ngVLA Project Update

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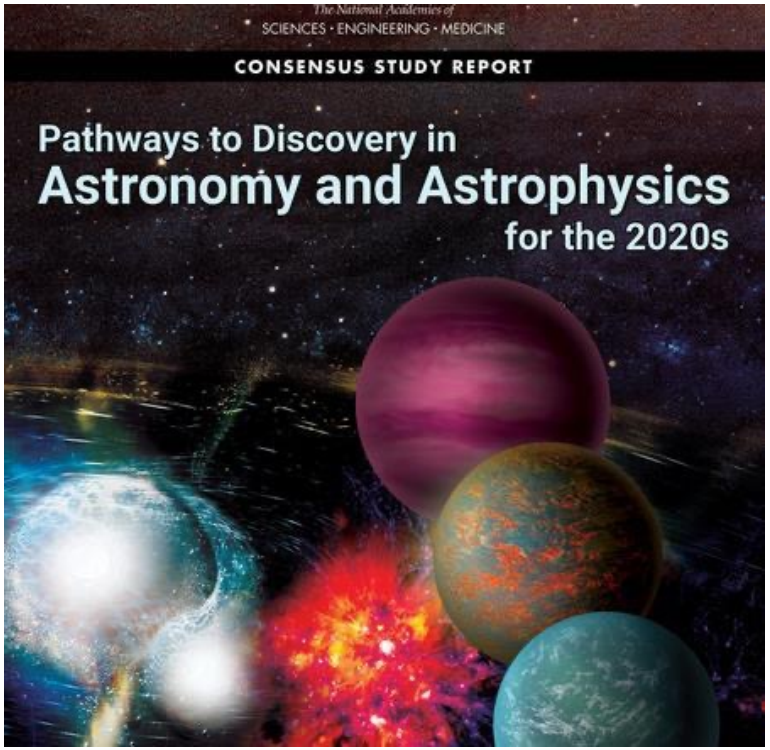
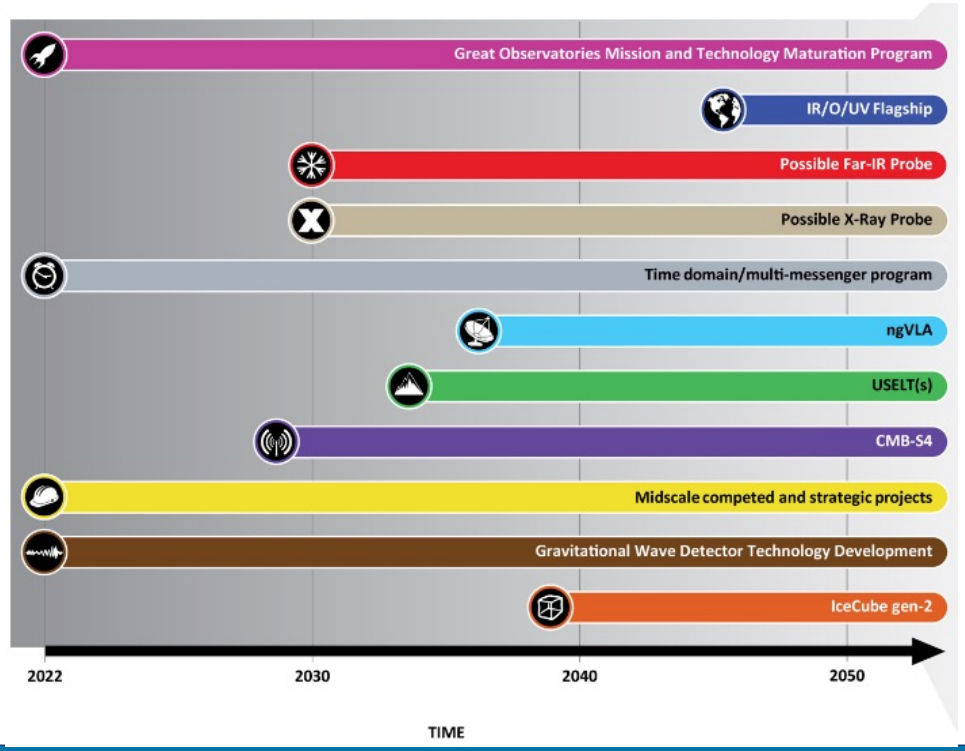
South American African Astronomy Coordination Committee, 5/2025

