Disaggregated Data and Display Centers for Seismic Hazard Monitoring: Abu Dhabi Emirate, UAE, a Case Study

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Abstract

Modern seismic data acquisition and processing relies on competent, reliable and robust software like the Antelope software. However, the information that is produced with such systems has to be disseminated in a fashion that is conducive for users such as first responders, other emergency personnel, and decision makers.

An example of such a system is the disaggregated data and display centers of the *Assessment of Seismic Hazard and Risk in Emirate of Abu Dhabi* project. In order to provide continuous operation two data centers operate in parallel. Each data center has the same hardware and software configuration. At the data centers information is generated in form of

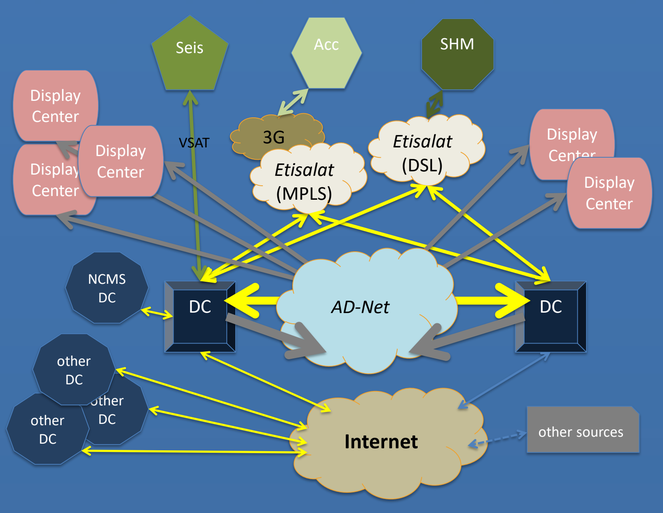
a) web services, e.g., USGS ShakeMaps and maps of seismic performance of lifelines, and
b) screen displays of structural health monitoring and general system status. All information will be available like broadcast channels at the two data centers so that the five display centers can access the information.

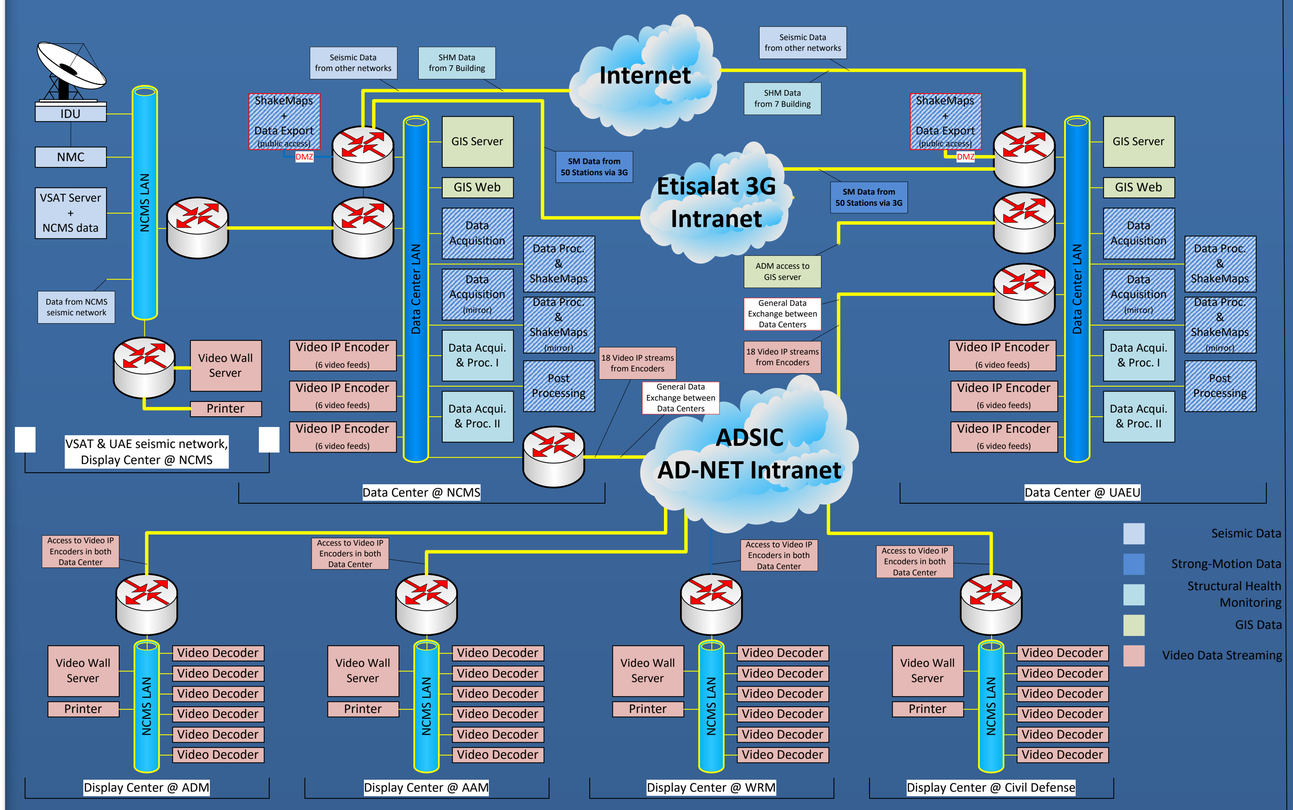
The display centers are distributed throughout the municipalities of the Abu Dhabi Emirate. The operator at each display center can select a subset of the available information in order to show relevant data of their area. However, in case of a crisis, an application installed at the data centers allows authorized personnel to synchronize the displayed output so that all viewers have the same information available.

