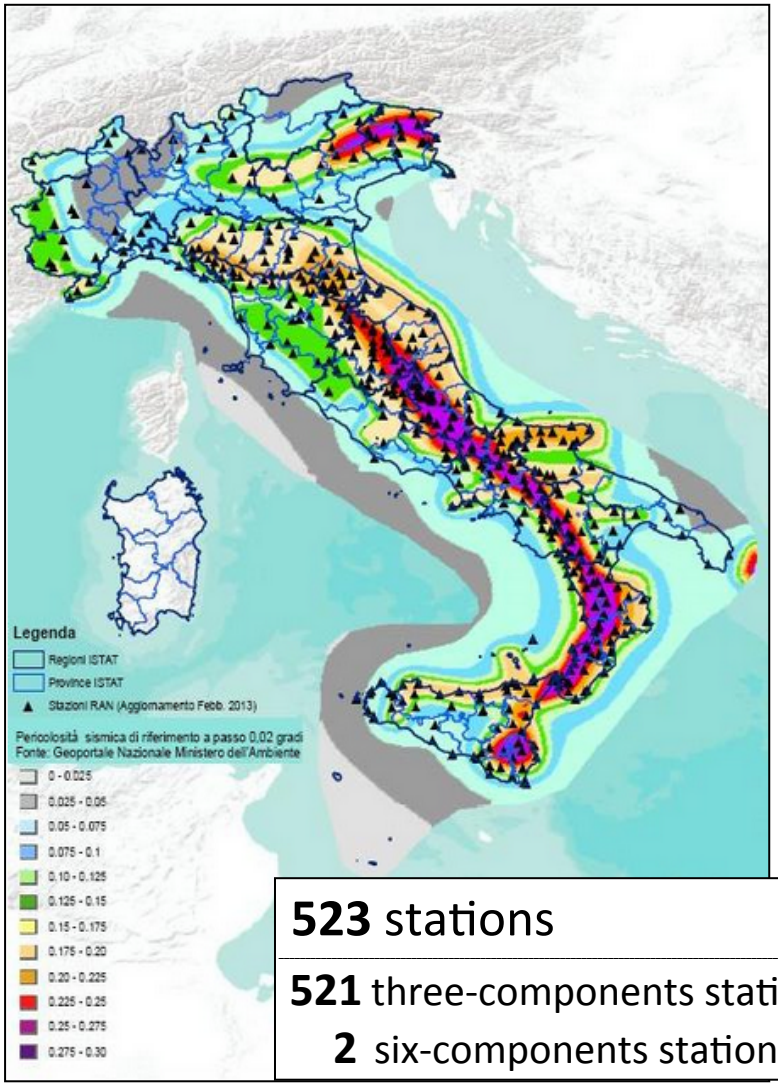
PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

RAN – Italian strong motion network

http://www.protezionecivile.gov.it/jcms/it/ran.wp



523 stations

521 three-components stations

2 six-components stations

DPC collects high-quality digital recordings of acceleration, in urban areas, at the occurrence of significant earthquakes for the Italian territory

Regional governments and municipalities, thanks to Inter-institutional agreements with DPC, collaborate making available public lands for monitoring and provide electrical supply for instrumentation.

DPC uses strong motion data

- ❑ to ***maximize*** the effectiveness of ***emergency response*** services
- ❑ to ***take a step forward*** in the assessment, prevention and ***mitigation of seismic risk***

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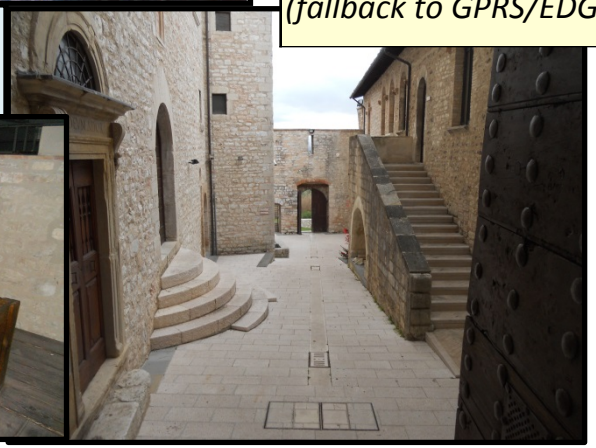
RAN – housing and instrumentation

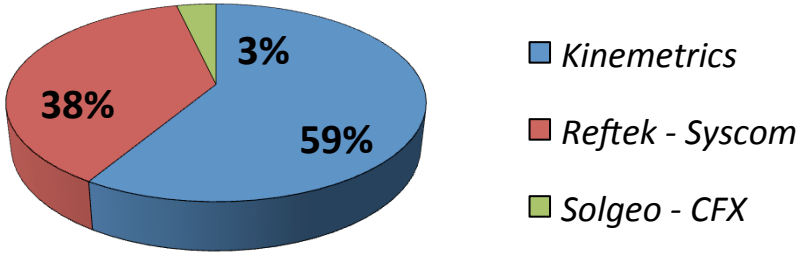
Forni di Sopra (Free field)

Vairano Patenora (close to the building)

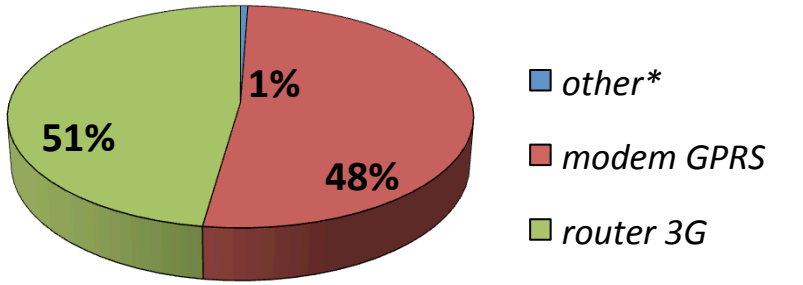
Gualdo Tadino (in the basement)



Company	*Kinemetrics*	*Reftek*	*Solgeo*	*Syscom*	*CFX*
Datalogger	**Etna - Makalu - K2 - Basalt**	**RT-130**	**EDAX**		
Sensor	**Episensor - Fba23 - Hyposensor**			**MS2007**	**US4**



Company	*APSystems*	*Sierra Wireless*	*NetModule*
Modem GPRS	**DM530 PC**		
Router 3G HSPA (fallback to GPRS/EDGE)		**Raven XE AirLink LS300**	**NB2240 NB500/NB2700**



(*) *analog or GSM modem, remote station*

RAN – improvements

- ❑ **Stations maintenance and safety**
- ❑ **Data transmission reliability**
- ❑ **Network functionality**
- ❑ **Data center reliability**
- ❑ **Contribution to information in seismic emergency**

- ➢ **The work timetable does not consider a h24 presence for the network management and for the management of data center**

- ➢ **Reliable and automatic tools must be adopted, far as possible, for ensuring the correct operating of stations and data center, information availability and dissemination in seismic emergency.**