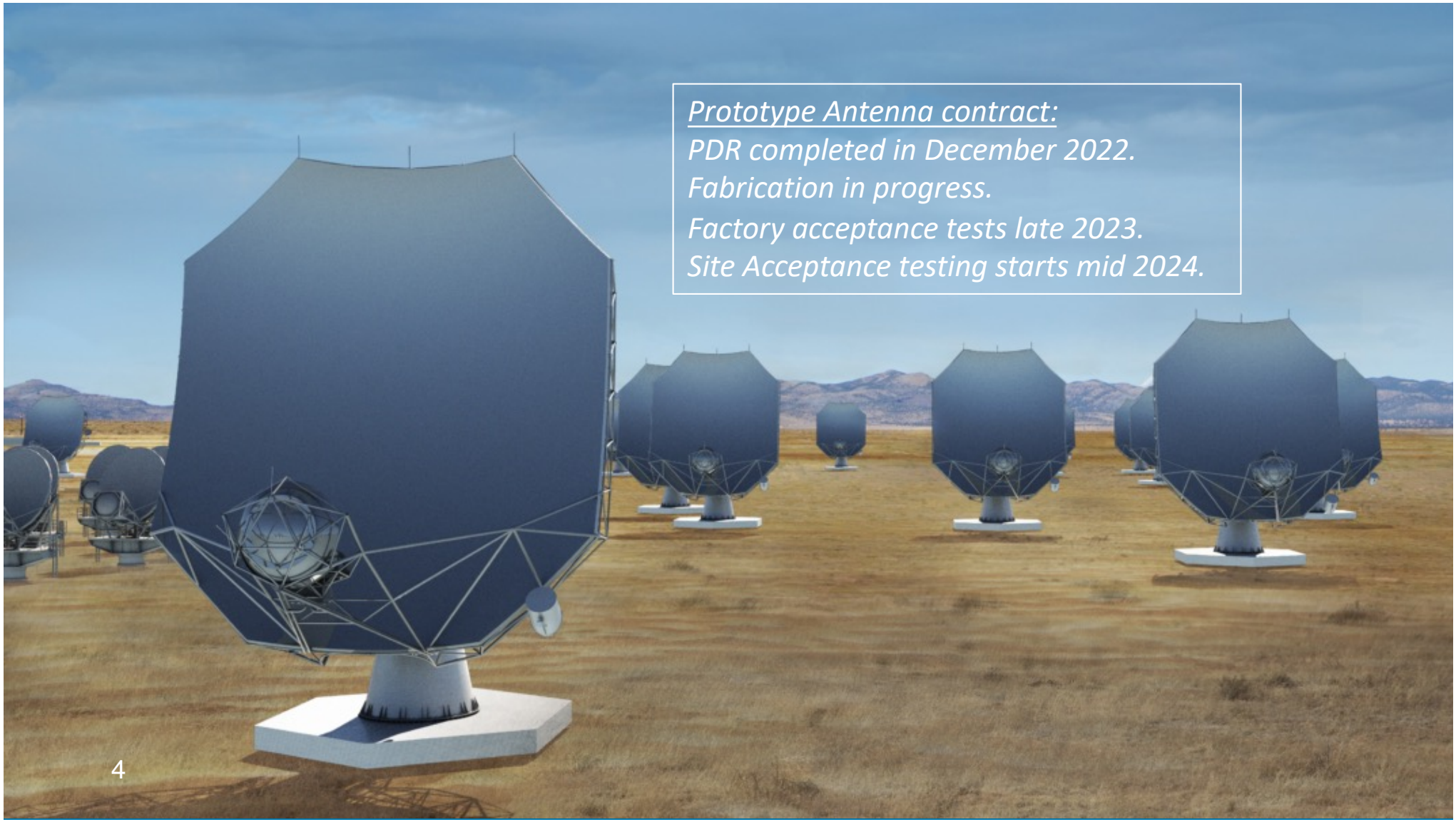
A next generation VLA

- Scientific Frontier: thermal imaging at milli-arcsecond resolution
  - 10x Sensitivity, 10-100x Resolution of VLA
  - Frequency range: 1.2-116 GHz
- Bridge SKA – ALMA
- Proposal driven, pointed telescope
  - Deep single fields, small area mapping.
- Centered on present location of VLA in Southwest USA
- Under evaluation as part of the Astro2020 Decadal Survey.

