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# 2021 AG OUTLOOK FORUM – RD PANEL

## SUPPORT/ENABLE RURAL PROSPERITY AND QUALITY OF LIFE GOALS

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# Outline

- Digital Agriculture and Technology
- State of California case study
- State of Indiana case study
- Mapping challenge
- Connectivity requirements

# What is Digital Agriculture?

*Digital agriculture is the realm in which our physical and social world is fused through digital devices. Integrated characterization and modeling improves decision making using modern data-intensive technologies that collect, connect, curate, communicate, and compute.*



<http://www.fao.org/3/a-i5564e.pdf>

# NEW PERSPECTIVE ON FARMING

- DRIVEN BY TECHNOLOGY INNOVATION, MULTI-BENEFITS, REAL TIME

## RURAL BROADBAND

### New Agriculture Technology

Production

Water<sup>R</sup>

<sup>R</sup>egulations

ENERGY<sup>R</sup>

ENVIRONMENT<sup>R</sup>

FOOD SAFETY<sup>R</sup>

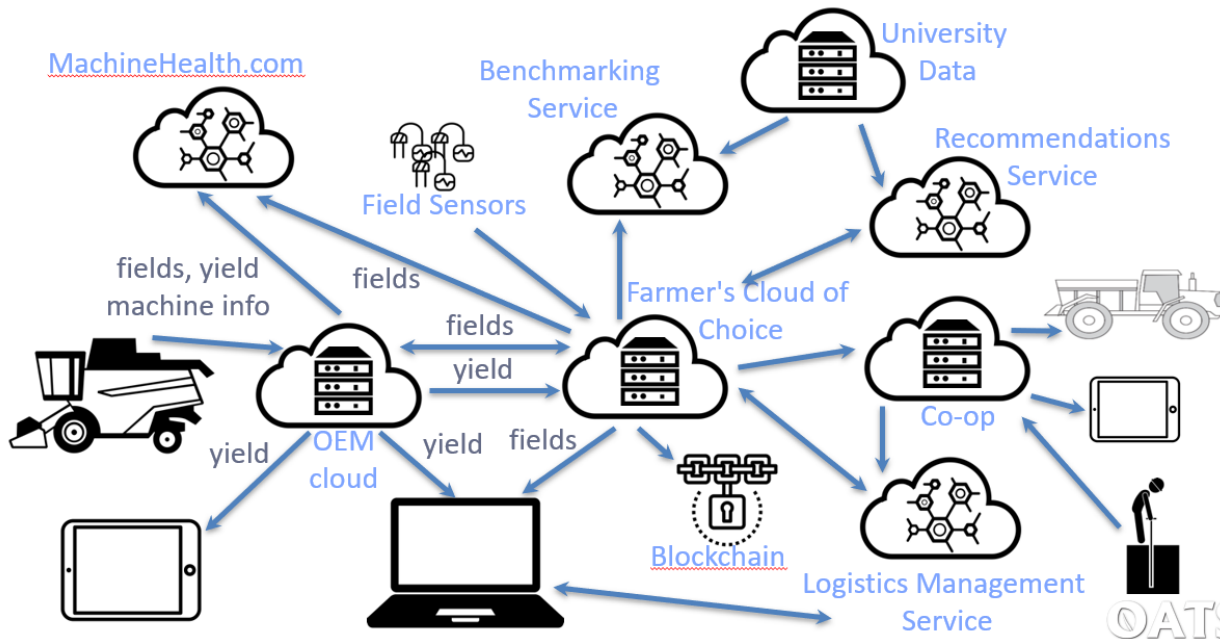
HEALTH<sup>R</sup>



# Interoperability – still a challenge

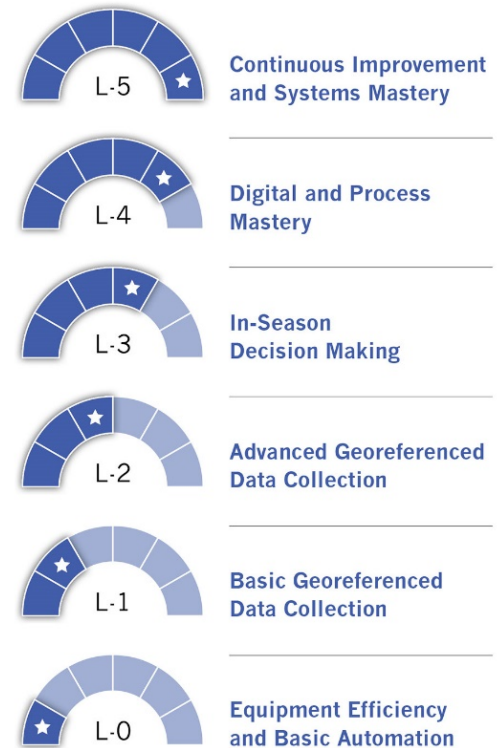
- Requires cooperation amidst competition
- Many stakeholders
- Multiple platforms and systems each with a “piece of the pie”
- Can enable efficiency, sustainability, traceability