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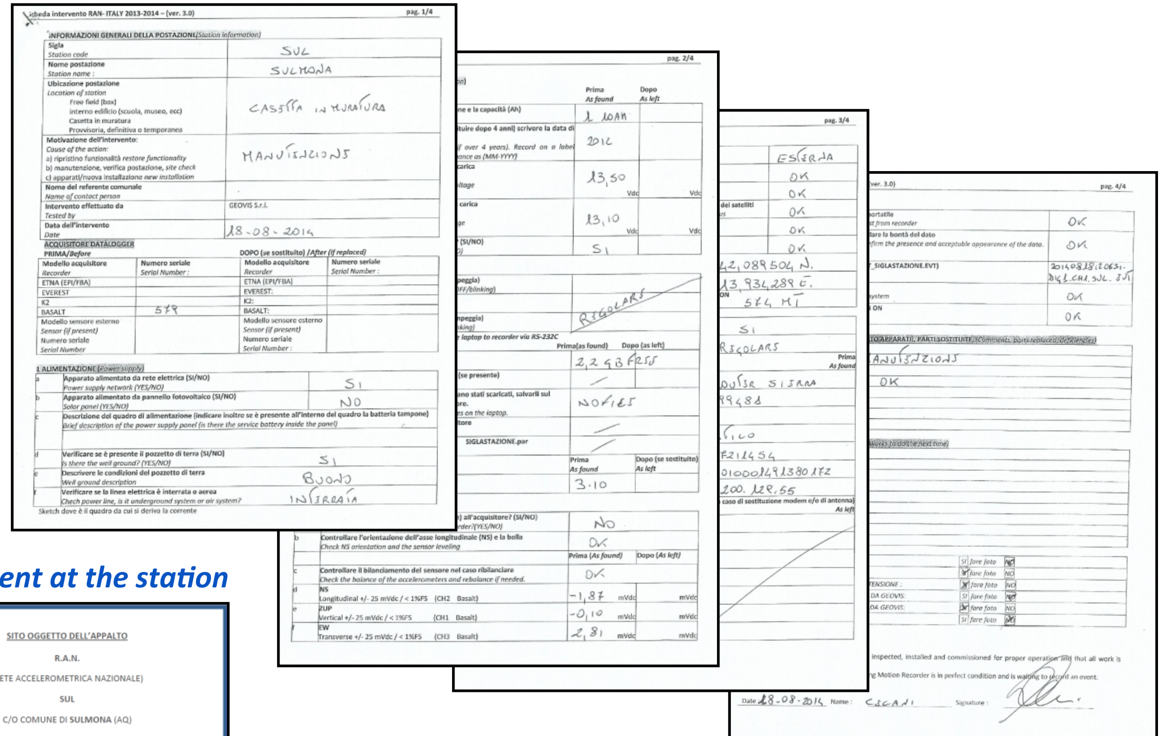
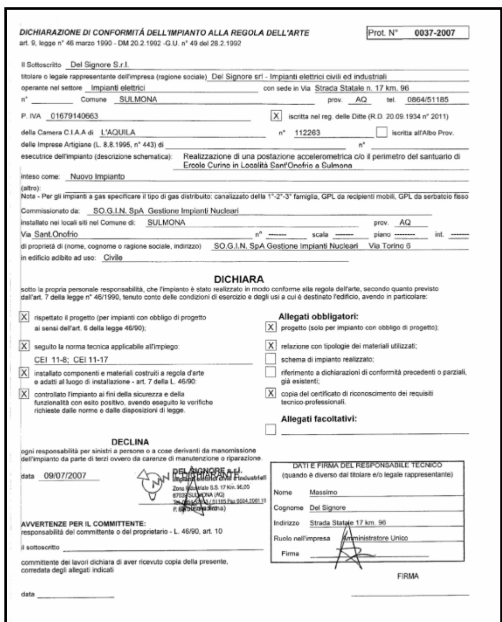
RAN – station maintenance and safety

Station maintenance checklist



Certification of station's electrical safety



Risk assessment at the station


SITO OGGETTO DELL'APPALTO

R.A.N.

(RETE ACCELEROMETRICA NAZIONALE)

SUL

C/O COMUNE DI SULMONA (AQ)

Convenzione CONSIP per la

" Gestione integrata della salute e sicurezza sui luoghi di lavoro negli immobili in uso, a qualsiasi titolo, alle Amministrazioni Pubbliche"

Lotti 1 - 2 - 3 - 4 - 5 - 6

DUVRI

DOCUMENTO UNICO DI VALUTAZIONE DEI RISCHI DA INTERFERENZA

(ai sensi dell'art .26 del D.Lgs. n° 81/2008 e ss. mm. e ii.)

Presidenza del Consiglio dei Ministri

DIPARTIMENTO PER LA PROTEZIONE CIVILE

Il presente documento è allegato ai contratti di appalto relativi ai servizi affidati a imprese esterne

Emissione Marzo 2014

REV 00_2014

- two scheduled visits to each station in one year; a single station cannot be out of order for more than 5 days.
- the station should be not a danger to things and people, in compliance to Italian laws about the health and the safety in workplaces.

RAN - data transmission reliability

DPC chose to use a private APN for:

- **Higher security and reliability in data transmission;**
- **Overcoming the difficulties related to the management of dynamic public IP addresses, that the public APN associates to SIM cards.**

This choice turned out particularly good, in more recent times, for:

- **Overcoming the difficulties related to the management of private IP, that the public APN associates to SIM cards because of the diffusion of internet devices and the delay in switching from Ipv4 to Ipv6 protocol.**

When the SIM is used to connect to internet, the private IP is translated (NAT) over a dynamic public IP shared by several SIM cards. Each of these SIM cards uses the same public IP address but a different port, whose number changes time to time.

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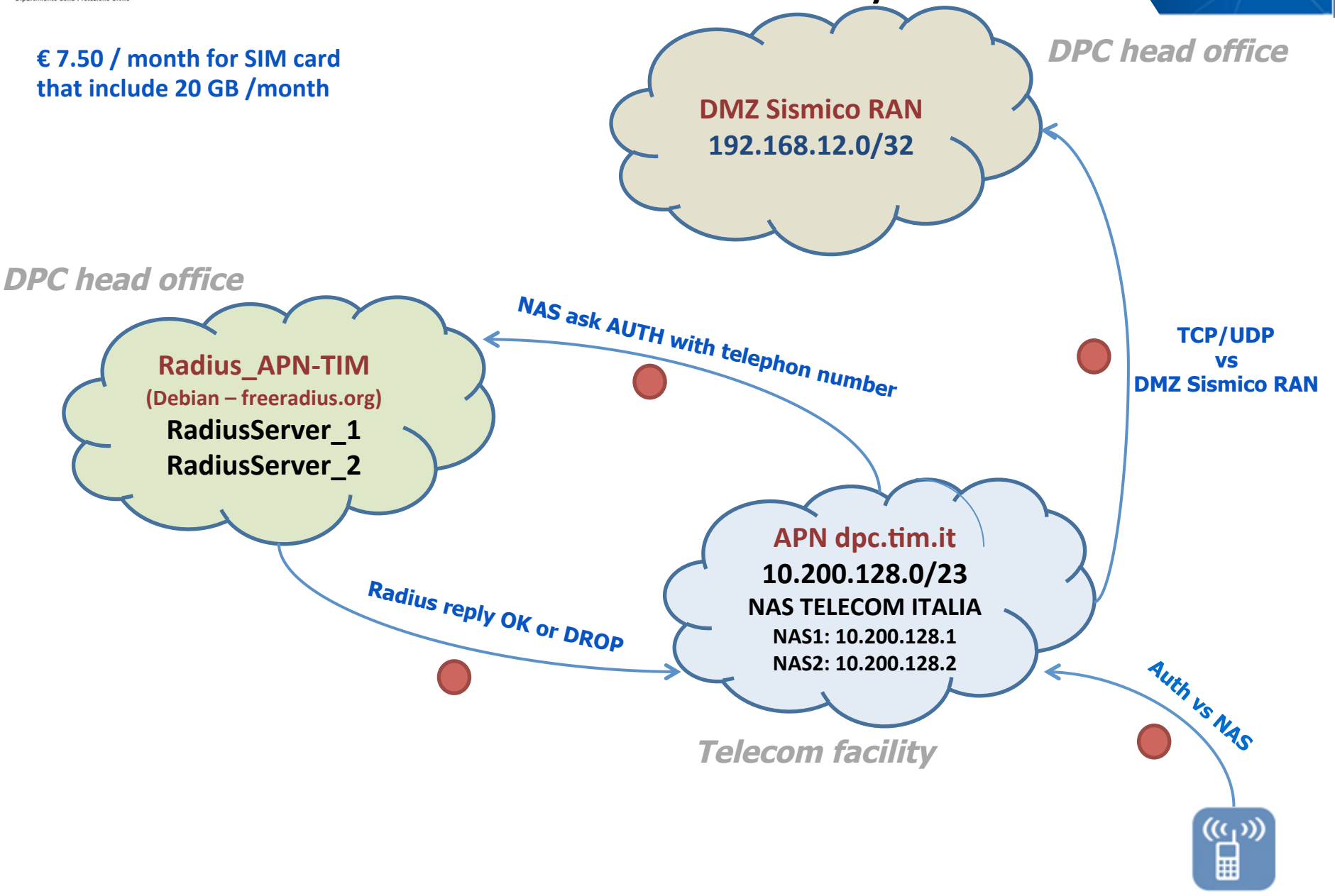
RAN - data transmission reliability