Astro2020 identified the ngVLA as a high-priority large, ground-based facility whose construction should start this decade.





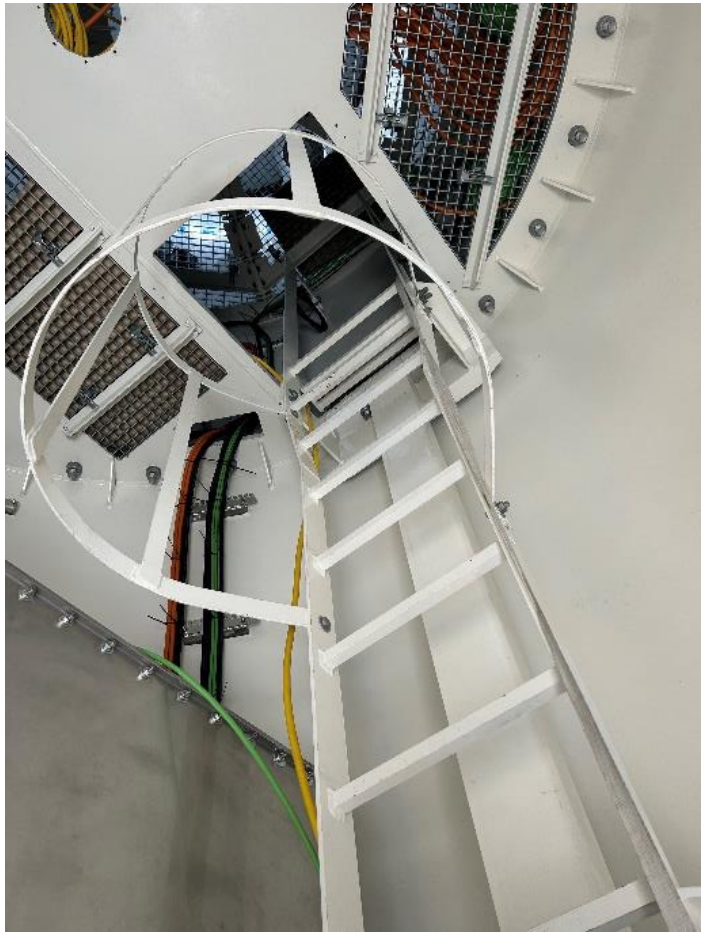

Prototype Antenna contract:
PDR completed in December 2022.
Fabrication in progress.
Factory acceptance tests late 2023.
Site Acceptance testing starts mid 2024.

We're Live!

You're looking at a live view of the site at the VLA where the prototype ngVLA antenna is to be constructed. The camera is mounted on our Control Building and updates every 15 seconds. Inside the gravel circle you can see three circular antenna pads that were used during prototyping for the ALMA project. The ngVLA prototype antenna is destined for the third pad from the camera. In the distance you can see the VLA antennas currently residing on the east arm of the VLA.