## Connection-based Architecture for Automated Data



## SIX LEVELS OF PRECISION AGRICULTURE ADOPTION

The PrecisionAg® Institute, administered by Meister Media Worldwide along with its Partner organizations, have proposed these six levels of precision adoption for row crop growers.



Source: PrecisionAg® Institute; PrecisionAg.com/Institute



# California Agriculture Innovation Strategy

## – University of California – THE VINE



### Agriculture + Technology to Address the Challenges

1. Internet of Things for the farm
2. Big data, machine learning, AI
3. Genomics, CRISPR/CAS9
4. Robotics and mechatronics
5. Plant biotechnology
6. Rural connectivity
7. Food science technology
8. Clean energy technology



# The Need for Ag Innovation Ecosystem in CA

## California Challenges for AgTech & Ag Innovation

- Lots of point solutions, no integration
- Heavy marketing, dubious science
- Silicon Valley and food valleys need each another, but cultures are different
- Workforce pipeline is not developed
- Need patient capital
- Accelerators aren't designed for Ag/Food models
- There is no world-class innovation ecosystem for agriculture – there is nothing like The VINE





# Places Needed for Innovation in Agriculture

Research



**Co-Creation Under One Roof:**  
Startup Commercialization  
Student Education  
Corporate Innovation  
Academic Research  
Field Trials and Demonstration