€ 7.50 / month for SIM card that include 20 GB /month



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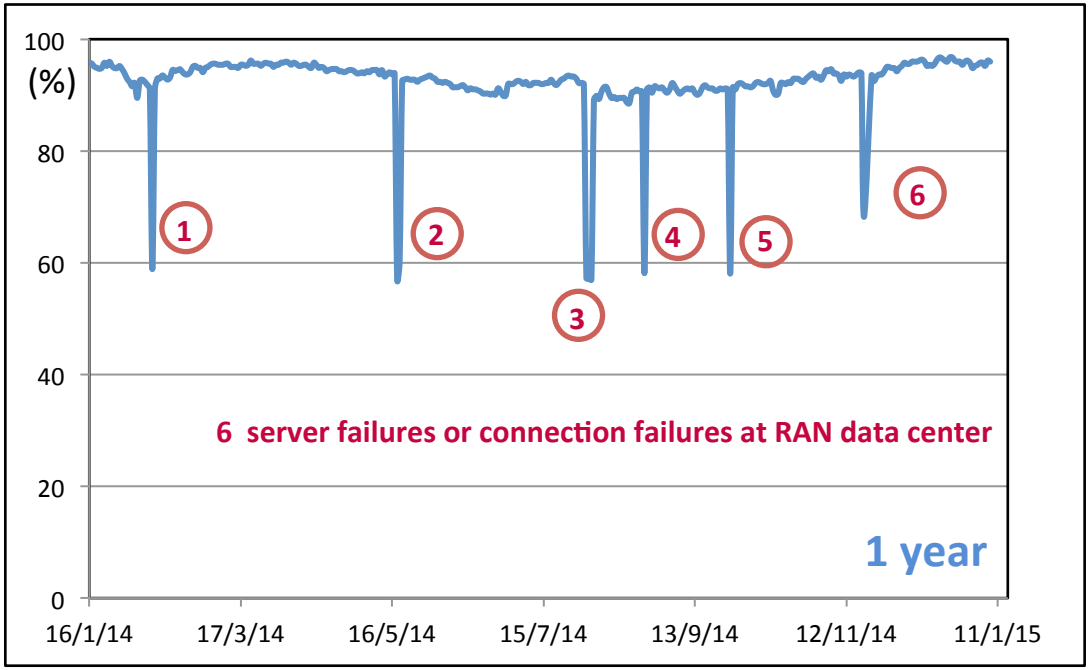
RAN – network functionality



Rapporto funzionalita rete RAN - 05/03/2015 12:00
ran_alert@protezionecivile.it
Inviato: giovedì 5 marzo 2015 12.00
A: RAN Alert 4

```
Rapporto sulla funzionalita' della rete RAN aggiornato al 05/03/2015 12:00


**********************************************************************
*      La funzionalita' della rete RAN e' pari al 96.17 %
**********************************************************************


========================== RIEPILOGO STAZIONI ==========================

Il numero totale delle stazioni e' 522
Il numero totale delle stazioni non funzionanti e': 20


========================== DETTAGLIO SOTTORETI ==========================

=> Rete RAN-KINEMETRICS

La funzionalita' e' del 97.26 %
Il numero totale delle stazioni e' 292:
Il numero totale delle stazioni non funzionanti e': 8:
- AQP: problema di comunicazione
- CON: problema di comunicazione
- ERI: problema di comunicazione
- GBL: problema di comunicazione
- PIC: problema di comunicazione
- SCM: problema di comunicazione
- SLO: problema di gps
- VNF: problema di comunicazione
============================ =========== ===

=> Rete RAN-SYSCOM

La funzionalita' e' del 94.95 %
Il numero totale delle stazioni e' 198:
Il numero totale delle stazioni non funzionanti e': 10:
- AVT: problema di comunicazione
- BCL: problema di comunicazione
- GLD: problema di comunicazione
- GTR: problema di comunicazione
- MDG: problema di comunicazione
- PTR: problema di comunicazione
- RNC: problema di comunicazione
- SDV: problema di comunicazione
- SPD: problema di comunicazione
- TRM: problema di comunicazione
============================ =========== ===

=> Rete RAN-CESI

La funzionalita' e' del 100.00 %
Il numero totale delle stazioni e' 19:
Il numero totale delle stazioni non funzionanti e': 0:
============================ =========== ===
```

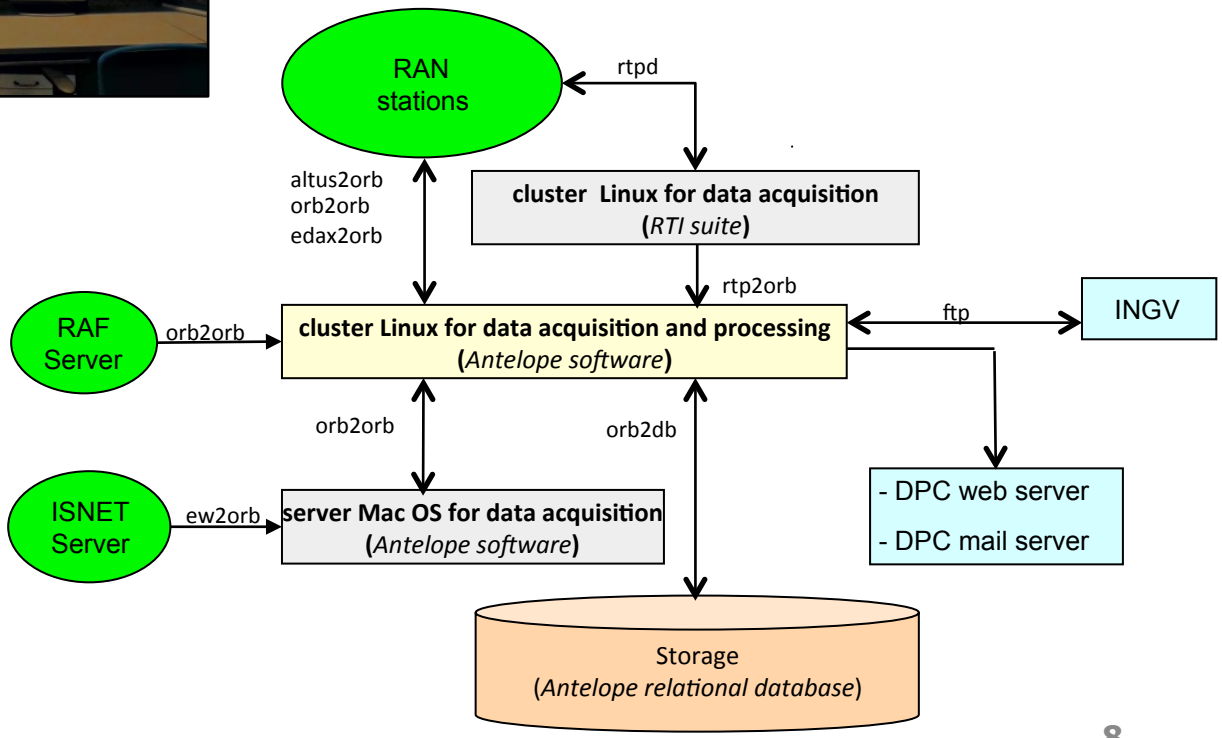
- **The network functionality is daily checked and an automatic report is generated by a script shell, in perl, that run, as "cronjob", in Antelope environment.**