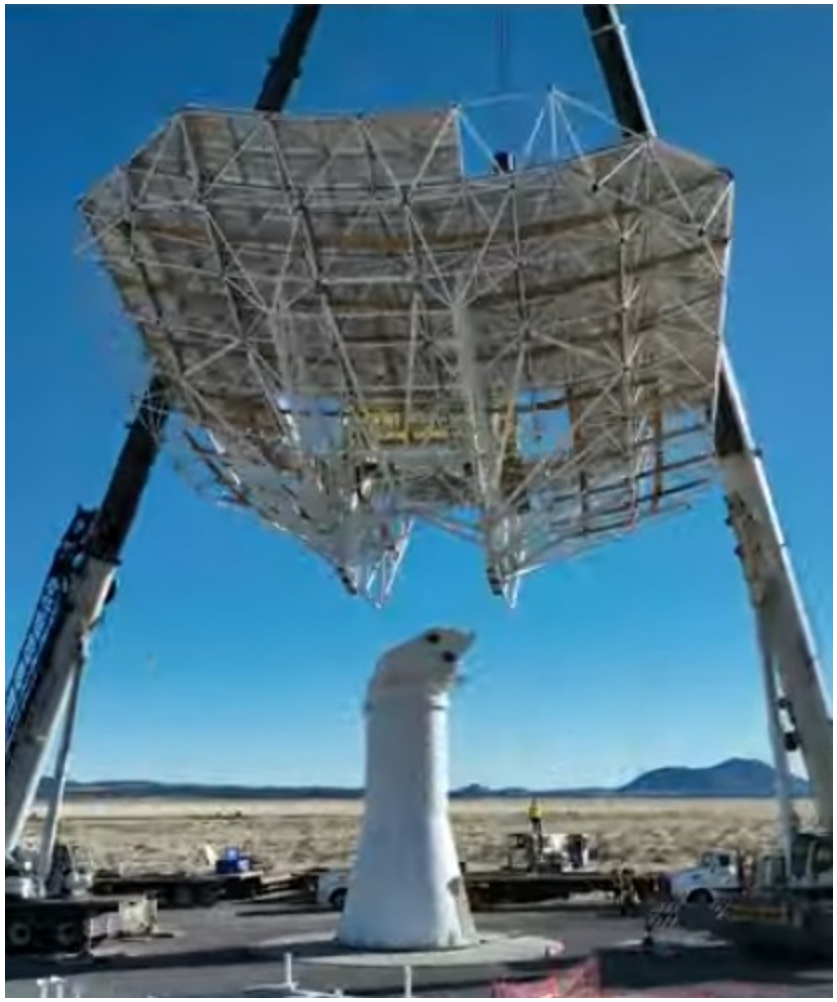
ngVLA prototype; installing a network switch to connect the prototype to the VLA network.

ngVLA prototype;
inside the pedestal.



ngVLA prototype; ready to mount the dish on the pedestal.

ngVLA prototype; lifting the dish to mount on the pedestal.



ngVLA prototype; dish on the pedestal.

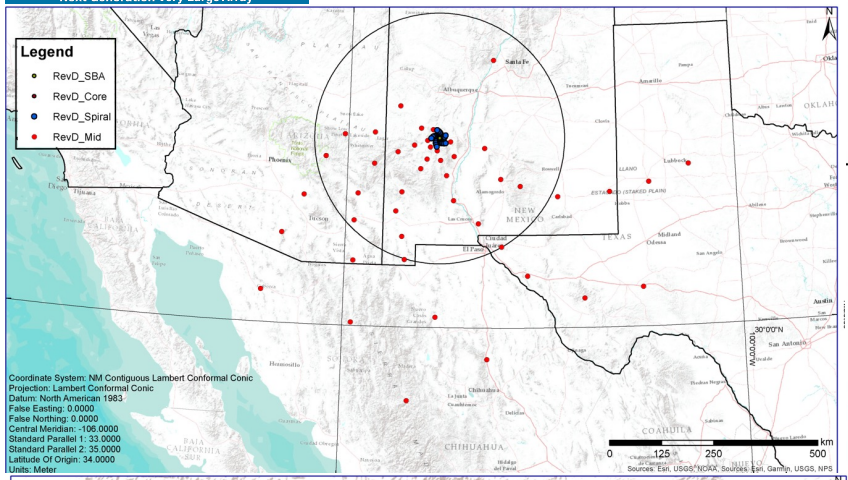
ngVLA prototype turned over to NRAO
by Mtex Antenna Technology to begin testing
4/24/2025.