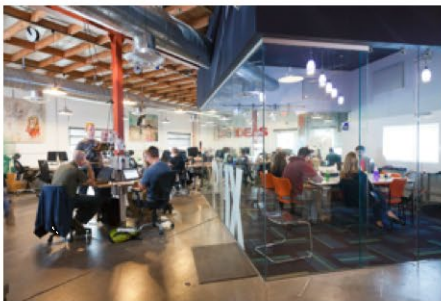
Indoor Agriculture



Wet Labs



Working & Meeting



Engineering Lab



AgTech Testing Fields



Rural/Urban Settings



# Create Agriculture Technology Testing at Field Innovation Centers

Precision irrigation



Ag robotics



Internet of Things



Distance learning



Big Data

Drones

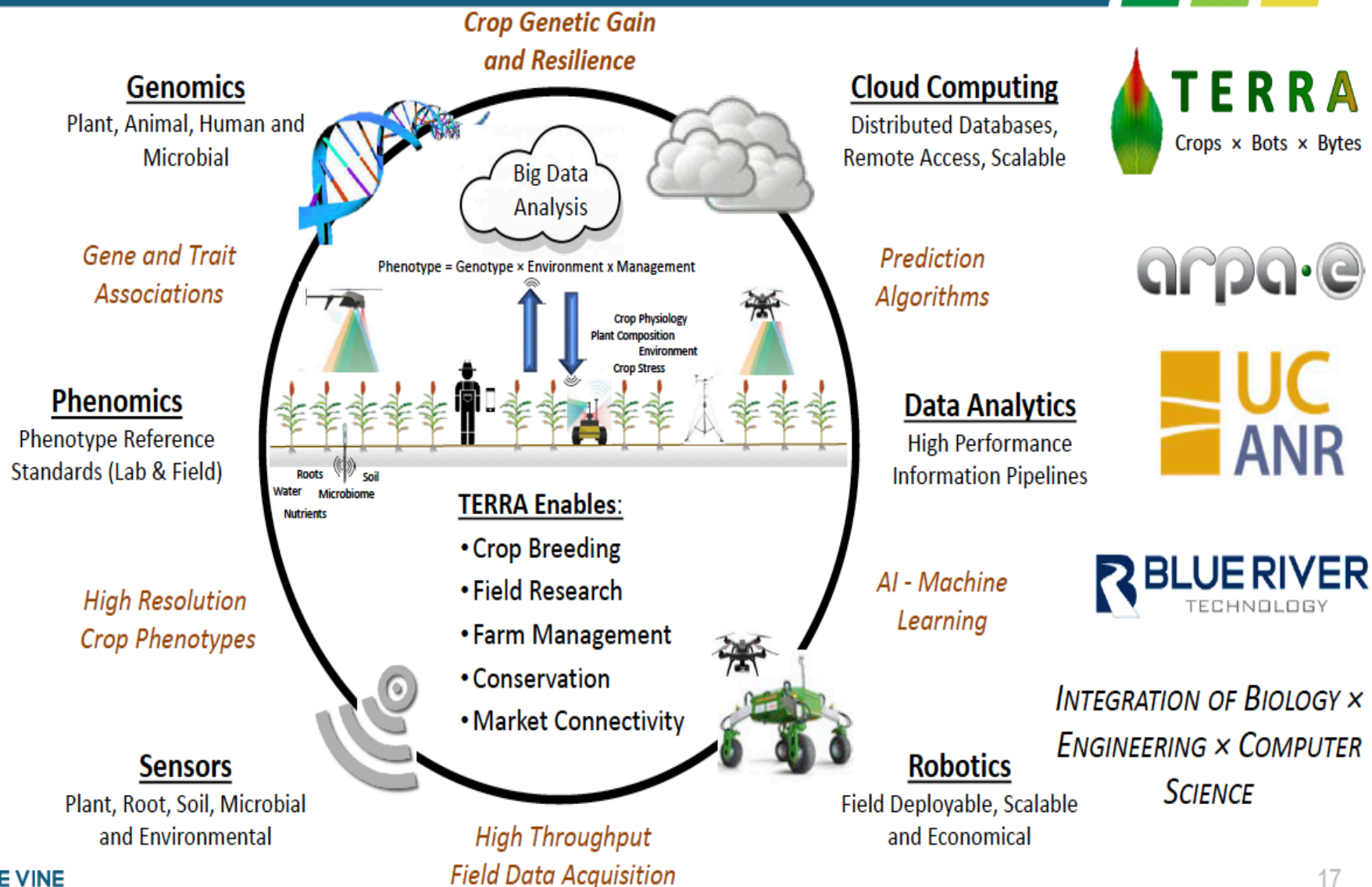


Field days/conferences





# Partnership for Precision Plant Breeding



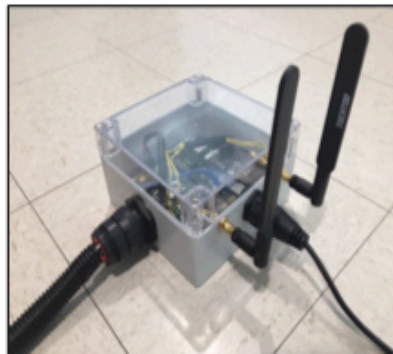
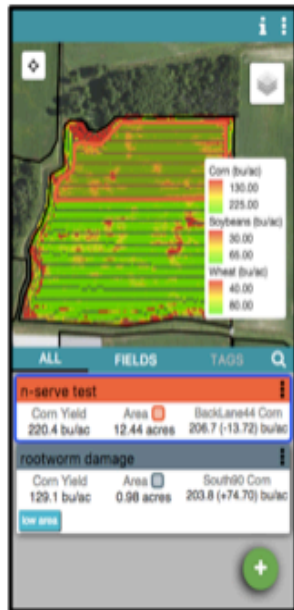
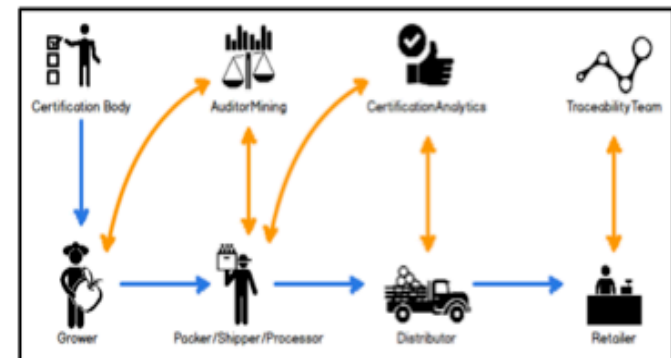
# Purdue University Ag Research Centers

