

Phased Arrays 4: Types of Phased Arrays

Roger H. Varney

†Center for Geospace Studies
SRI International

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Passive Phased Arrays: Jicamarca

- One transmitter feeds entire array



Passive Phased Arrays: Jicamarca



Active Electronically Steerable Phased Arrays

The AMISR UHF System

AMISR AEU = Tx/Rx Unit

- 500 W solid state transmitter
- Phasing control
- Status monitoring
- 4096 AEU's/AMISR radar face

Antenna Element Unit (AEU)



32/panel

AMISR Panel

- 32 Antenna Element Units arranged in hexagonal pattern
- 3.5 x 2 meters; 19.8 dBi / panel
- 16 kW peak power per panel
- Basic system building block for AMISR
- Embedded linux controller



Panel (with PCU)



AMISR UDU

- 400 Hz JetPower converters
- Remote power control units
- Fiber distribution system

Face



Utility Distribution Unit (UDU)

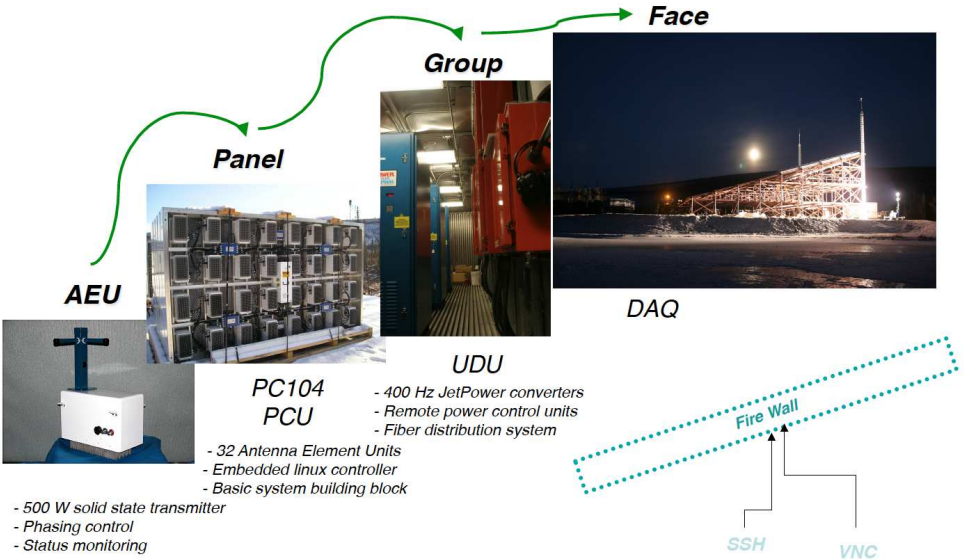


AMISR Control System (ACS)

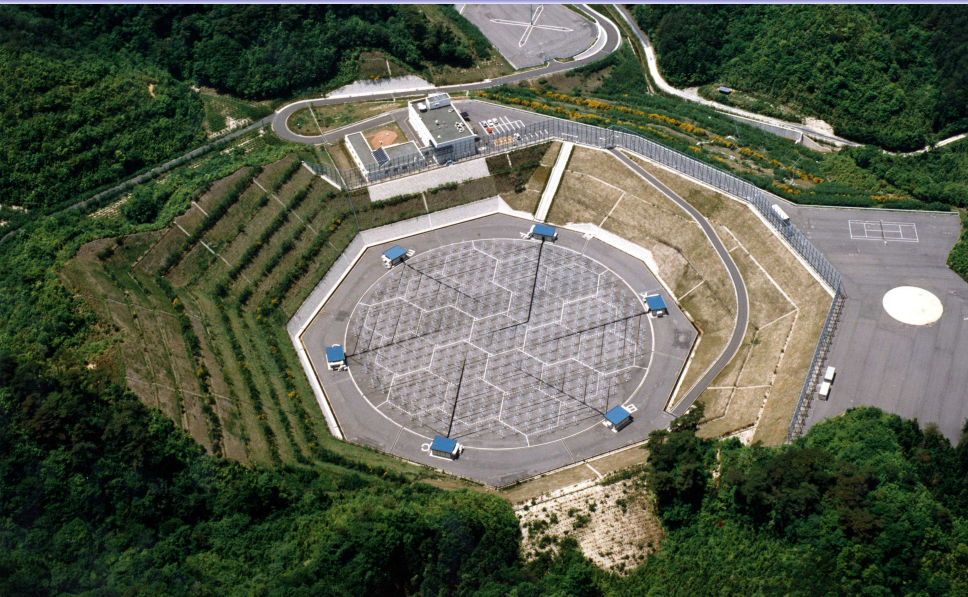
AMISR ACS

- Flexible transmit and receive system
- Completely remotely controlled
- Experiments run off a scheduler

