



ARA Infrastructure: what's new?

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arawireless.org

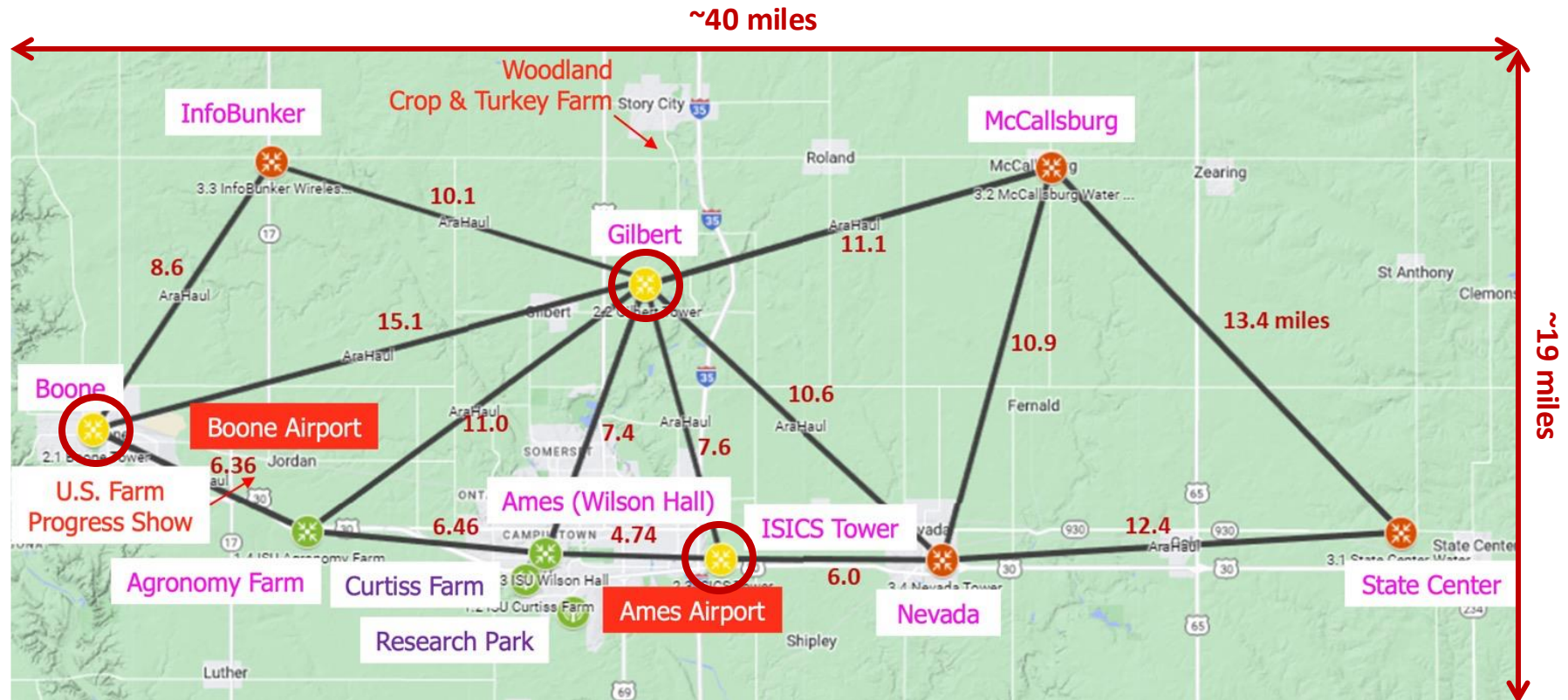
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University of California, Irvine

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INTERNATIONAL
COMPUTER SCIENCE
INSTITUTE
Berkeley
UNIVERSITY OF CALIFORNIA

ARA Deployment



- Phase 1
 - 4 BS sites (marked in **green**) completed in 2023 and are fully operational
- Phase 2
 - 3 new BS sites (circled in **red**) completed in 2024 and are fully operational
- Phase 3
 - InfoBunker site – in progress (marked in **orange**)

Two Wireless Experimental Platforms

- **AraHaul:** multi-modal, long-distance, high-throughput x-haul

- Terrestrial communications

- FSOC (AraOptical)
 - mmWave (Aviat WTM 4800)
 - microwave (Aviat WTM 4200)
 - multi-band (WTM 4811, MB-XD)

