ARA (THE ASKARYAN RADIO ARRAY)

Motivation: Detecting the GZK-flux

The GZK-mechanism as a "guaranteed" neutrino source:
- Very few protons accelerated to UHE within GZK-interaction length (most accelerators are further away from earth)
- GZK-mechanism should lead to cutoff in the UHECR spectrum
- Cutoff confirmed by the Pierre AUGER Observatory


Detection method:
- Emission of coherent radio waves from neutrino
- Cutoff

Radio waves have long attenuation length in ice (~800m), large volumes with small number of antennas

The ARA collaboration
- BELGIUM: Univ. Libre de Bruxelles.
- GERMANY: Univ. of Bremen, Univ. of Wuppertal.
- JAPAN: Chiba university.
- TAIWAN: National Taiwan Univ.
- UNITED KINGDOM: Univ. College London.
- USA: Ohio State Univ., Univ. of Delaware, Univ. of Hawaii.

ARA (THE ASKARYAN RADIO ARRAY)

SURFACE PROCESS SYSTEM

STATION CONTROLLER

The challenge - Distance: 350-meters Speed: (~3000km/s) Time precision < 100 ps

Advantages:
- 4 pairs of differential signals
- Immunity to common mode noise
- Standard high speed protocol (10/100/1000Mbps)

Disadvantages:
- Can't support more than 100 meters (100 Base-T)
- Increased signals jitter

37 stations

Spacing: 2 km

Depth under ice surface: 200 m
Surface coverage: ~160 km²
Ice thickness below: ~3000 m

Each station:

16 + 4 sub-firm antennas (sensitive between 250 and 800 MHz):
- 8 vertically polarized
- 8 horizontally polarized
- 4 calibration pulsers (v-pol + h-pol)
- X surface antennas

DATA AND CLOCK DISTRIBUTION SYSTEM

Cable driver:
- Amplifying the incoming clock to transfer it
- +800 ps rise time, 25 ps output jitter
- +5 Vpp output
- Power consumption: 320 mW

Cable equalizer:
- Equalization
- OC-rejection
- +750 mVpp output
- Power consumption: 255 mW

Clock conditioner:
- Loop filtering
- Jitter cleaning
- Clock distribution
- +200 s output jitter
- Power consumption: 578 mW

With synchronized clock, stable connection can be established between two PHY via 250 meters cat5 cable.

Performance:
- Original clock: yellow
- Recovered clock: turquoise

Future plan

Optical data and clock distribution system (2.5Gbps)

Univ. of Maryland, USA: Univ. of Wisconsin, USA;
Univ. of Hawaii, USA;
Univ. of Maryland,
Univ. of Wisconsin Madison.

Interuniversity Insitute for High Energies (IIHE), Brussels

Kael Hanson, Thomas Meures, Yifan Yang

An Extended-Range Ethernet and Clock Distribution Circuit for Distributed Sensor Networks