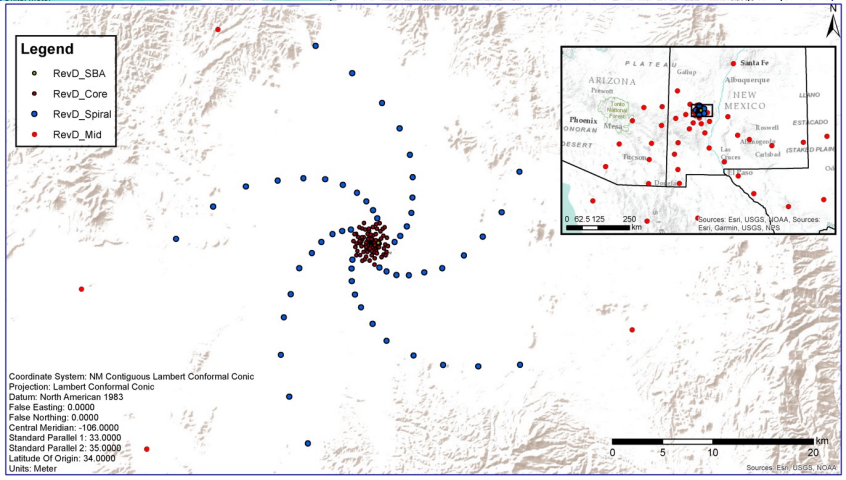
- **1.2 - 116 GHz** Frequency Coverage
- **Main Array**: 214 x 18m offset Gregorian Antennas
  - Fixed antenna locations across NM, TX, AZ, MX.
- **Short Baseline Array**: 19 x 6m offset Greg. Antenna
  - Use 4 x 18m in TP mode to fill in (*u, v*) hole
- **Long Baseline Array**: 30 x 18m antennas located across continent for baselines up to 8860km

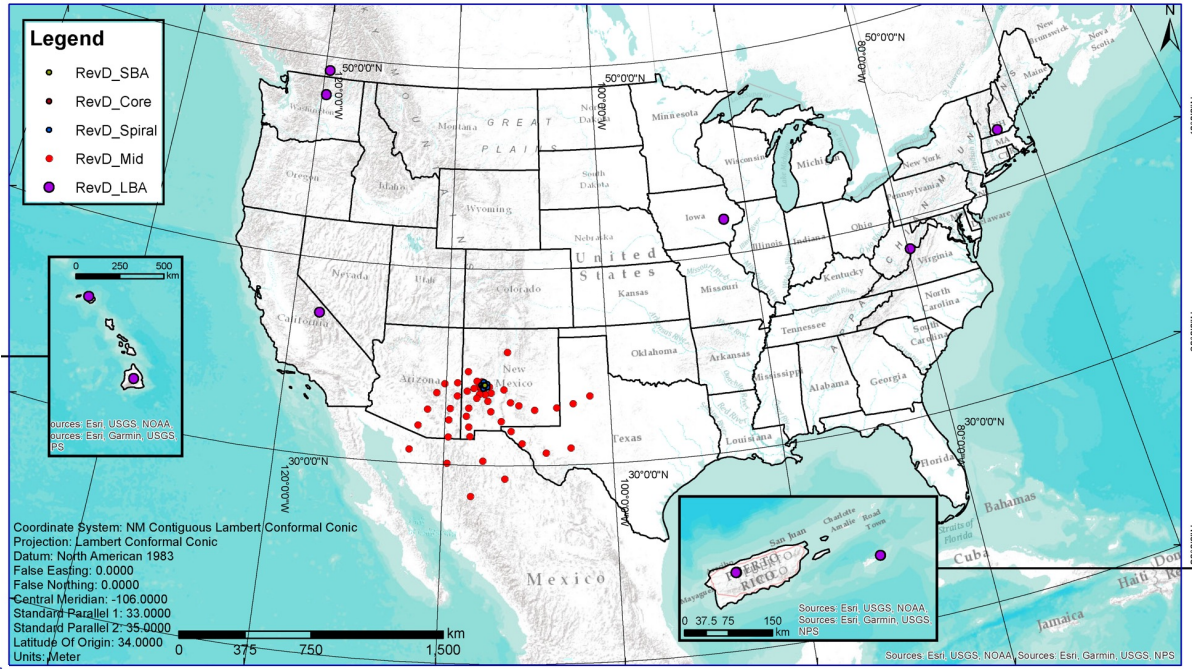
Band #	Dewar	f_L GHz	f_M GHz	f_H GHz	f_H: f_L	BW GHz
1	A	1.2	2.35	3.5	2.91	2.3
2	B	3.5	7.90	12.3	3.51	8.8
3	B	12.3	16.4	20.5	1.67	8.2
4	B	20.5	27.3	34.0	1.66	13.5
5	B	30.5	40.5	50.5	1.66	20.0
6	B	70.0	93.0	116	1.66	46.0

ngvla
Next Generation Very Large Array

Distribution of Antennas







Long Baseline Antenna Locations

Qty	Location	Notes	Qty	Location	Notes
3	Puerto Rico	Arecibo Site	3	Green Bank, WV	GBO
3	Immokalee, FL	New Site	3	Brewster, WA	VLBA Site
3	Kauai, HI	Kokee Park Obs.	3	High Park, WY	New Site
3	Hawaii, HI	Not MK Site	3	North Liberty, IA	VLBA site
3	Hancock, NH	VLBA Site	3	Owens Valley, CA	VLBA site