- NTN / LEO satcom

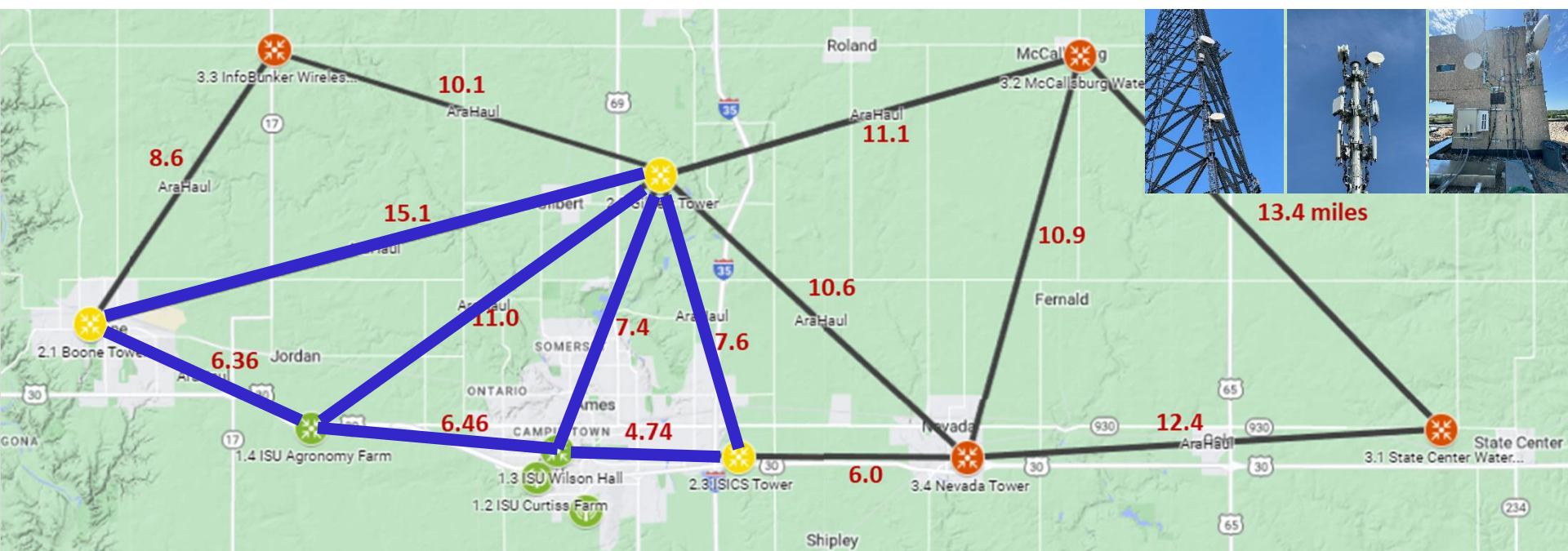
194THz	100Gbps+	15km+
71-86GHz	20Gbps	15km+
11GHz	2.5Gbps	20km+
11,71-86GHz	2.5-20Gbps	15km+
10-30GHz	100Mbps	across planet

- **AraRAN:** high-throughput COTS & SDR systems

- low-UHF mMIMO (Skylark)
 - mid-band (Ericsson, NI)
 - mmWave (Ericsson)

460-776MHz	100Mbps+	10km+
3.4-3.6GHz	600Mbps+	4km+
27.5-28.35GHz	2Gbps+	400m+

Phase 1 & 2 AraHaul Links



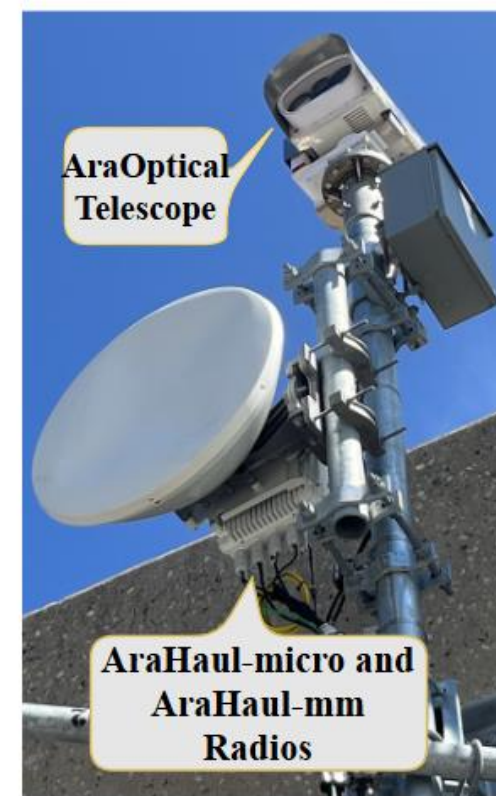
- AraHaul
 - ▢ Mesh topology
 - ▢ 7 links
 - ▢ Diameter tripled: 6.5 to 18+ miles