*We achieved approximately 2 miles in a one hop LoRa communication*



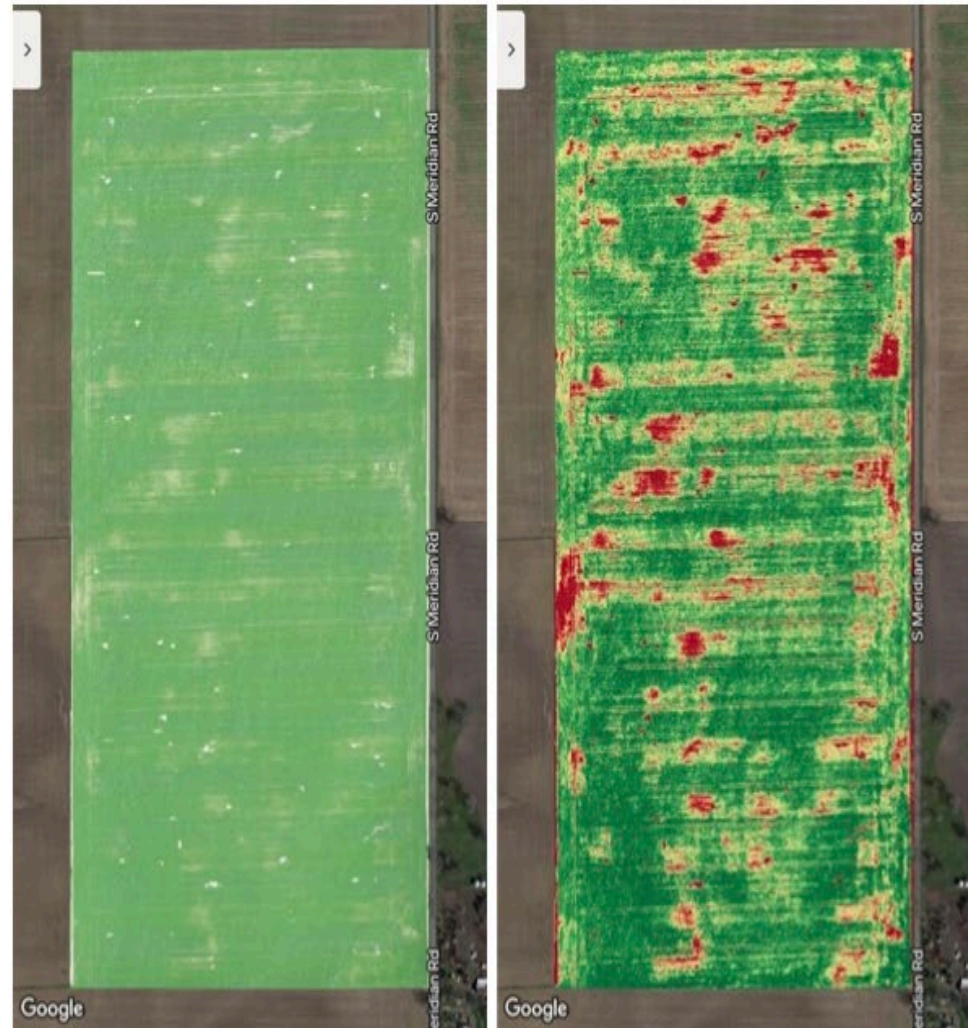


- ISOBlue telematics – support for logistics as well as artificial intelligence
- Food traceability for security and safety
- TrialsTracker app
- Livestock treatments & weighing
- CONTxT metadata app



# Real time connection is often critical

- UAV (~ 40 MB/s)
  - Big picture
  - Closer view
  - Take action
- RGB
- Multispectral & hyperspectral images
- LiDAR
- Thermography
- On-ground and in air machine to machine communications enable ...

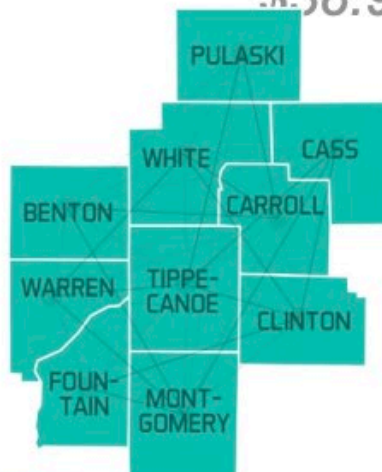


Impact of sulfur deficiency – easily corrected if you know in time.