- **The high level of network functionality is ensured by three Companies, besides the University of Trieste, that must guarantee high service levels for the stations maintenance.**

RAN – data center reliability

The upgrade of data center was completed in February 2015

- ❑ **The new system is more reliable**
- ❑ **The servers and the network devices are monitored**
- ❑ **Antelope ver. 5.4 is running**



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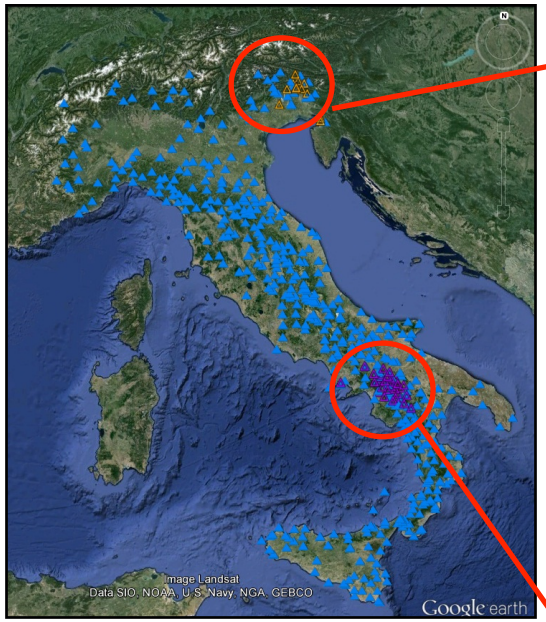
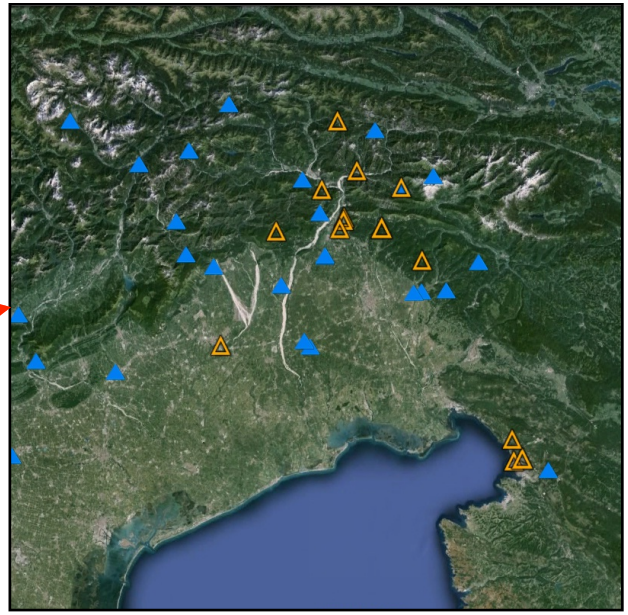
RAN - "Integrated" Networks

RAN network - 523 stations

FDSN code "IT"



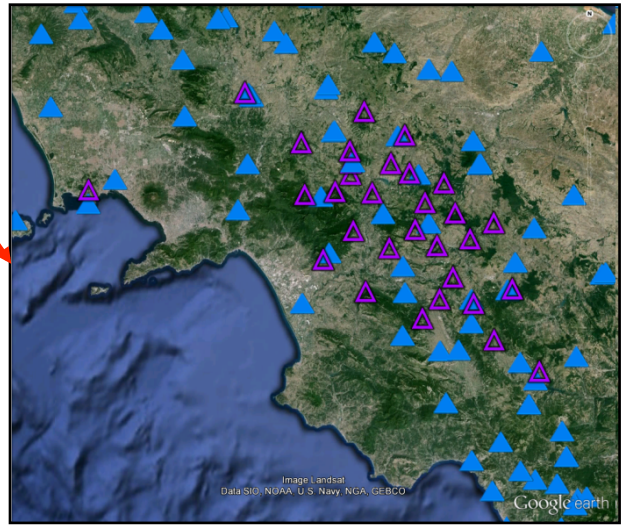


RAF network - 14 stations

FDSN code "RF"

http://rtweb.units.it/

Agreement between DPC and University of Trieste



ISNET network - 31 stations

FDSN code "IX"

http://isnet.na.infn.it/

Agreement between DPC and AMRA consortium

RAN – contribution to information in seismic emergency

At data center an automatic procedure, developed within the collaboration with University of Trieste (Giovanni Costa and his group), is running. This procedure is

- ❑ **developed in Antelope environment**
- ❑ **triggered by a new event location in Antelope database**

It generates and transmit, automatically

- ❑ **SMS with event location from Antelope database**
- ❑ **e_mail with event location and phases from Antelope database**
- ❑ **e_mail with event report. This report contains values of "Mw", response spectra "PSA" as well as other parametric information calculated from recorded waveforms by the procedure itself.**

It also

- ❑ **updates private or public sites for data dissemination**
- ❑ **stores the calculated PSA in a folder**

Antelope database schema was modified in order to add tables

- ➢ **for the management of the procedure**
- ➢ **for storing the new parameters calculated by the procedure.**

RAN – automatic procedure

Strong motion waveforms

Antelope automatic location

RAN Alert SMS (U +393357322767): DPC-RAN: OriginTime=2013/07/21 01:32:24 Ml=4.90 Place=Ancona lat=43.5010 lon=13.6680 depth=8.4 nrec=37 maps.google.com/maps?q=43.5010,13.6680

Automatic procedure (*trigger: Antelope location*)

phases report (M_L, Lat, Lon, Origin time, P-phases) — Email

event report (M_W, PGA, PGV, PGD, PSA, IH, IA, Instrumental Intensity,…) — Email

Late waveforms

ftp waveforms

INGV (lat, lon, depth, T_o, M) — *Web services*

INGV

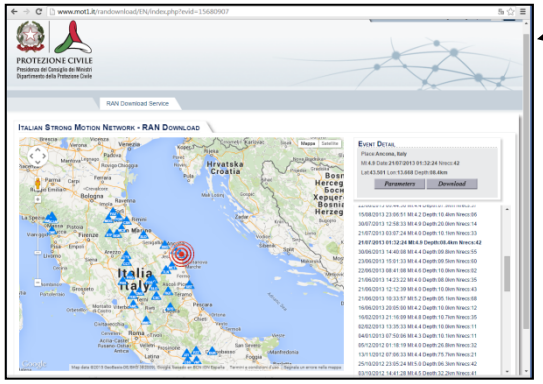
Automatic procedure (*trigger: Ingv location*)

Revised event report — Email

ftp Strong motion parameters

INGV (Shakemap)

www.mot1.it/randownload



shortened version of revised seismic report and waveforms in sac and ascii formats for M_L >= 4

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Dipartimento della Protezione Civile

RAN – phases report and event report

phases report

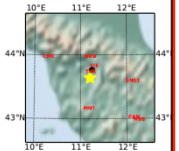
ORID: 202416 EVID: 202412

PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

Earthquake AUTOMATIC REPORT

Dipartimento di Protezione Civile
Rete Accelerometrica Nazionale
RAN

WARNING:
These information are preliminary
and may be revised when more data are available.