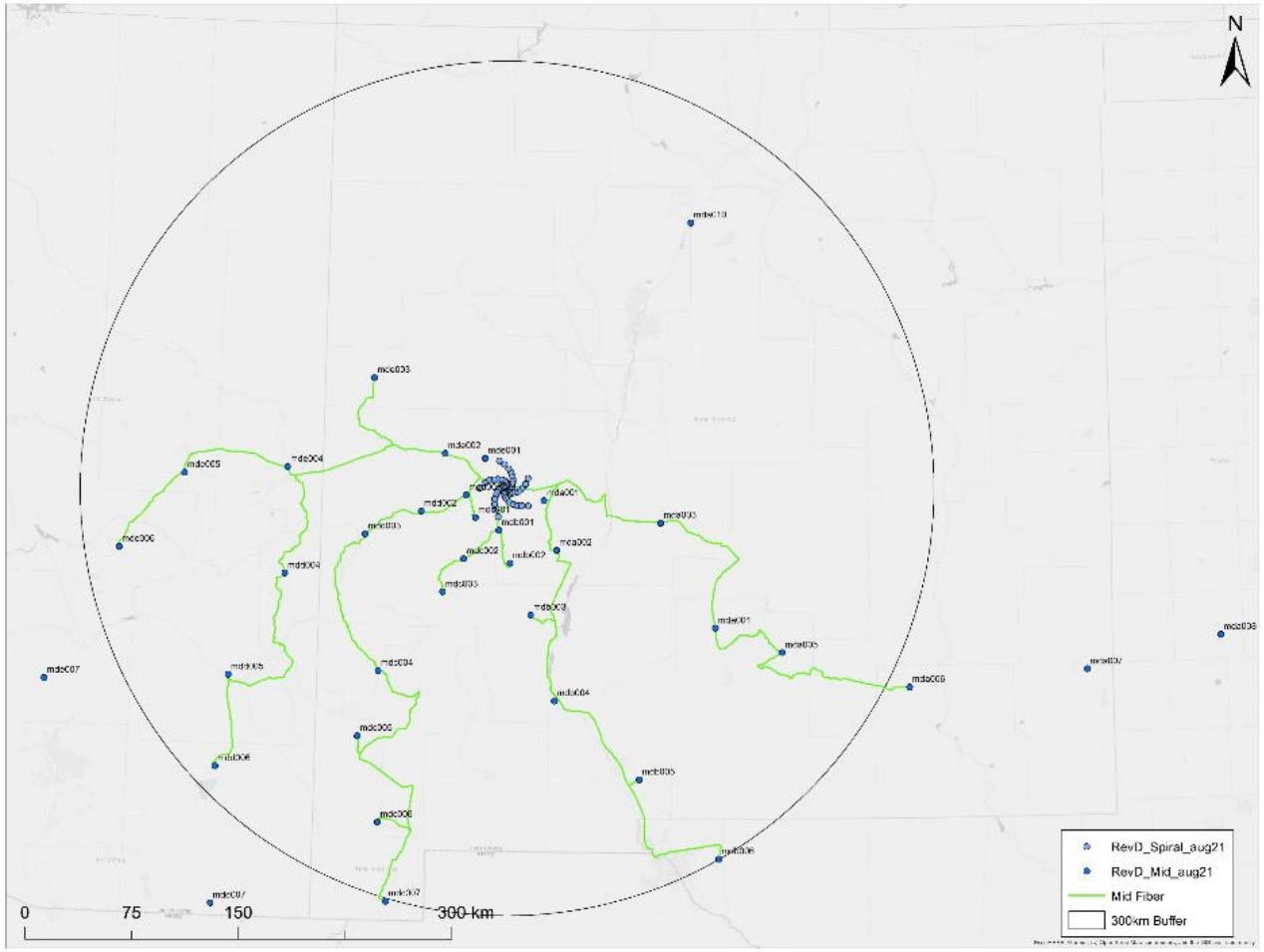
NSF AUI NRAO

Antenna Data Rates

- Real-time correlation of all 244 18m array elements.
- Up to 20 GHz of instantaneous bandwidth per polarization.
- 8-bit digitization at all bands.
- 723 Gbps per antenna, over 2x400 Gbps links on ngVLA installed fiber.
- Requantized and formatted for data transmission on packet-switched networks
- ~3 antenna LBA sites = ~2.4 Tbps link (goal, TBC)

