6G Research and Precision Agriculture

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6G Wireless Research and Applications

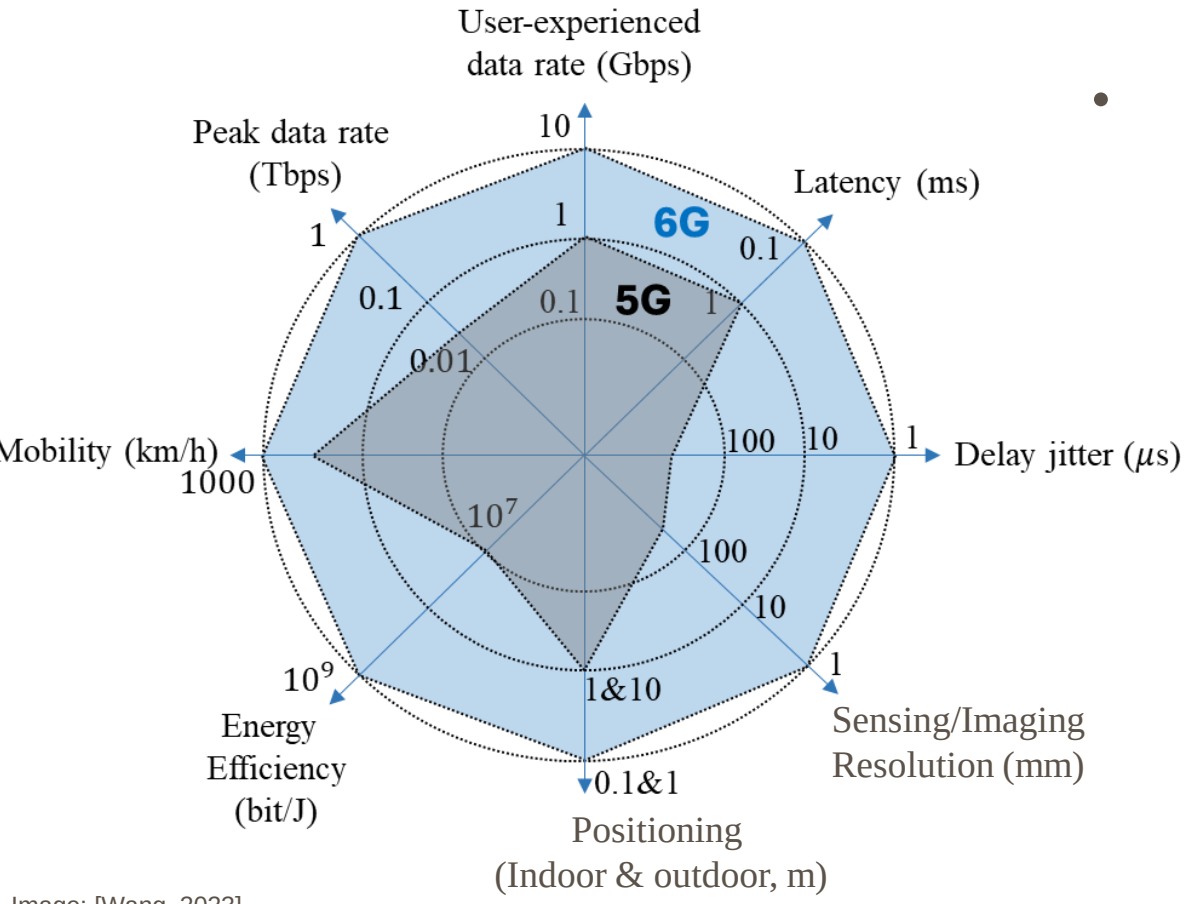

Image: [Wang, 2023]

- Purdue has a long history of early contributions that have revolutionized access
  - **2G** – mathematical models of wireless channels, CDMA contributions
  - **3G** – space-time coding, adaptive modulation
  - **4G** and **5G** – feedback precoding, rank adaptation, opportunistic scheduling, millimeter wave,
  - **6G** – machine learning for comm, new multiple access