Event: Firenze
Origin time: 2015/03/04 00:00:05
Latitude: 43.639 Longitude: 11.206
Magnitude MI: 4.0
AGENCY: DPC
nass: 13

Nearest cities:
Firenze 15 km
Prato 28 km
Siena 37 km
Pistoia 40 km

sta	cham	dist	EvAz	Phase	Time	TRes	SNR	Ml	mb	Ms
TVR	HG	4	187	S	2015/03/04 00:00:07.490	-0.6	65.334	2.73		
TVR	HG	4	187	P	2015/03/04 00:00:07.680	0.7	30.691	2.73		
FIE	HG	10	201	P	2015/03/04 00:00:09.500	0.4	16.848	3.24		
BMB	HG	18	181	S	2015/03/04 00:00:17.930	1.9	11.311	4.23		
BMB	HG	18	181	P	2015/03/04 00:00:11.950	0.3	69.107	4.23		
MNT	HG	29	2	P	2015/03/04 00:00:14.330	-0.9	6.277	4.49		
SNS1	HG	39	276	P	2015/03/04 00:00:19.655	0.5	7.377	4.69		
CME	HG	42	115	P	2015/03/04 00:00:19.650	-0.5	19.810	3.96		
PAN	HG	54	313	P	2015/03/04 00:00:23.000	-0.5	18.072	3.64		
MVR	HG	59	312	P	2015/03/04 00:00:25.615	-0.2	14.669	3.74		
GNU	HG	75	311	P	2015/03/04 00:00:31.000	0.5	17.061	3.49		
TRE	HG	78	305	P	2015/03/04 00:00:31.620	0.1	10.883	4.11		
DSG	HG	108	166	P	2015/03/04 00:00:39.000	0.0	11.324	4.05		

event report

ORID: 9561 EVID: 732

PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

Earthquake AUTOMATIC REPORT

Dipartimento della Protezione Civile - Rome - Italy
Rete Accelerometrica Nazionale
RAN

WARNING:
These information are preliminary
and may be revised when more data are available.

Event: NORTHERN_ITALY
Origin time: 2012/05/20 02:03:52
Latitude: 44.889 Longitude: 11.228
Magnitude MI: 5.9
AGENCY: INGV

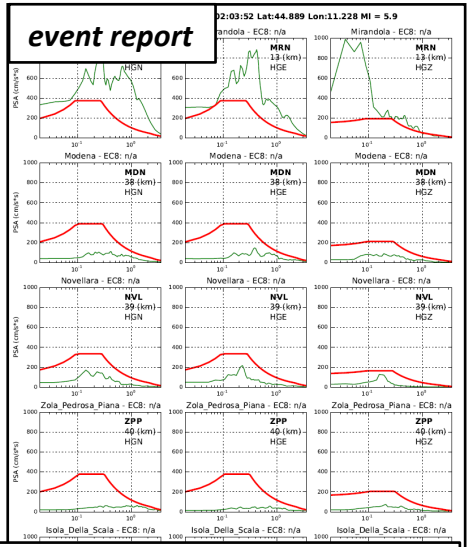
Seismic Moment: 4.31e+18 Nm
Mw: 6.2
AGENCY: DPC

Records analyzed by procedure: 173
Selected limits: max distance=100.0 km min PGA= 1.0 cm/s*s
min PGA to show response spectra= 1.0 cm/s*s
Records inside the selected limits: 86 response spectra inside the limits: 86

Nearest station: MRN distance: 13.55 km
HGN - PGA=329.76 cm/s*s, PGV=44.49 cm/s

Procedure implemented by SeisRaM group, University of Trieste, Italy - ver: SPT - 2015

event report



PSA spectra (black) compared to design response spectra (red) from Italian building code

event report

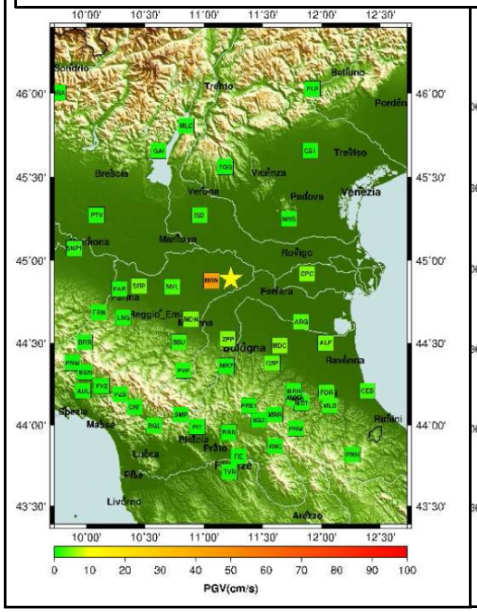
RAN - Origin time: 2012/05/20 02:03:52 Lat:44.889 Lon:11.228 MI = 5.9 Agency: INGV
Mt: 4.310e+18 Nm - Mw = 6.2 Agency: DPC

