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Egyptian National Seismic Network(ENSN) Lab.

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Outline

- ENSN Overview.
- Activities of the ENSN.
- ENSN Stations.
- Communication types.
- Data stream in ENSN.
- Devices & equipments.
- Software & databases.
- GIS application.
- Seismic data mining.
- Early earthquake warning.

ENSN Overview.

- ENSN started in 1997 and completed in 2003.

- The seismological acquisition and processing at the ENSN is fully automate network system dedicated to the digital acquisition and real-time process of seismological data, as well as the rapid exchange of earthquake information.

- All digital recording instruments are equipped with velocity sensors and 24 analogue-to-digital converter.

- data are digitized at a sampling rate of 100 samples per second with a Hig Resolution Digitizer (HRD) or Trident Digitizer.

- The instruments response is flat in the range between 1.9 and 38 Hz.

- The ENSN consists of 87 seismic stations in operation. The distribution of the stations almost covers all of the important areas in Egypt as shown in Fig 1

ENSN Overview.

Figure 1 the ENSN station distribution

Activities of the ENSN

- Monitoring of natural and induced seismicity.

- Preparing the seismological data base for the advanced research work.

- Collaborative observational research with the international seismological centers.

- Establish one and three dimensional velocity structure.

- Seismic source physics and seismotectonics.

- Simulation of earthquake ground motion.

- Seismic Hazard assessment.

- ENSN Produces earthquake hazard estimates for many major engineering projects in Egypt.

ENSN Stations.

- **ENSN consists of 87 seismological stations:-**
  - **2** broadband stations (STS2 seismometer type).
  - **14** broadband station   (Trillium seismometer type).
  - **1** very broadband station (Borehole seismometer type).
  - **70** short period stations   (SS1 seismometer type).
- The ENSN network is a hyper network:-
  - Depends on Several variables like path distances, terrain, link availability and licensing as shown in Fig 2.
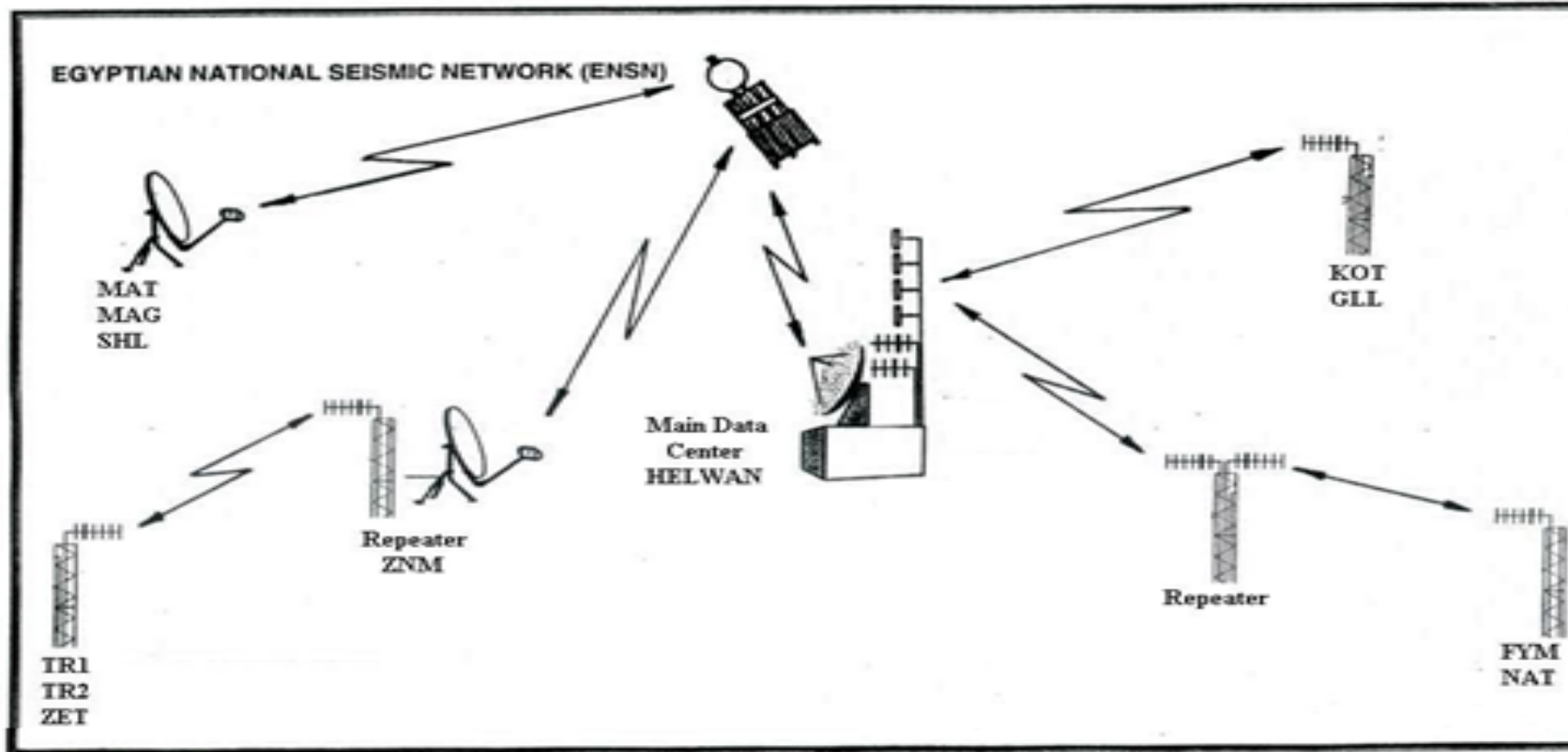
ENSN Communication Scheme.