Main Array Fiber Optic Network

- Dedicated point-to-point fiber links for ~196 antennas in NM within ~300 km radius of core.
- ISP connected elements beyond inner stations.
- ISP connections to LBA sites.
- Leased fiber vs spectrum vs bandwidth (TBD)



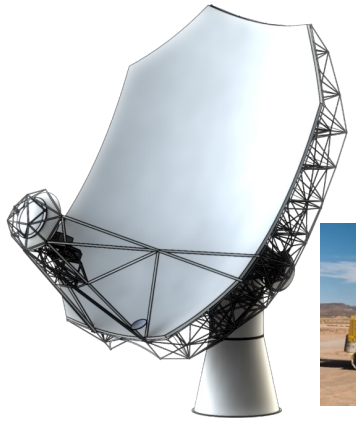
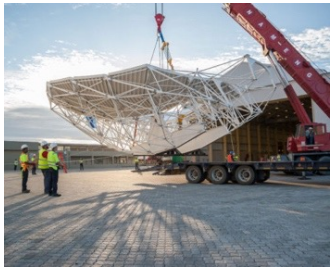
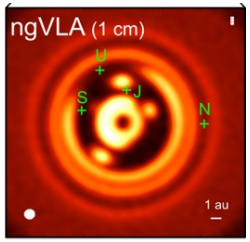
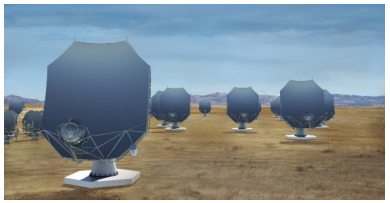
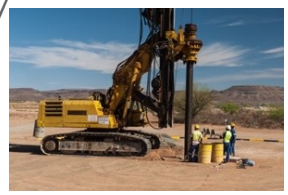
Data Processing

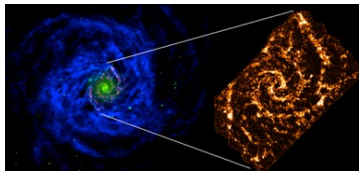
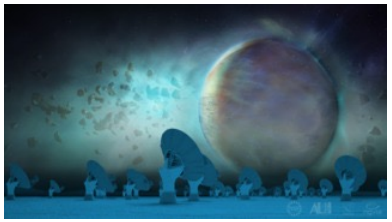
- **Post Processing**: storing the raw visibilities will be possible.
  - Data processing is post-facto, with system sized for average throughput.
  - Data Rates:
    - Average – 8 GB/s.
    - Peak - 128 GB/s.
- **Computing:** Challenging, but feasible with current technology.
  - Sized by time resolution, spectral resolution, and multi-faceting in imaging.
  - ~60 PFLOPS/s (inc. efficiency factors) matches average data throughput.

Serving Data to Users

- “Science Ready Data Products” Operations Model
- Process-in-place for data to most PIs.
- Data products requested in proposal; Pipeline interaction possible.
- Low-level data products (visibilities, flagging tables)
- High-level data products for Standard Observing Modes (e.g., calibrated image cubes)
- Archive reprocessing interface for users.
- Data Reduction S/W; Data Analysis S/W
- Distributed archive and re-processing capacity amongst international partners? (ALMA-like model)

Project Timeline

2019 — ngVLA Submission to Astro2020

2021 — Astro2020 Recommendation Published

2024 — Submit ngVLA Proposal to NSF/MREFC

2027 — Prototype Delivered to VLA Site; Complete NSF/MREFC FDR

2028 — ngVLA Construction →

2031 — Initiate ngVLA Early Science (> VLA capabilities)

2038 — Achieve Full Science Operations

ngvla
Next Generation Very Large Array