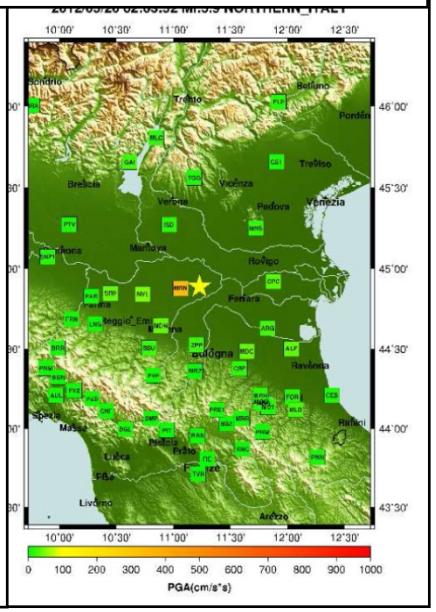
		km	Hz	cm/s*s	EPA cm/s*s	PGV cm/s	PGD cm	PSA03 cm/s*s	PSA10 cm/s*s	PSA30 cm/s*s	EC8	location
MRN	HGE	14	0.2-50.0	302.43	284.58	23.41	5.76	869.61	311.99	43.76	na	Mirandola
MRN	HGN	14	0.2-50.0	329.76	261.79	44.49	7.22	746.80	561.31	62.49	na	Mirandola
MRN	HGZ	14	0.2-50.0	316.73	94.39	6.85	0.87	188.07	45.67	11.28	na	Mirandola
MDN	HGE	38	0.2-50.0	38.28	36.25	4.73	1.13	70.97	68.83	15.66	na	Modena
MDN	HGN	38	0.2-50.0	39.32	34.87	3.93	0.91	75.54	53.94	9.19	na	Modena
MDN	HGZ	38	0.2-50.0	28.11	26.57	1.76	0.76	79.09	28.00	4.48	na	Modena
NVL	HGE	40	0.2-50.0	48.20	42.57	2.83	0.60	93.85	27.47	6.83	na	Novellara
NVL	HGN	40	0.2-50.0	47.44	44.63	2.27	0.50	123.13	29.98	7.08	na	Novellara
NVL	HGZ	40	0.2-50.0	28.89	18.32	0.99	0.14	26.76	4.82	2.80	na	Novellara
ZPP	HGE	41	0.2-50.0	14.86	15.41	2.33	1.20	33.23	38.52	10.98	na	Zola_Pedrosa_Piana
ZPP	HGN	41	0.2-50.0	20.78	19.31	5.01	2.05	46.14	60.05	18.44	na	Zola_Pedrosa_Piana
ZPP	HGZ	41	0.2-50.0	19.67	20.29	1.52	0.93	45.89	16.19	7.81	na	Zola_Pedrosa_Piana
ISD	HGE	48	0.2-50.0	15.50	14.92	1.75	0.62	36.41	27.21	12.02	na	Isola_Della_Scala
ISD	HGN	48	0.2-50.0	16.22	15.67	1.85	0.78	33.59	27.71	8.90	na	Isola_Della_Scala
ISD	HGZ	48	0.2-50.0	8.58	8.58	1.15	0.64	17.03	8.91	6.91	na	Isola_Della_Scala
CPC	HGE	51	0.2-50.0	27.00	23.11	3.64	1.85	65.69	35.88	18.45	na	Copparo_Coccanile
CPC	HGN	51	0.2-50.0	33.87	34.32	4.93	1.95	83.37	46.03	18.23	na	Copparo_Coccanile
CPC	HGZ	51	0.2-50.0	10.97	9.17	1.16	0.74	25.03	4.30	8.59	na	Copparo_Coccanile
SSU	HGE	55	0.2-50.0	20.62	21.69	1.92	0.55	51.04	29.59	4.52	na	Sassuolo
SSU	HGN	55	0.2-50.0	16.19	18.49	1.64	0.39	55.32	19.15	4.30	na	Sassuolo
SSU	HGZ	55	0.2-50.0	11.40	13.84	0.94	0.25	28.75	11.66	3.12	na	Sassuolo
ARG	HGE	55	0.2-50.0	24.39	19.90	3.09	1.11	37.93	23.85	13.20	na	Argenta
ARG	HGN	55	0.2-50.0	18.68	18.56	2.59	0.94	42.21	23.93	12.43	na	Argenta
ARG	HGZ	55	0.2-50.0	10.36	9.90	0.93	0.45	30.53	6.40	5.32	na	Argenta
MDC	HGE	56	0.2-50.0	23.97	21.88	3.34	1.58	77.87	33.07	30.03	na	Medicina
MDC	HGN	56	0.2-50.0	39.34	32.05	5.29	2.68	81.78	42.67	24.10	na	Medicina
MDC	HGZ	56	0.2-50.0	10.68	10.78	1.59	0.99	21.18	14.99	11.00	na	Medicina
MNS	HGE	56	0.2-50.0	18.05	11.75	0.62	0.12	26.61	3.83	1.01	na	Monselice

dista = epicentral distance
filter = automatic band pass butterworth filter
EC8 = site classification (Eurocode from ITACA)

PGA,PGV,PGD = peak ground acceleration, velocity and displacement
EPA = effective ground acceleration (Kramer, 1996)
PSA03,PSA10,PSA30 = spectral acceleration (0.3, 1.0, 3.0 sec)

Waveform parametric information (table and graphic format)





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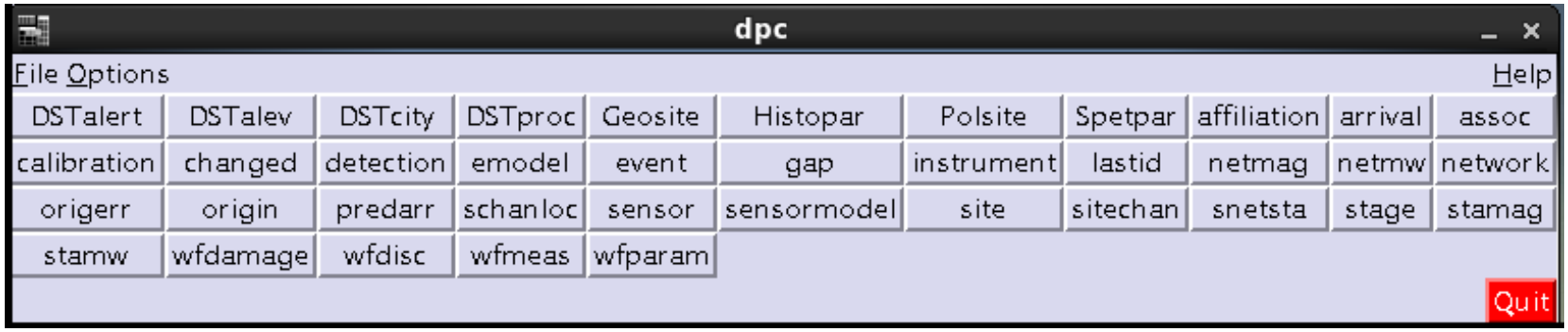
RAN – new database tables



DSTalert:
DSTalev:
DSTcity:
DSTproc:

to manage the automatic procedure

Polsite: municipality, province, region

Histopar: parametric information of waveforms recorded in the past and that are uses , as a term of reference, in the event report;

Stamw: station moment magnitude

netmw: network moment magnitude

Geosite: EC8 code associated to station used to calculated reference response spectra at the station according to Italian building code

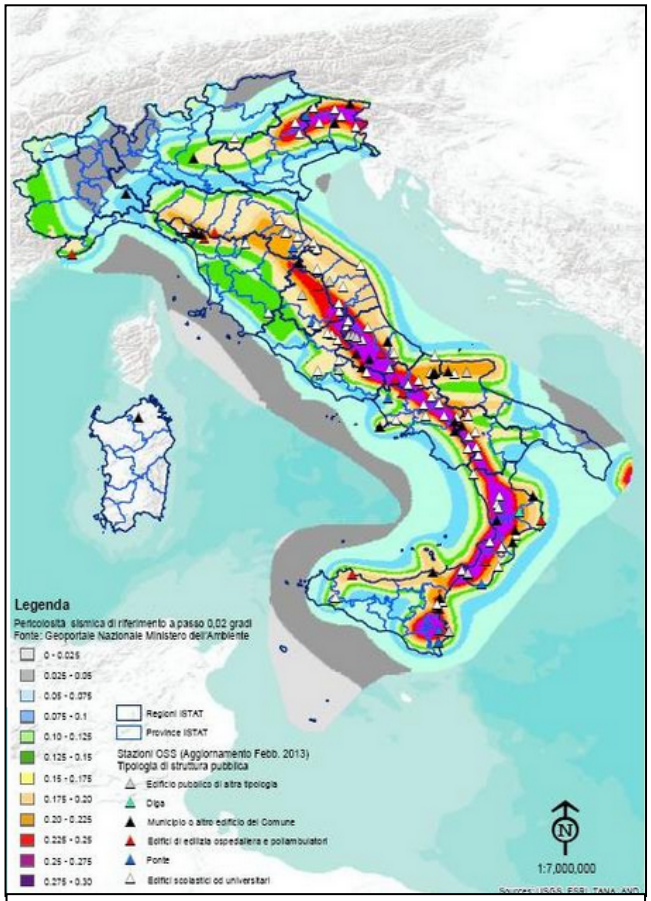
Spetpar: parametric information of response spectra from recorded waveforms

wfdamage: parametric information of waveforms

wfparam: parametric information of waveforms

RAN – planned developments

OSS – Seismic Observatory of Structures
http://www.protezionecivile.gov.it/jcms/it/osservatorio.wp