Building on this infrastructure, future extensions could include applications that provide online action plans and procedures based on the type and severity of an emergency leading the way to a "situation room."

Communication

A reliable and high bandwidth communication infrastructure is required in order to realize a disaggregated system.





The Antelope middleware binds all data sources into redundant (where possible) acquisition links. In order to achieve this, a program is required that

a) Handles redundant physical communication links from the members of the system → **link redundancy**
b) Assures that data packets are not duplicated → **data uniqueness**

Data Center

Each data center is operating in parallel as mirror. That permits the instant and complete substitution of all functions of the other one. Actually, all resources , data and information are available at all times from both centers. Also , the data centers are interconnected using the link as alternative data acquisition link and for synchronization of data, meta-data, and information when required.

Seismic Network

In the scope of the project the UAE seismic network was augmented by four (4) stations. Each station communicates via a VSAT satellite link to the VSAT hub at NCMS. There are aggregated as external sources the data streams of the existing seismic network.

Accelerograph Network

The 50 stations of the accelerograph network are connected to Etisalat's 3G network. From Etisalat a dedicated communication link for each data center delivers independent and alternative communication feeds.

Structural Health Monitoring

In the Abu Dhabi Emirates seven (7) unique structures are instrumented for structural health monitoring. Each structure has 24 or 36 acceleration channels plus a wind sensor. Each structure is connected to both data centers through VPN over DLS.

Other sources

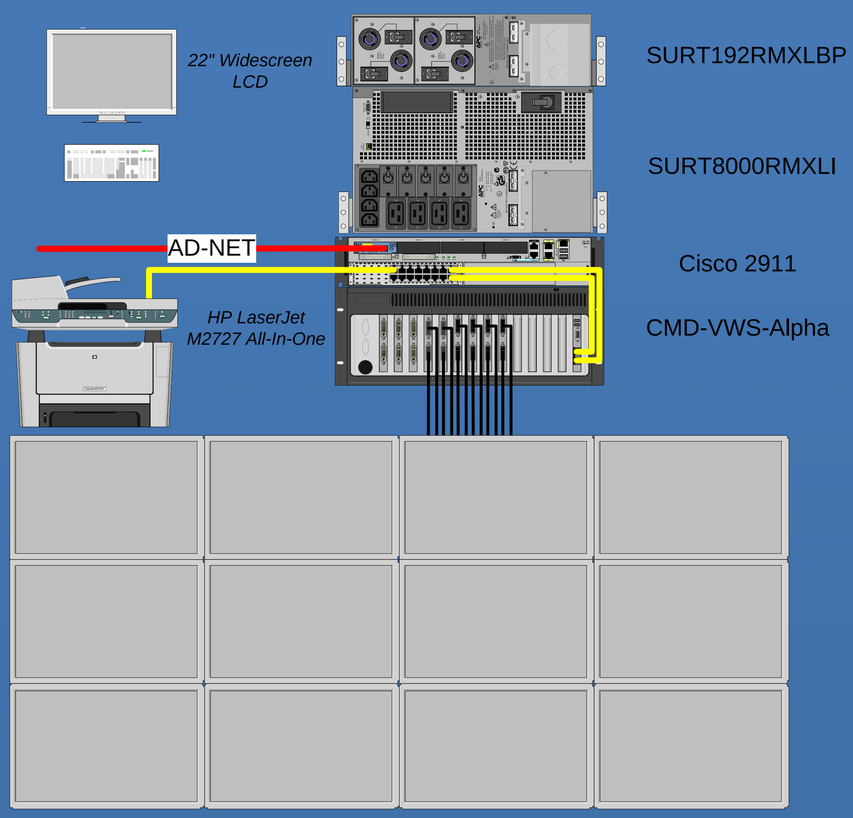
The exchange of real-time seismic data is realized through an Internet connection at each data center. Currently, data exchange will be carried out between the Dubai Municipality, the Seismic Monitoring Center of Oman and KISR in Kuwait.

Display Centers

The display center consists of a 3-over-4 video wall. A video wall server handles the graphical input and the size and location of the input on the video wall. The graphical input can be divided into two classes:

a) Output from web-servers at the data centers, e.g., web-GIS and ShakeMap
b) Direct video feeds from the graphic cards of the computers in the data centers

In the latter case, graphical output at the data centers it transcoded in IP packets and encoded in h.265 video streams.



Cinemassive Displays
3x4 24" Slim-Line LCD Displays

The SVSi transcoder provides point-to-multipoint broadcast capability via IGMP (Internet Group Management Protocol). The IGMP is carried via Ad-Net provided GRE (Generic Routing Encapsulation) connections from the data centers to the display centers. With a VLC media player any of the broadcast video feeds can be selected at both of the display center.

At the data center side the SVSi Conductor Server Virtual Machine gives the operator to configure the quality, number and availability of the video feeds per display center. Moreover, the software can enforce to show certain channels at all display centers simultaneously. In case of a crisis, this feature can enforce the broadcast of emergency contents or synchronize the video walls at the display centers so that disperse personnel can collaborate on the same available information. In the future these capabilities can be harness to develop a disaggregated "situation room."

The Future Situation Room

As shown above, graphical information can be flexible and on-demand distributed to one or more users. However, the information consumer is not necessary versatile in the intricacies of the available information. Therefore, another program layer is required that

a) prepares the existing information so that it is conducive, e.g., for the first responder or other officials involved in emergency response, to carry out the task or request on hand,
b) supplies instructions or protocols how to respond to a given situation according to standard processes and policies, and
c) connects to a dispatch systems.

Besides the seismic and structural engineering content, other relevant sensors and video cameras may be included promoting a complete situation awareness.