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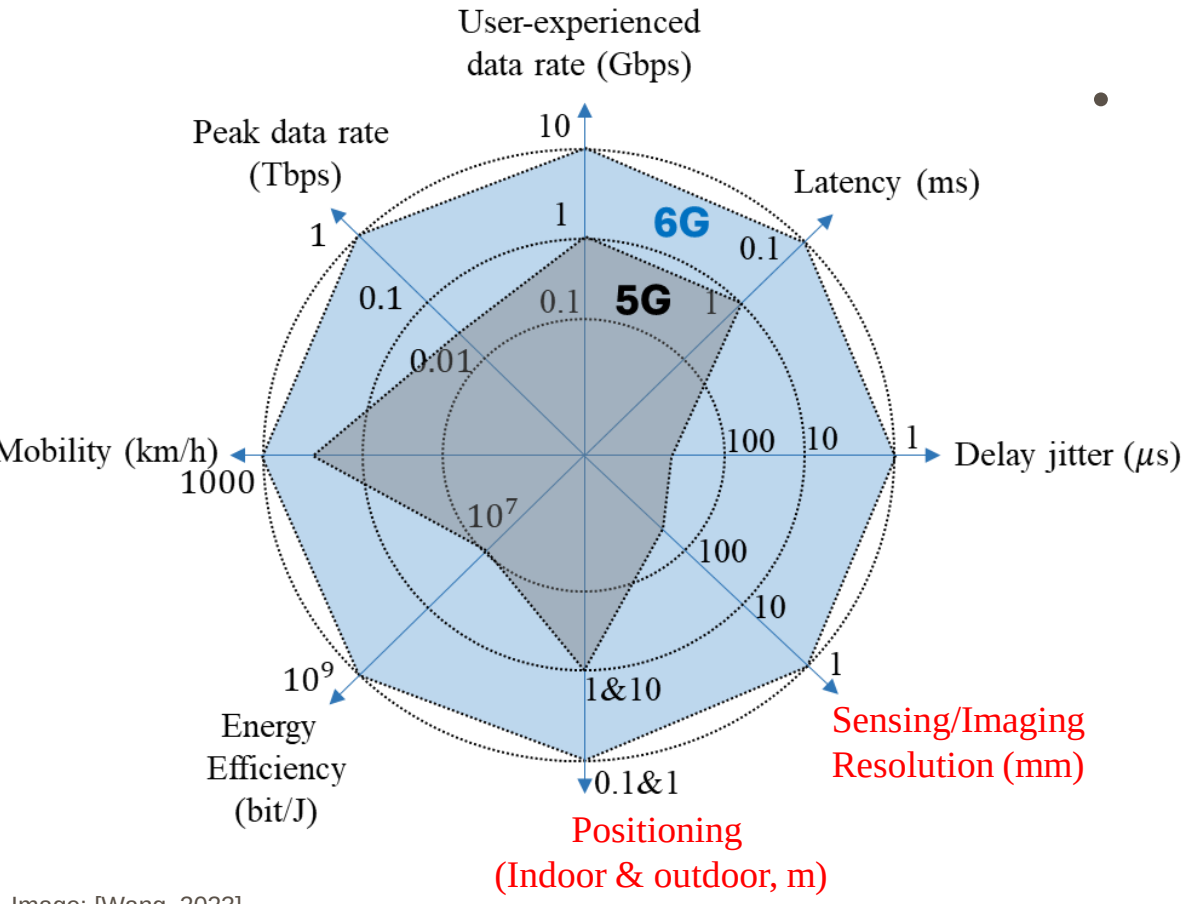
6G Wireless Research and Applications