AraHaul Phase 1	Aviat WTM 4811	Aviat MB-XD	Aviat 4200
Ag Farm – Wilson Hall	WTM 4811 (+FSOC)		

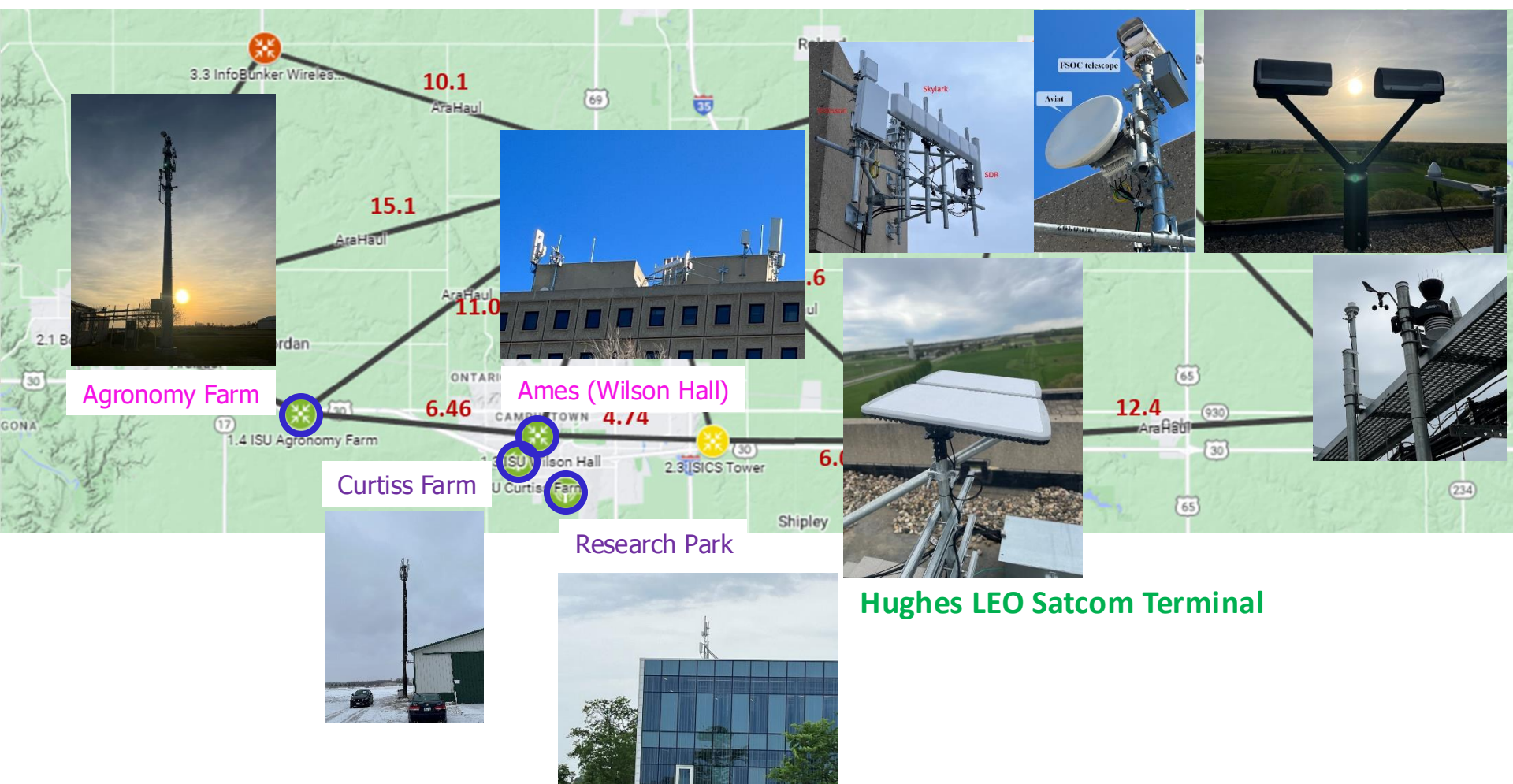
AraHaul

■ AraOptical

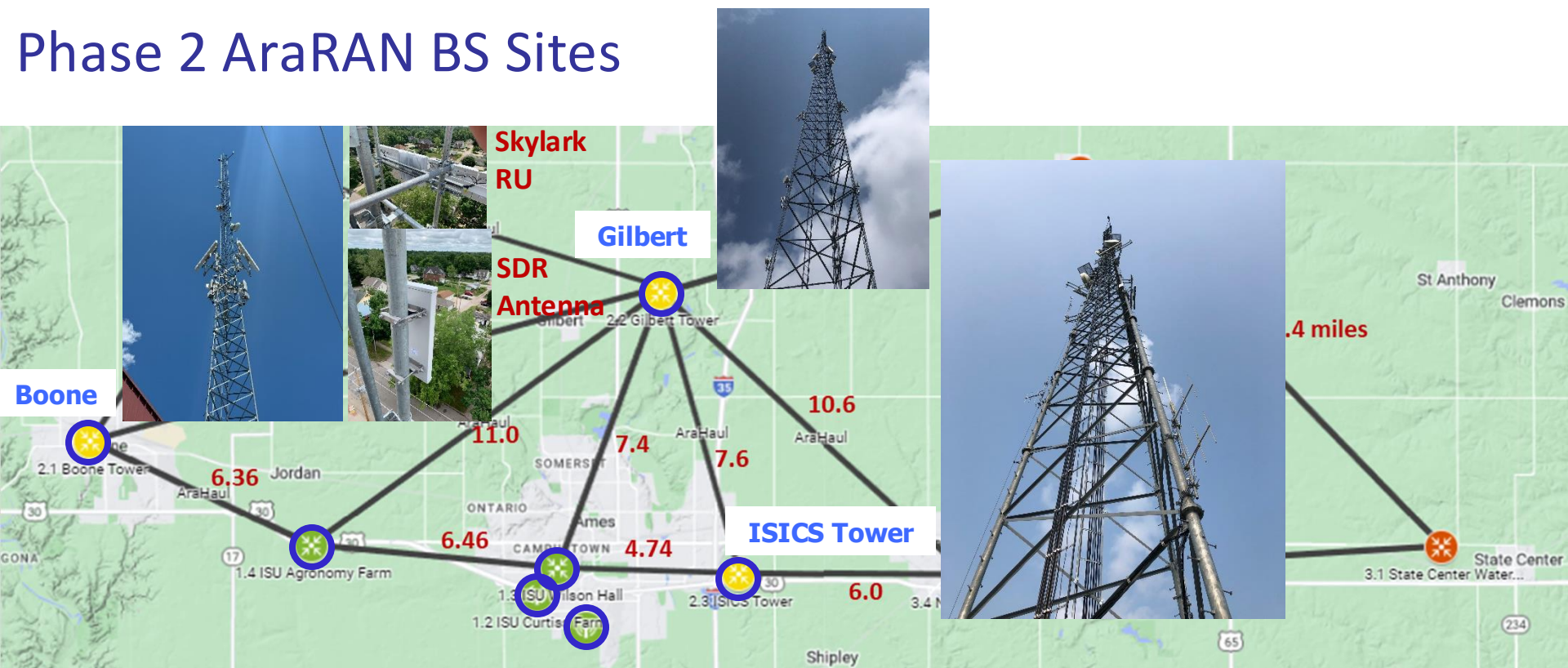
- Long-range, high-capacity terrestrial FSOC system
- A first-of-its-kind outdoor 10+ km FSOC x-haul system
- Operational frequency range: 191.7-194.8THz
- Supports up to 10 Gbps per channel, 16 channels in parallel
- **Recent measurement: 2.92 Gbps on a single channel**
- Experimental platform for future FSOC research
 - Measurement study of the FSOC link behavior over long distance
 - 2 more links in progress -> FSOC network



Phase 1 AraRAN Base Station (BS) Sites



Phase 2 AraRAN BS Sites



AraRAN Phase 1 & 2	Skylark mMIMO: 460-776MHz, 40MHz	NI N320: 3.4-3.6GHz, 200MHz
Wilson Hall	✓	✓
Research Park		✓
Curtiss Farm		✓
Agronomy Farm		✓
Boone	✓	✓
Gilbert	✓	✓
ISICS Tower	✓	✓