Advanced Modular Incoherent Scatter Radar



MU Radar



MU Radar Cabling



MU Radar Cabling

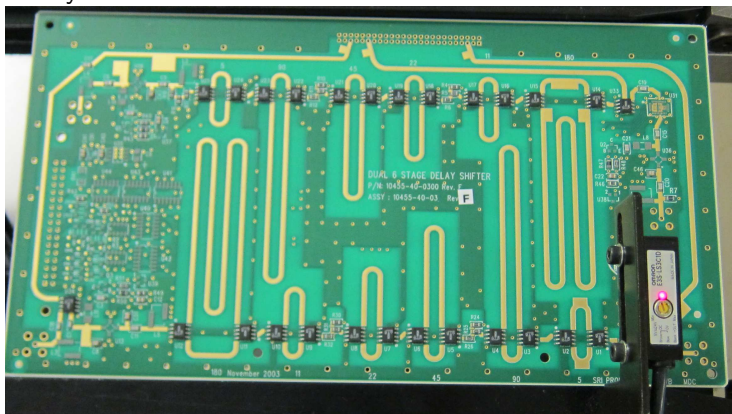


MU Radar Power Amplifiers



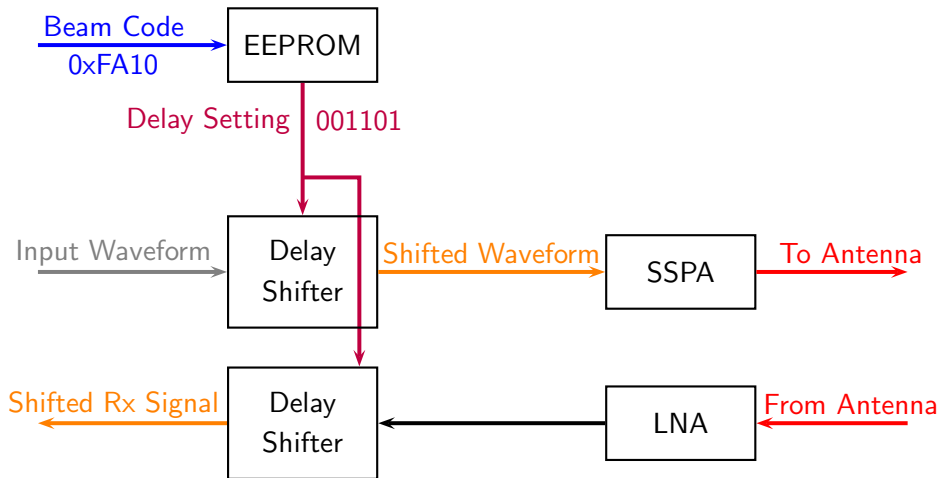
Electronic Steering with Delay Shifters

AMISR Delay Shifter

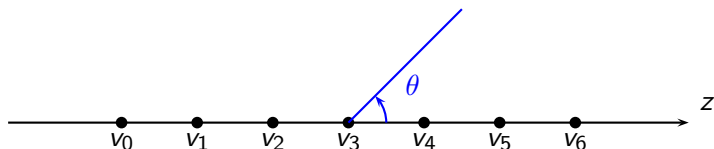


- $2^6 = 64$ steps spaced by $\pi/32 = 5.625^\circ$

Conceptual Diagram of Steering with AMISR



Digital Beam Forming



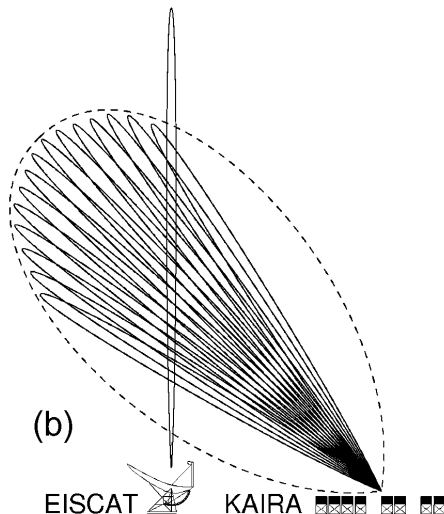
On reception:

- Digitize the signals v_n on every antenna (**expensive!**)
- Synthesize any beams you want by forming different linear combinations in software/firmware (**computationally intense!**)
- Allows you to form custom beam patterns \rightarrow look at signals of interest while nulling interference.
- Allows you to form any number of different radiation patterns \rightarrow look in multiple directions at once.

Hybrid approach:

- Digitize signals from subarrays instead of individual antennas
- Accept limited range of steering on reception

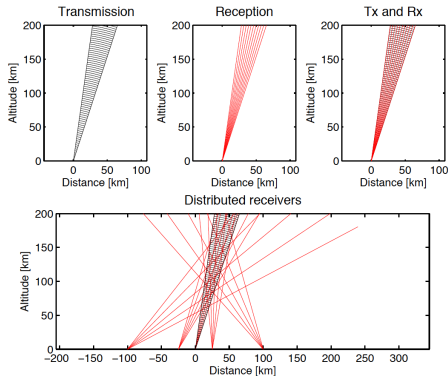
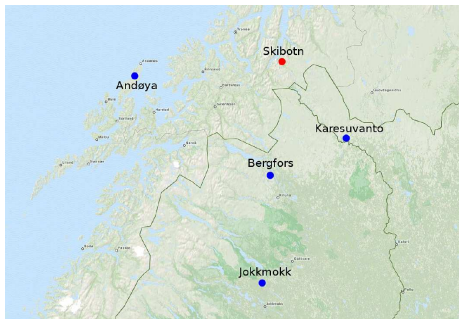
Digital Beam Forming in Multi-static Radar Experiments



KAIRA = The Kilpisjärvi
Atmospheric Imaging
Receiver Array

McKay et al. (2015)
10.1109/TGRS.2014.2342252

Major planned facility:



Operational 2022?

Summary of Types of Phased Arrays

- Transmitter architecture
 - Passive: One high power transmitter feeds whole array
 - Active: Small transmitters for each element distributed throughout the array
- Phasing architecture
 - Manual changing of cables
 - Electronic steering with delay shifters
 - Digital beam forming