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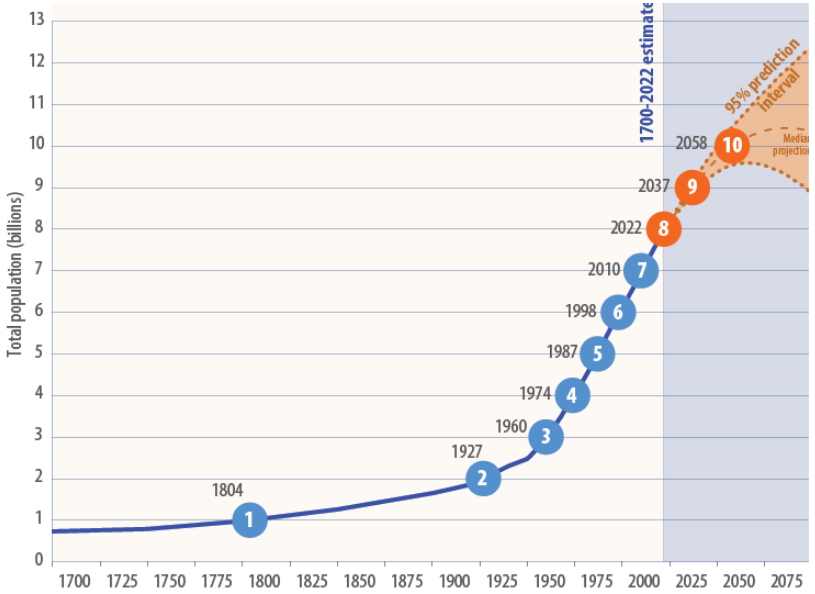
Population Growth and Shrinking Farmland

Global population 1700-2022 and estimates 2022-2100



Source: United Nations, DESA, Population Division (2022). World Population Prospects 2022.

Note: The solid blue line is the estimates from 1700 to today, the dotted red line the projection for the future up to 2100, and the dashed red line the upper and lower bounds of the 95% prediction interval for the projections.