# Wabash Heartland Innovation Network

## The Wabash Heartland Innovation Network

\$.38.9M, 2018-2022



1. Demonstrate **large-scale wireless IoT network at work.**
2. Bring the entire **vertical software and hardware stack** together (sensing technologies, wireless protocols, distributed algorithms, and data analytics).
3. Engage companies to use **IoT testbed** to experiment and showcase latest developments. A platform for **benchmarking** smart communities.



Purdue/WHIN Region as  
a sandbox to test new IoT  
technologies





# Purdue – Birck Center

## Roll-to-roll nanomanufacturing

PURDUE UNIVERSITY  
**Discovery Park**

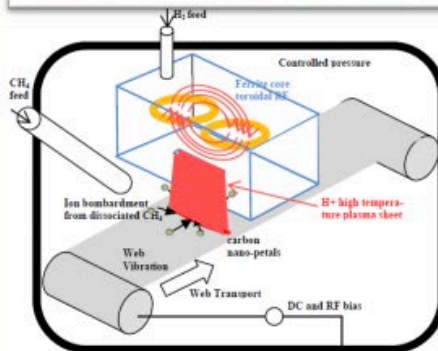
### R2R Inkjet/Laserjet



### Microgravure Slot Die



Installed Sept. 2013



### Plasma CVD

Installed Dec. 2014



### R2R Functional Film



Low cost sensor manufacturing

Installed May 2018



# Low Cost Sensor Manufacturing – Purdue University

**Chiu (ME)**  
**Cheng (IE)**

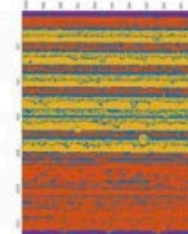
**Electrodes (Ag/AgCl)**  
Inkjet, Screen Printing,  
Evaporation, Laser

**Cakmak (MSE/ME)**  
**Wei (Chemistry)**

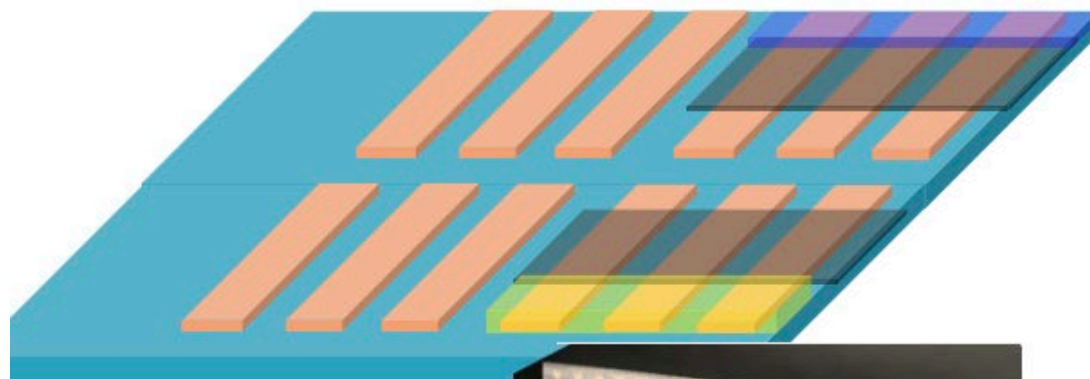
**Ion selective  
membrane, Solid  
electrolyte,  
Passivation**  
Multistrip, Slot die,

**Allebach (ECE)**  
**Chiu (ME)**  
**Shakouri (ECE)**

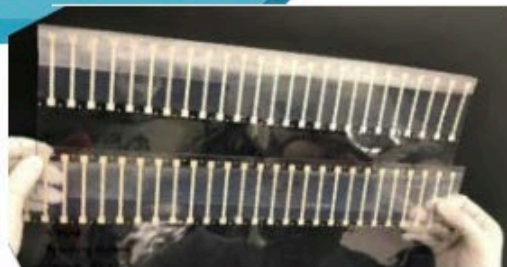
**Imaging quality  
control**



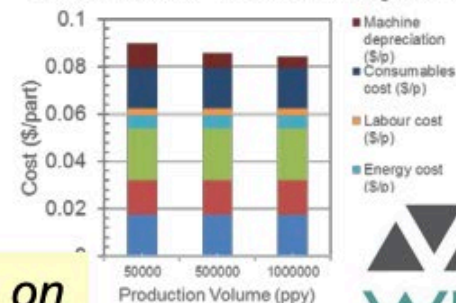
**Flexible  
substrate**  
(PET, PLA,  
Paper)