Figure 2 ENSN communication scheme

Communication types

- **RF communications (9 Stations)**
  - Fixed frequency (FF) RF solutions are used extending up to 100 km.
  - Operates on licensed frequencies in the 150 to 170 MHz VHF range.
  - VHF FF telemetry is more forgiving of path obstacles and offers greater range th
    spread spectrum systems.

- **Satellite communications (78 Stations)**
  - Have a number of distinct advantages over terrestrial RF types.
  - VSAT also offers a solution to long distance communications.
  - Any location with a clear view of the satellite in the sky is a suitable remote site
    location.

Data stream in ENSN

- **Primary data streams (Sensor data)**

  - Contains the seismic data which are recorded by the seismometer.

  - converted form analog measurements into digital measurements, and then they put a data packet.

  - A data packet always consists of a timestamp header followed by n data bundles (where n is user defined).

  - A timestamp header bundle contains a sequence number, the time of the first sampl instrument ID (model and serial number), sample rate of packet and channel numbe and the first sample.

  - A data bundle contains between 4 and 16 compressed samples of data.

  - The samples are compressed using a first difference algorithm.

  - The data is compressed as byte, word, or long differences. Each set of four bytes con either 4 byte differences, 2 word differences, or 1 long difference.

  - The compression bits indicate how each set of 4 bytes is packed. For each 4 byte set there are 2 compression bits.

  - The compression bits define the compression type depend of the noise level.

Data stream in ENSN cont.

- **Secondary data stream (SOH data)**
  - This type of streams contains the State of Health (SOH) data are generated by site instruments, to monitor the status of them, and then they put into a SOH packet. There are many types of SOH packets corresponding to the instrument model and function, a common data can be in these packets are instrument temperature, power supply voltage , instrument location, log message ,number packets were sent and much more information.

Devices & equipments.

- All devices and equipments form Nanometrics company http://nanometrics.ca/

Software & databases.

- Acquisition software.
  - Apollo Server.
- network management software
  - Antares.
- Retrieval time series software.
  - Apollo Project.
- Waveform software.
  - Apollo waveform.
- Publishing software.
  - Athena.