Farmland per capita

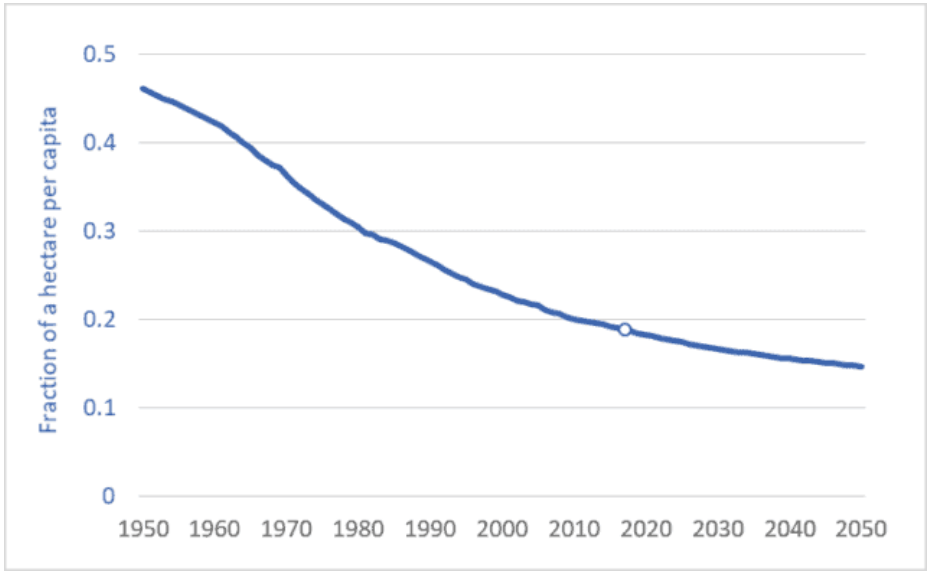


Image: https://www.darrinqualman.com/per-capita-farmland/

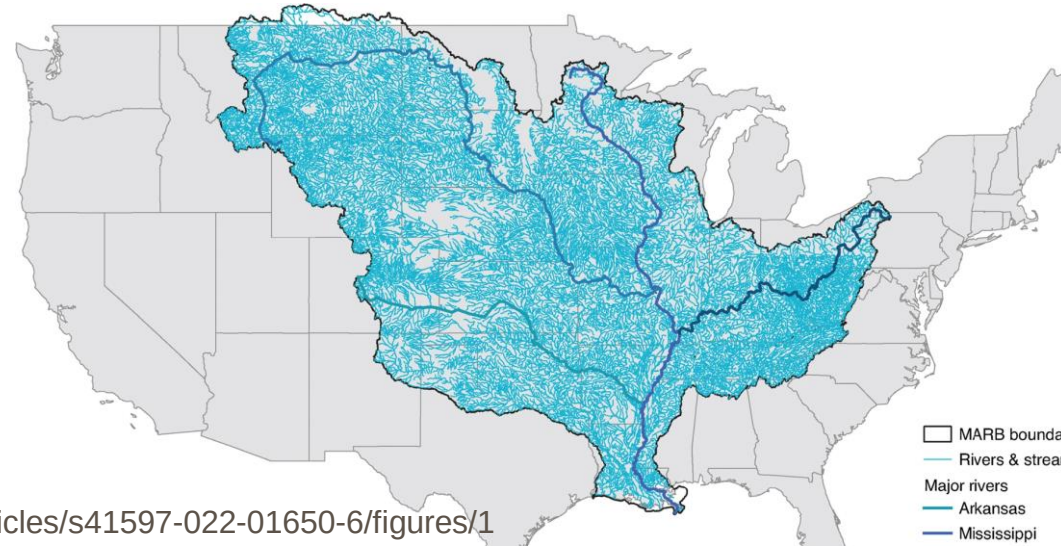


Image: https://www.nature.com/articles/s41597-022-01650-6/figures/1

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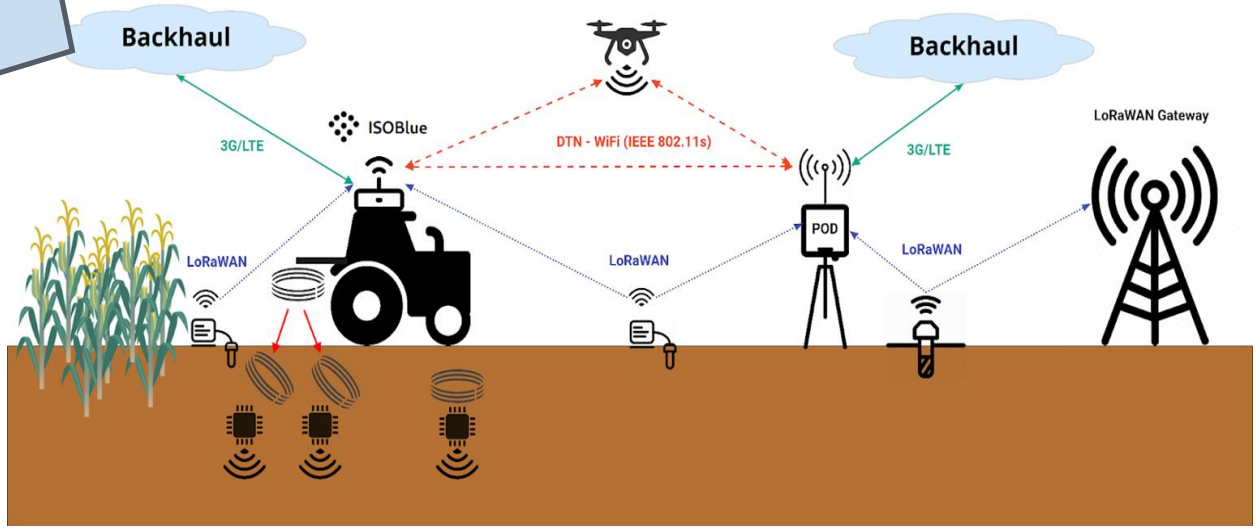
Precision Agriculture Goal

- Expand sensing by 100x-1000x
- Reduce costs per sensor
- Use advanced communication, robotics, and autonomous machinery



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Sensor image: https://www.agric.wa.gov.au/horticulture/soil-moisture-monitoring-selection-guide

Sensor Tag Planting at Purdue Research Farm

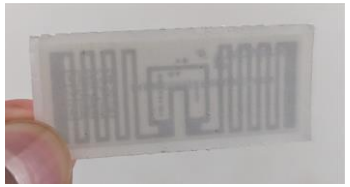
1

Seed packet

Corn seeds with RFID tags

2

Plot planter drops sensors and seeds



Paper Tags planted 1.5” deep

- Proof of concept work with RFID
- Planter offers efficient way to place sensors
- Paper tags offer biodegradability