152 monitored structures
an
3053 strong motion 1Comp. sensor
65 relative 1Comp. sensor

- **Integration of "near field" sensors of DPC network for structures health monitoring**

The RAN and OSS projects were designed and implemented separately for several reasons. As a consequence:

- **RAN and OSS instrumentation is different, but few cases;**
- **RAN and OSS data center are different.**

- **Improvement of data security and data center security**

  - **to design and to implement, in a safe site, a system for <u>data replication and synchronization</u>;**
  - **to design and to implement, in a safe site, a system for <u>"disaster&recovery" of data center</u>.**

- **Improvement of data dissemination**

  - **To design and implement a <u>WEB Portal with web services</u>.**

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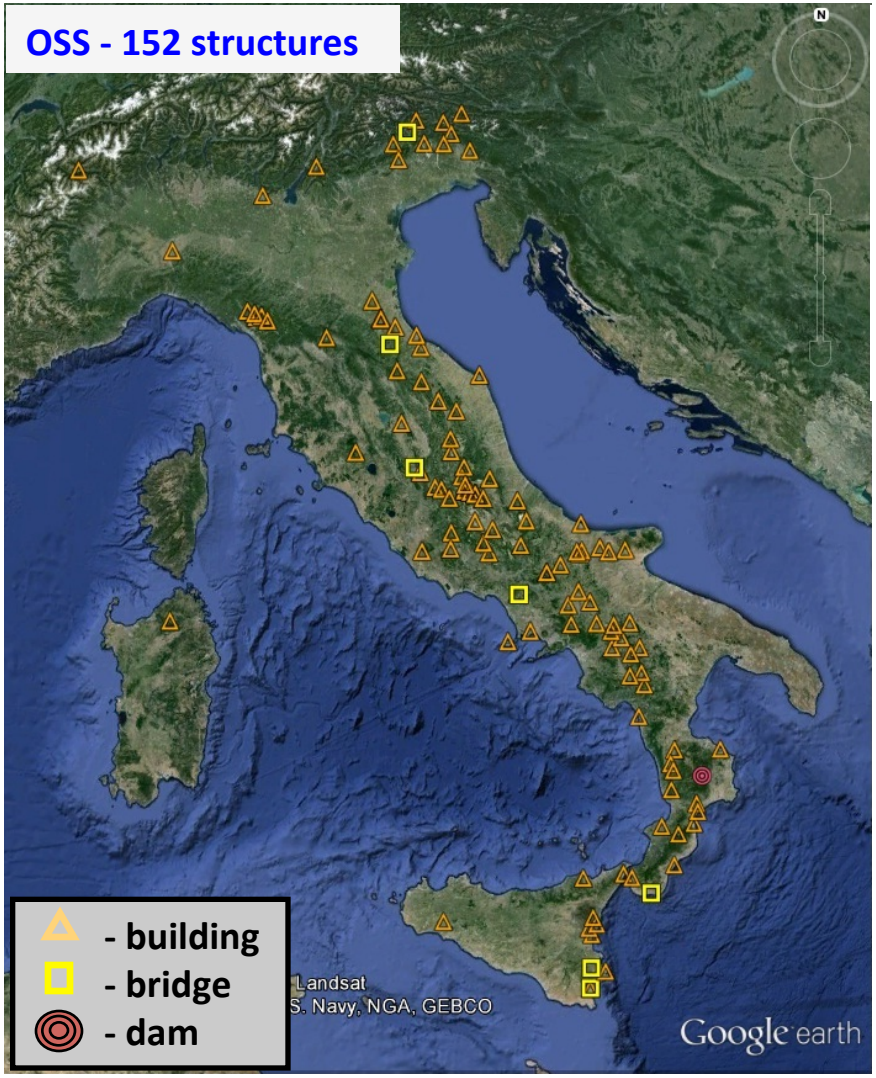
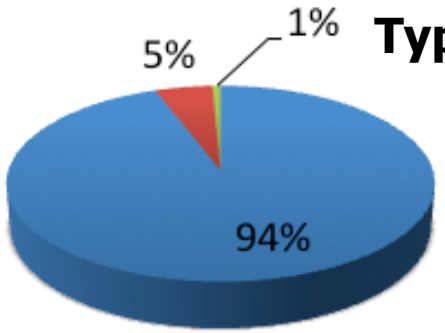
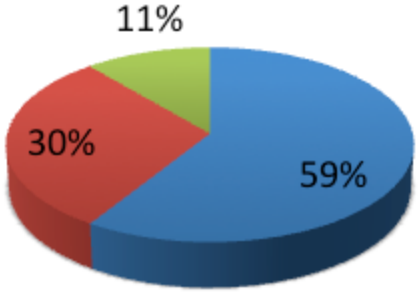
OSS - Seismic Observatory of Structures



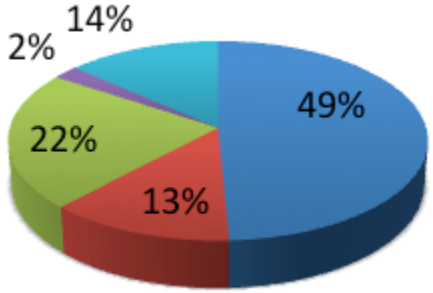
Type of structures



Characteristics of buildings



Usage of buildings



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OSS – emergency response and data dissemination

Strong motion waveforms

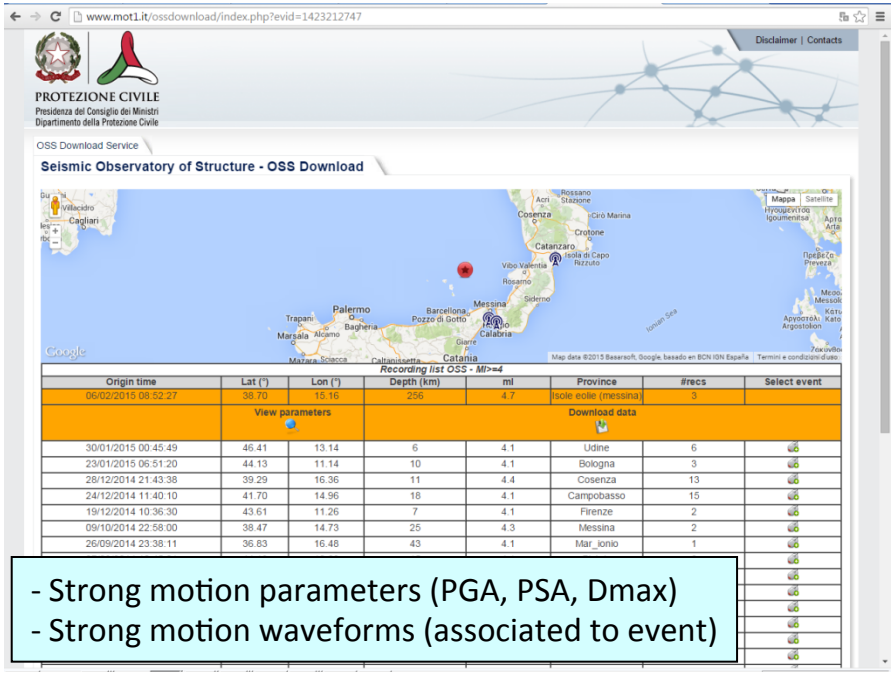
Web services ← *INGV (lat, lon, depth, T_0, M)*