- Data processing.
  - Atlas with Oracle database.
- Response Software.
  - Hydra by the National Earthquake Information Center
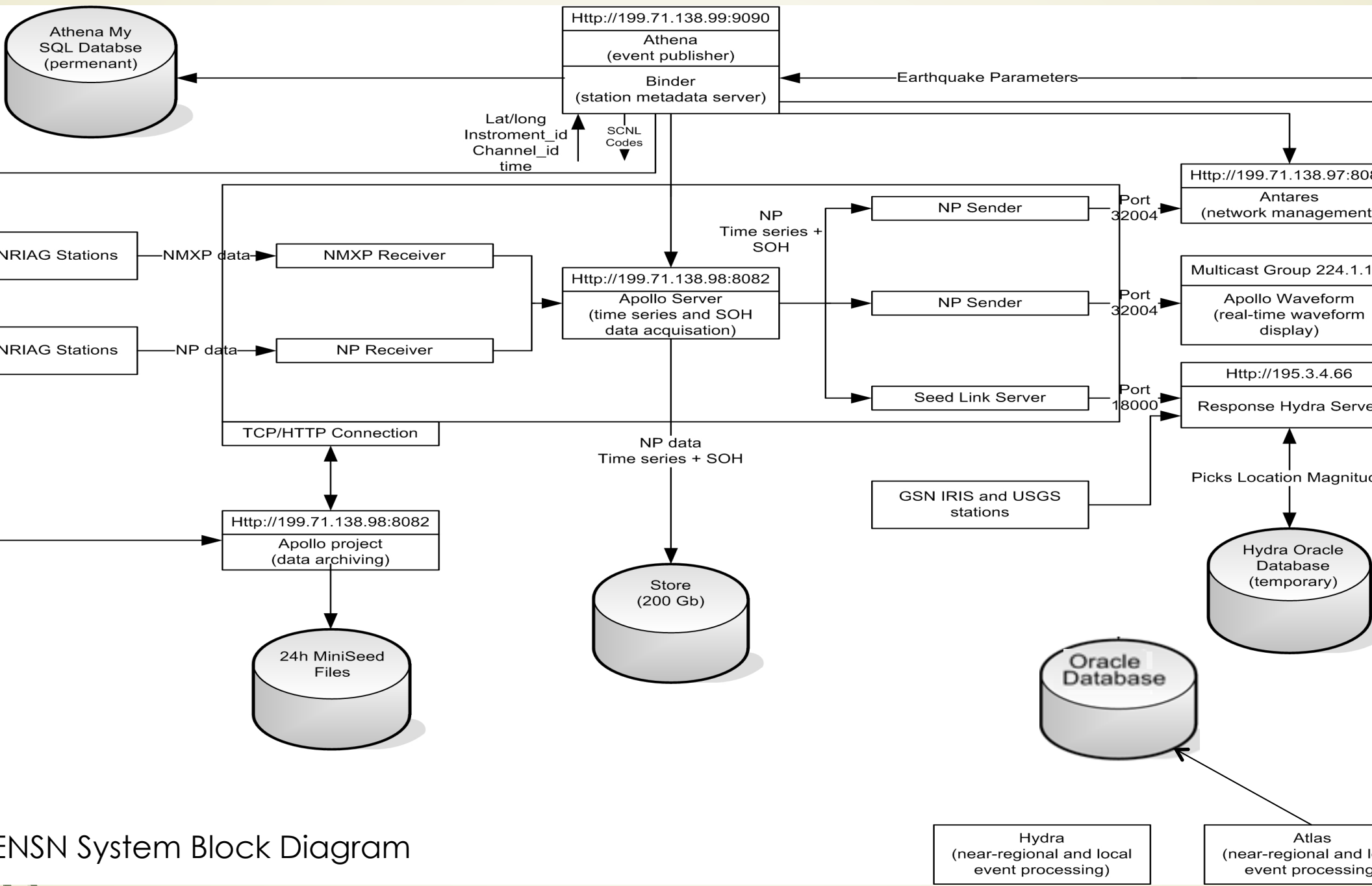
ENSN System Block Diagram

GIS map for Egypt .

- Simulate the seismological data management and analysis network.

- organizing and integrating data geographically.

- Real time processing.

- What we do ?

  - Data was collected for Cairo city(active regions , organization , highways,...etc).

  - Mapping Geographic map into database parameters.

  - Training staff of the ENSN on GIS technology.

Seismic data mining

- Decisions-makers are in desperate need to discover consistent and us patterns.

- Earthquake prediction.

- Integration with other seismic data repositories.

- What we do ?

  - Oracle database(ENSNDB) was built 1 years ago.

  - Merging old seed files from 2008 into ENSNDB to have one database.

 - Studying Data Mining Techniques and how we can apply on the seismic data.

Development of Earthquake Warning System Based On Wireless Networks

- Earthquake is a nature phenomenon with very low prediction capabilities.

- People intend to deal with the disaster and recover the losses preventing them.

- Each seismic station transmits data to the main center and the earthquake parameters will be located. But every seismic static can only transmit data at a specific time according to TDMA that makes a delay which is undesirable during earthquake disaster; also locating the earthquake parameters takes time.

Development of EWSBWN cont.

- proposing a model or framework for wireless mobile/module which can be used in seismic station transmitting or processi data or sending alarm to specific places or persons over loc GSM network or satellite.

- How we can use this wireless modem for locating earthqu automatically through 3 or more stations . The key idea t The challenge for the proposed architecture for t framework is how many logical tiers and what the role each tier that determines certain well defin procedures and functions like Cisco routers.