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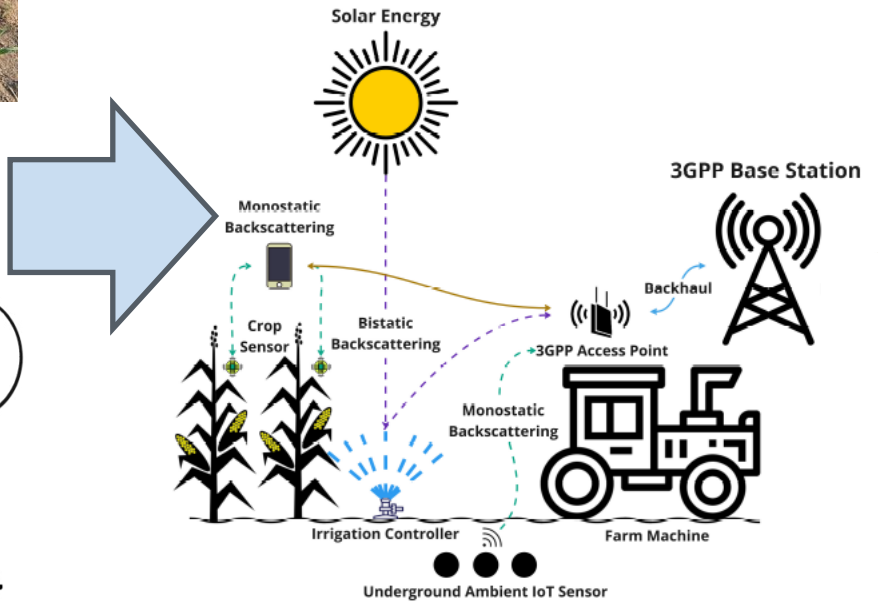
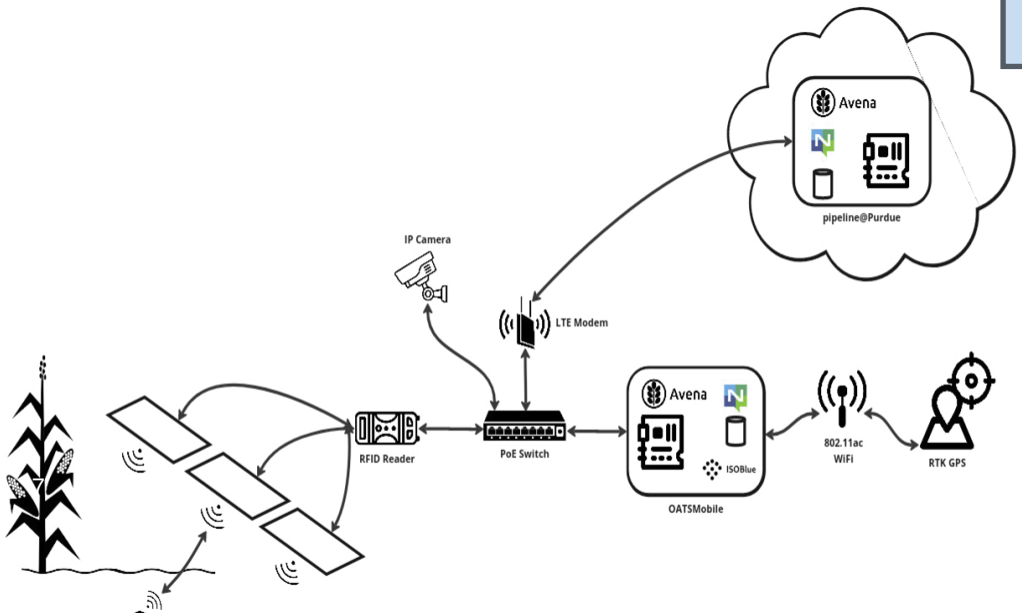
Reader and Sounding Evolution





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Conclusions

- Purdue has an on-going tradition of excellence in communications research
- 6G promises to offer orders of magnitude improvements
- New applications will drive future wireless
- Precision agriculture is a research area critical to solving world's food issues