Automatic procedure

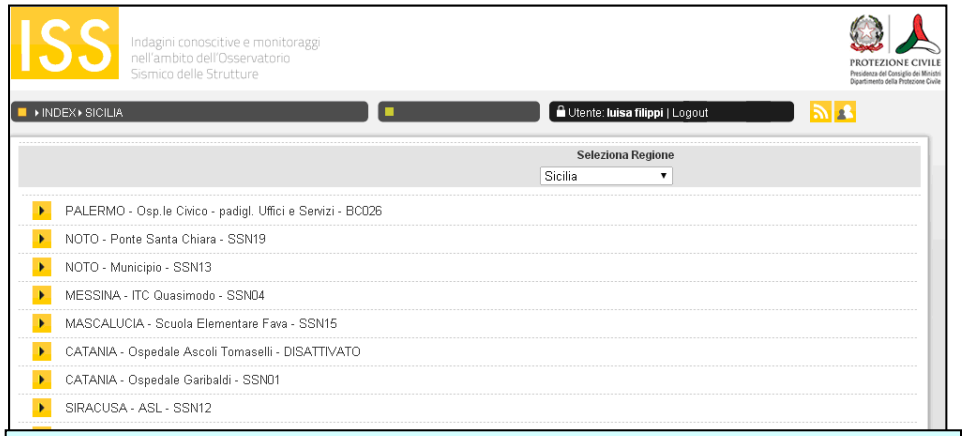
→ Seismic event report
*Max interstory drift (**Dmax**)*
correlated to level of possible damage
→ *e_mail*

→ *www.mot1.it/ossdownload*

→ *www.mot1.it/iss*



- Strong motion parameters (PGA, PSA, Dmax)
- Strong motion waveforms (associated to event)



- Documentation on the structure
(design documents, geological report, structural assessment)
- Results of geometric reliefs and non-destructive surveys
- Results of experimental modal analysis
- Numerical models (linear, non–linear)
- Strong motion waveforms (associated to monitored structure)

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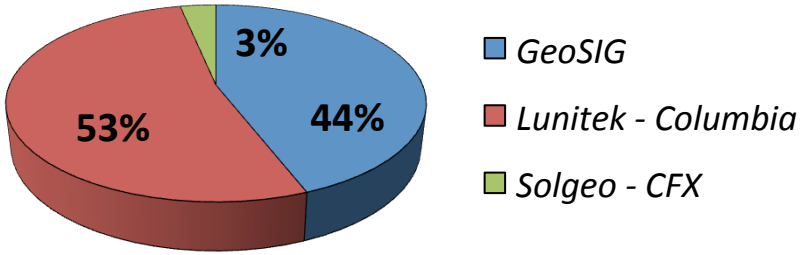
OSS – housing and instrumentation ("near field" sensor)

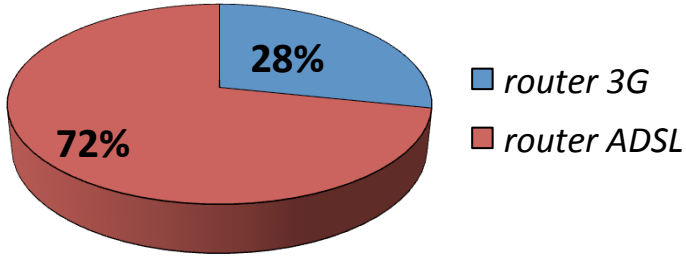
Cividale del Friuli
Sensor in the basement

Napoli
Sensor close to building

Company	*Solgeo*	*Lunitek*	*GeoSIG*	*Columbia*	*CFX*
Datalogger	**MCCA-02**	**MCDR**	**CR-4 CR-6 GSM-18**		
Sensor			**SSA320 AC53 AC63**	**SA213417 SA213445**	**US4**



Company	*FASTweb*	*CradlePoint*	*Sierra Wireless*	*MultiTech*
Router + modem ADSL	**Cisco 1841**			
Router 3G HSPA (fallback to GPRS/EDGE)		**MultiModem rCell**	**Helix RT Airlink GX400**	**IBR600P**



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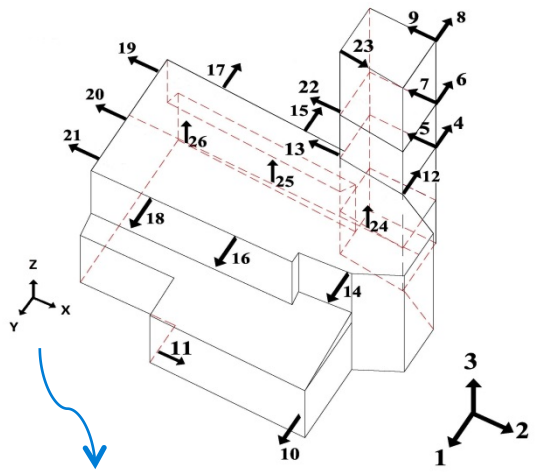
Integration of near field sensors of OSS network: 1th step



3G/ADSL

OSS – "Vmware vCenter Server"
(DPC head Office)

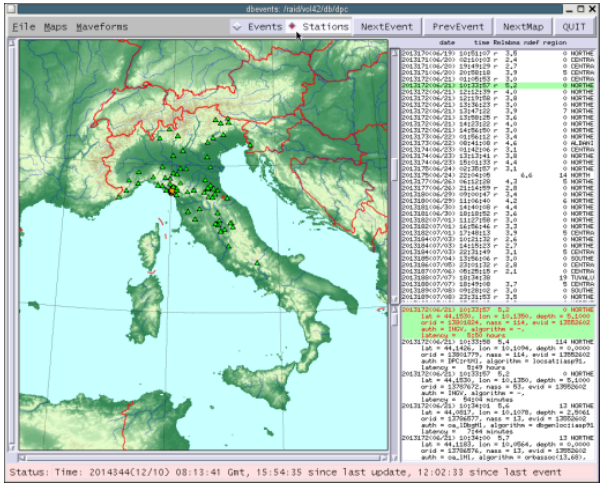
NF waveforms are available, in few minutes after recording, in ASCII format and in acceleration unit (g or cm/s2) in a shared folder.

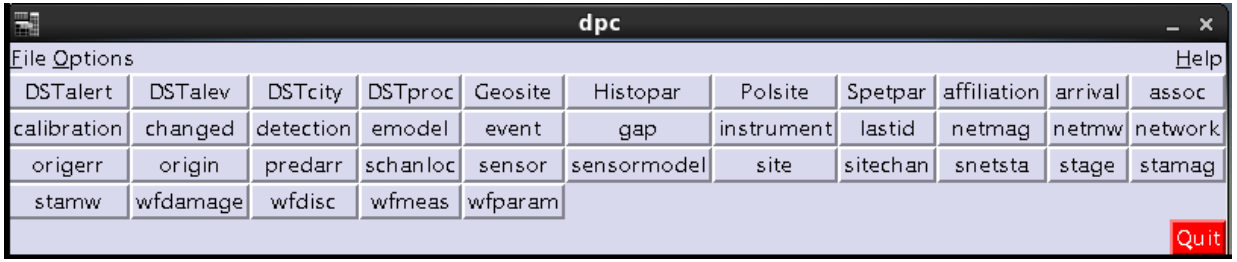
xy2sac
sac2db ???????

???????

Antelope database

Antelope rtsystem





The components of motion are in the reference system of the structure, in OSS database: we need to check rotation angle and to update sitechan table.

We need that dbe and dbpick, for example, use sitechan table. Probably it is already possible.