Development of EWSBWN cont.
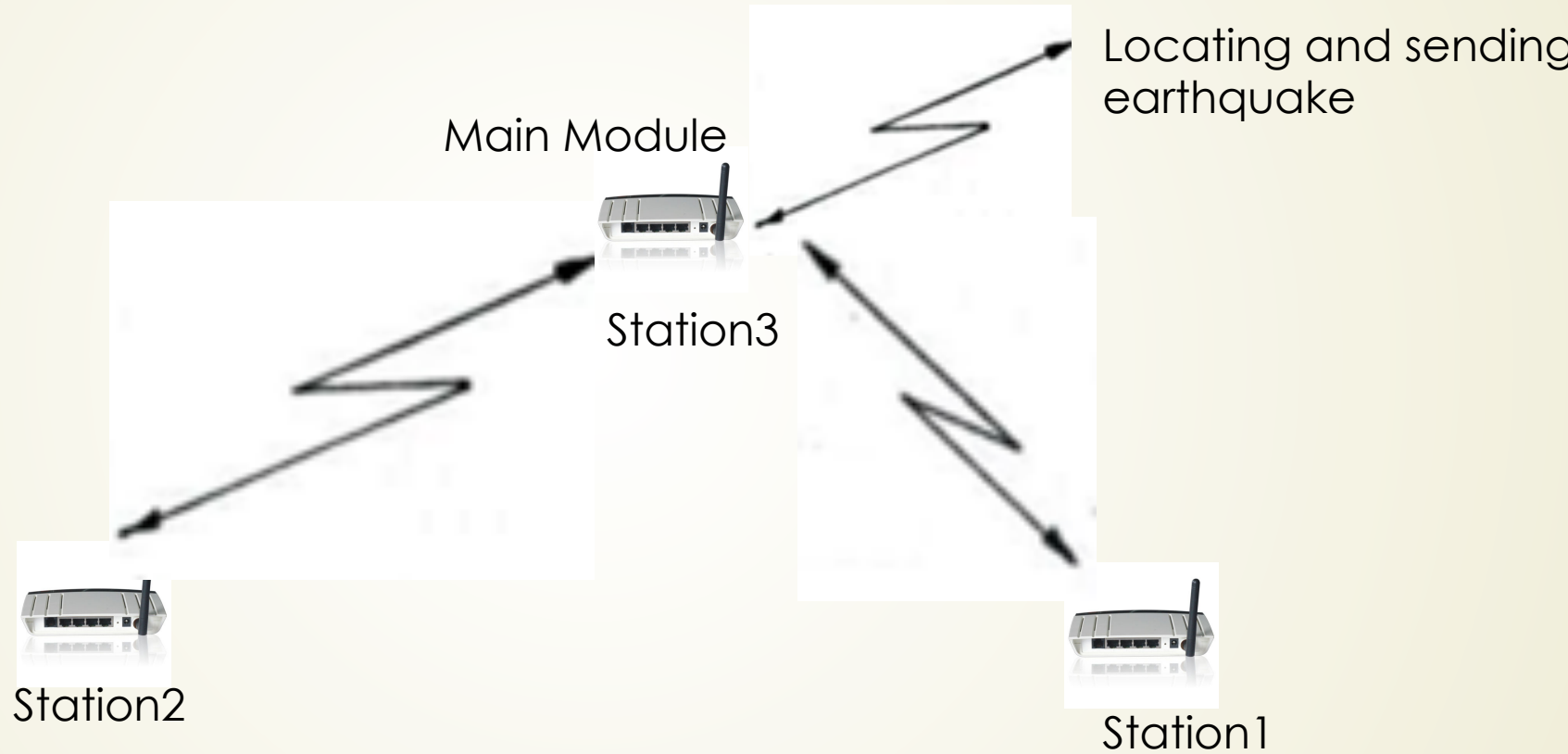
Development of EWSBWN cont.

➡ This module can be applied as a node in the wireless networks intended to any Seismic Wireless Network for fast earthquake warning.

➡ We can use this module to build automated warning wireless syste where Seismic Wireless Network can be connected to the vital organization such as nuclear establishments, pumping gas companies, underground metro, electricity centers…etc. Our visio to reduce the risk is turn off the vital systems in automatic manner during earthquake.

Development of EWSBWN cont.

- Risk reduction during earthquake disaster.

- Decision-makers in desperate need to know the time and locatio of the earthquake without delay and track earthquake's waves,

- Capability of design automated wireless system that can be used different systems.

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Thanks for listening ☺