**Coordination:**  
**Glassmaker (BRK)**  
**Telesnicki (BRK)**



**Mansson (MSE/ChE)**  
**Technical cost analysis**

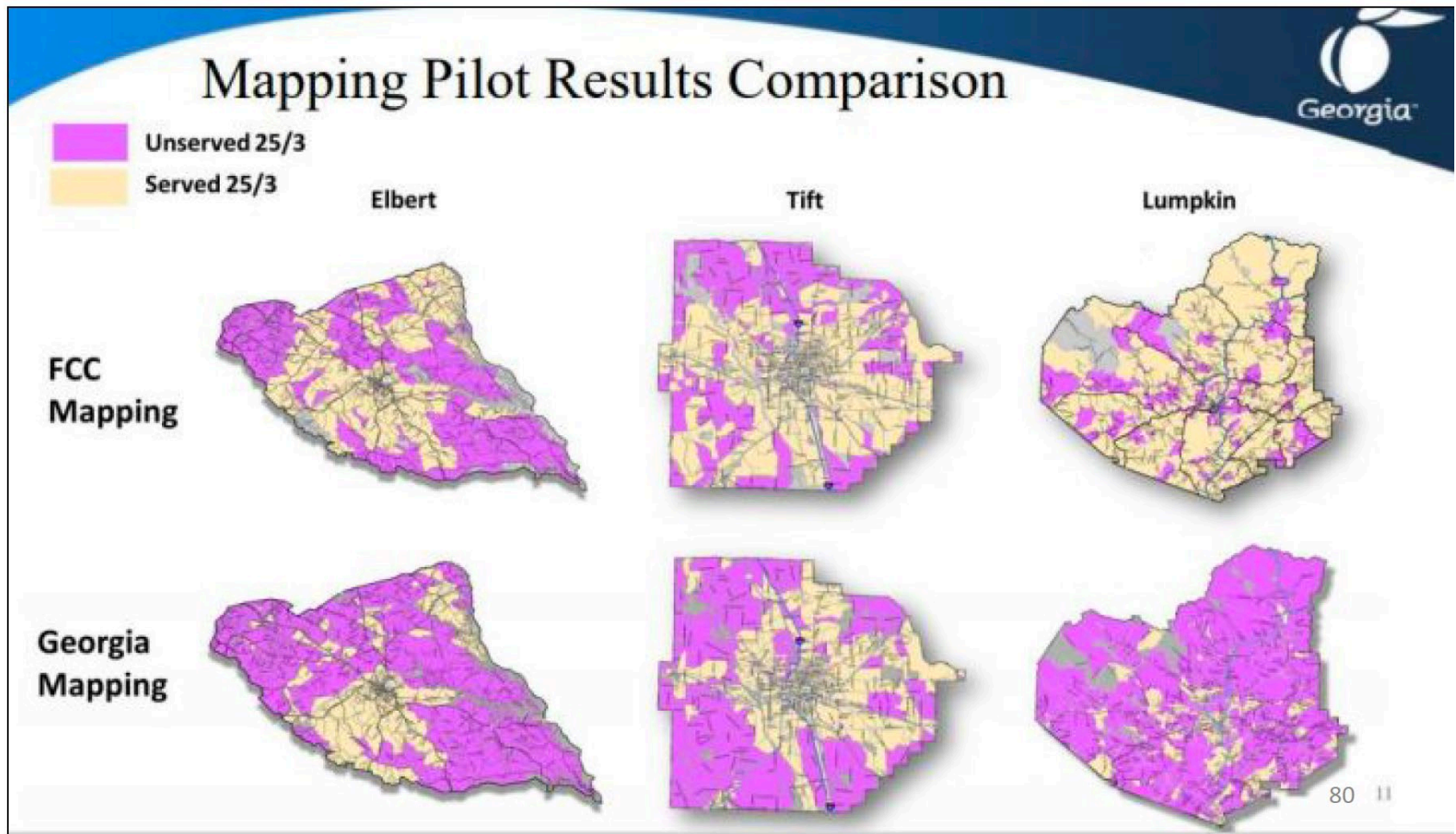


**Teams (Faculty/ Dept.) working on  
sensor manufacturing**



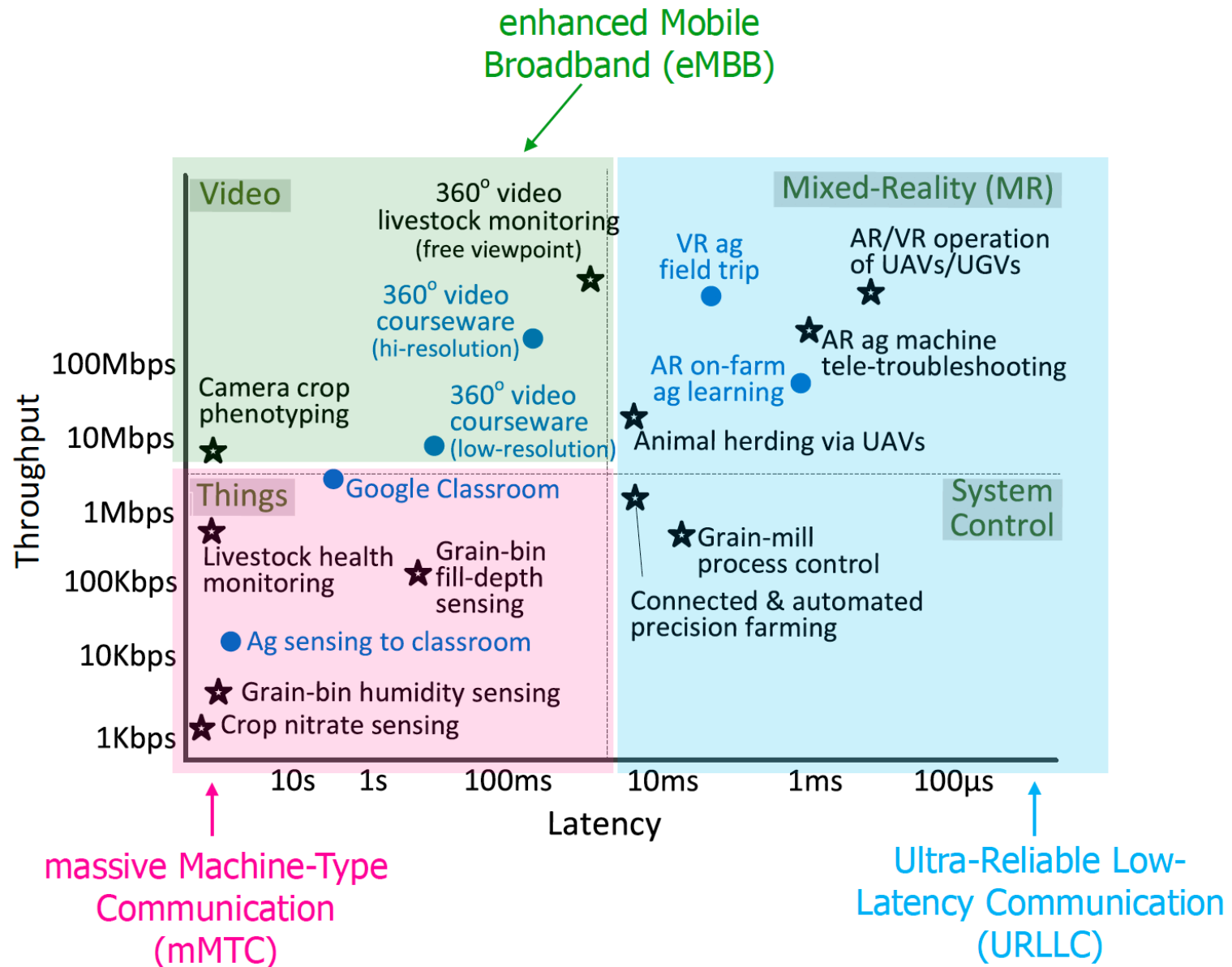
# Importance of Accuracy in Mapping

Georgia decided to map broadband availability to prove that maps prepared by FCC are inaccurate. **A three-county pilot shows the federal maps missed half of all addresses without broadband service.** The statewide survey is scheduled to be completed by June. (Emma Hurt/Marketplace)





# Wireless Requirement (Connectivity versus Broadband)



THANKS!

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