- **Skylark**
 - Coverage from about 55 to 290 mile²
 - Boone (west), Nevada (east), Story City (north), Kelly (south)
 - Multi-cell measurement & control study
 - New control APIs: frequency, tx power, mMIMO user grouping & beamforming, etc.
- **SDR coverage doubled**
 - Robust open-source 5G & O-RAN support
 - **Supports both OAI and srsRAN outdoor**

BS resources available to users via ARA portal

- Experiments with AraHaul link
 - Programmable Aviat radios via custom-developed API
 - FSOC - Programmable AraOptical radios and measurement study
 - Hughes OneWeb SatCom terminal – configurable and measurement study
- Experiments with AraRAN base stations
 - BS host computers
 - NI N320 SDR base stations
 - fully programmable
 - **Supports both OAI and srsRAN outdoor experiments**
 - Skylark base station – partially programmable
 - Ericsson base stations
 - Configurable via Ericsson Moshell
 - **Supports experiments on Ericsson commercial RAN + Open5GS open-source core**
 - Keysight RF sensors – spectrum sensing
 - High-precision weather stations and smart PDUs – data collection

New UE Sites in Phase 2



Residential



Portable Traffic Light

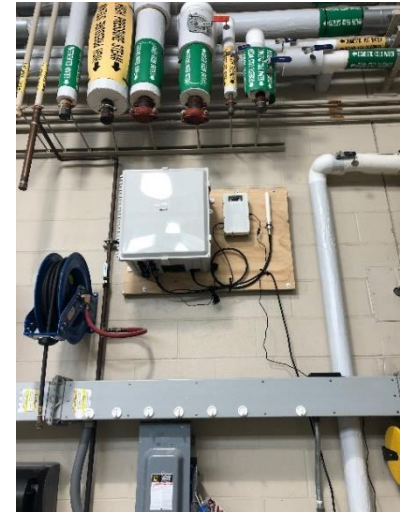
ISU Feed Mill



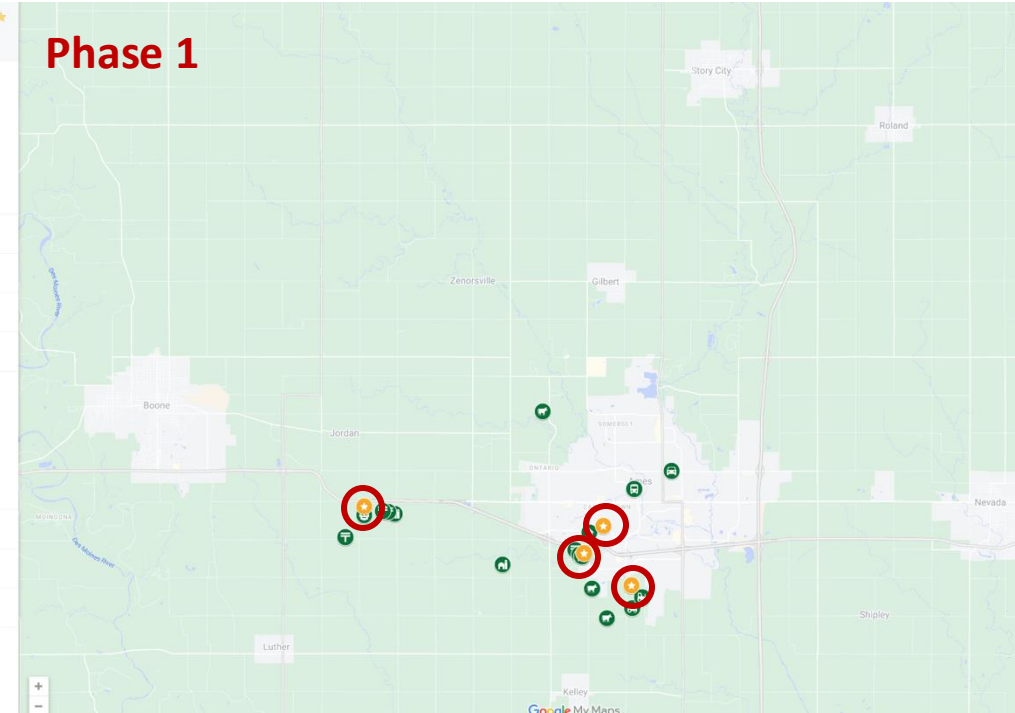
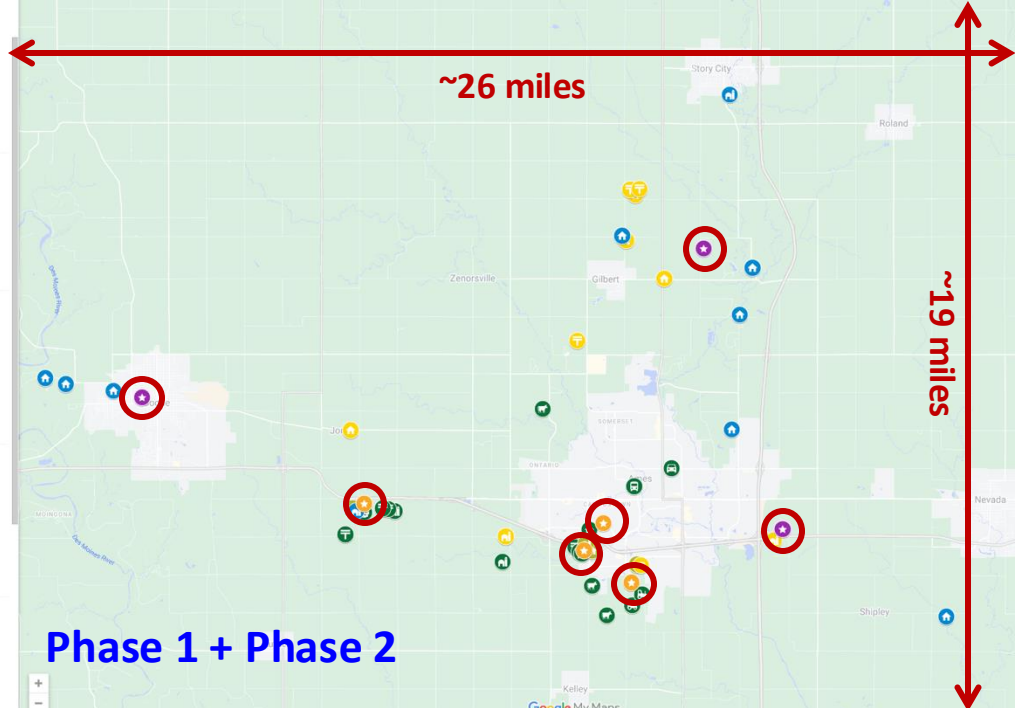
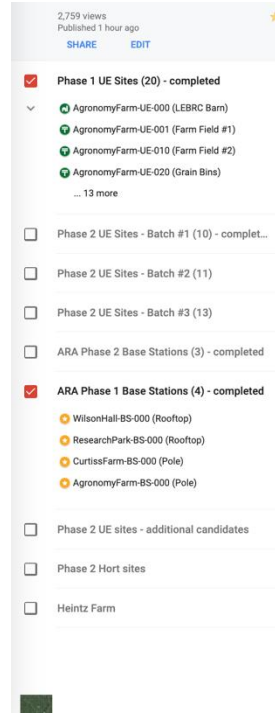
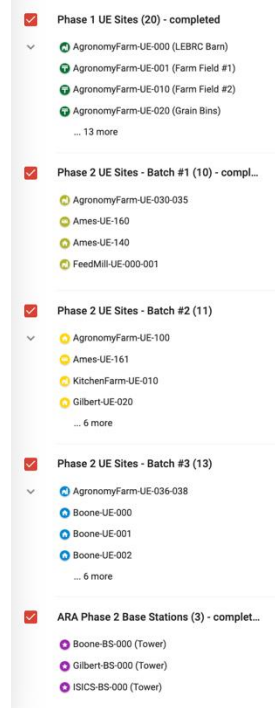
ISU Bioprocessing Plant



Amiga Robot



- **7 BSeS** deployed (circled in **red**)
- **40+ UEs** in total
- **10+ solar-powered UE trailers** in progress



UE resources available to users

- Experiments via ARA portal:
 - UE host computers
 - Skylark CPE – to work with the Skylark base station
 - NI B210 – to work with N320 base stations
 - Quectel CPE – to work with Ericsson base stations
 - NI B205 – spectrum sensing
 - **Enabling advanced wireless research:**
 - E.g., massive MIMO in TVWS, O-RAN with srsRAN and OAI, spectrum sharing
- Experiments in collaboration with ARA team:
 - Quectel CPE – to take advantage of 5G connection to the Ericsson BSs
 - **Enabling innovations in rural and agricultural applications:**
 - E.g., livestock health monitoring, agricultural machinery teleoperations