2021 AG OUTLOOK FORUM – RD PANEL
SUPPORT/ENABLE RURAL PROSPERITY AND QUALITY OF LIFE GOALS

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Dr. Mo Shakouri

Dir Community Broadband, Joint Venture Silicon Valley
Innovation Partners Institute Fellow, Purdue Research Foundation
Co-chair Ag-Rural Supercluster GCTC
shakouri@alumni.Stanford.edu
+1.408.482.3850 cell

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

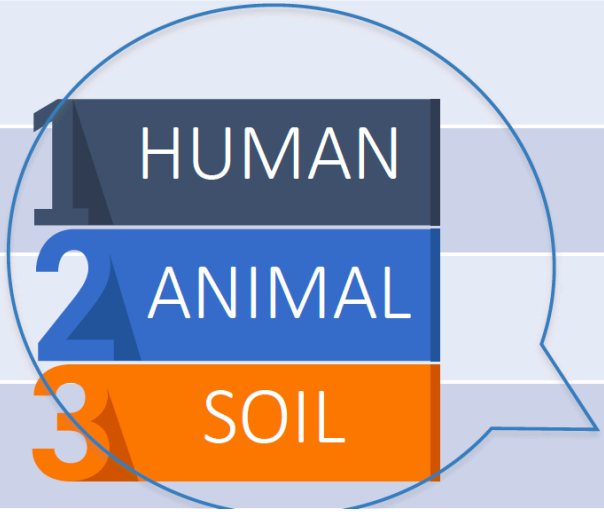
Water[R] [R]egulations

ENERGY[R]

ENVIRONMENT[R]

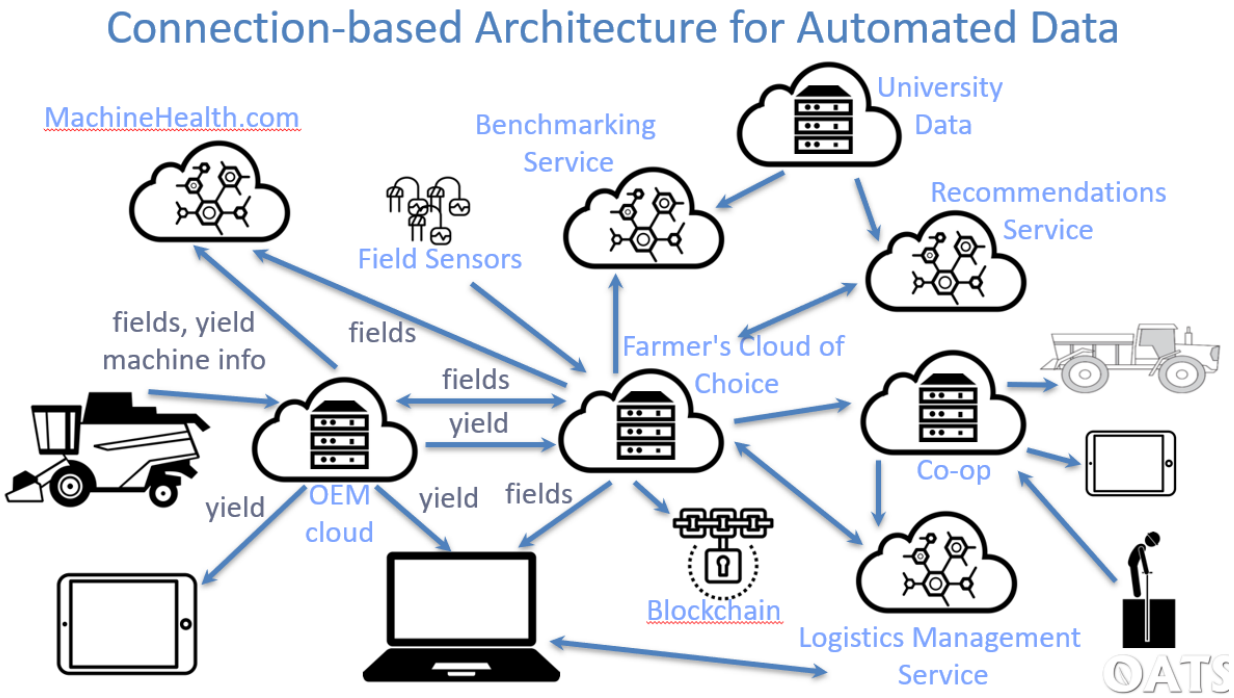
FOOD SAFETY[R]

HEALTH[R]



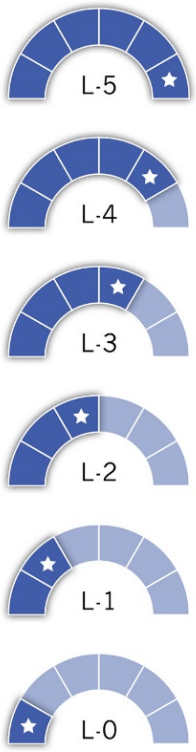
Interoperability – still a challenge

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



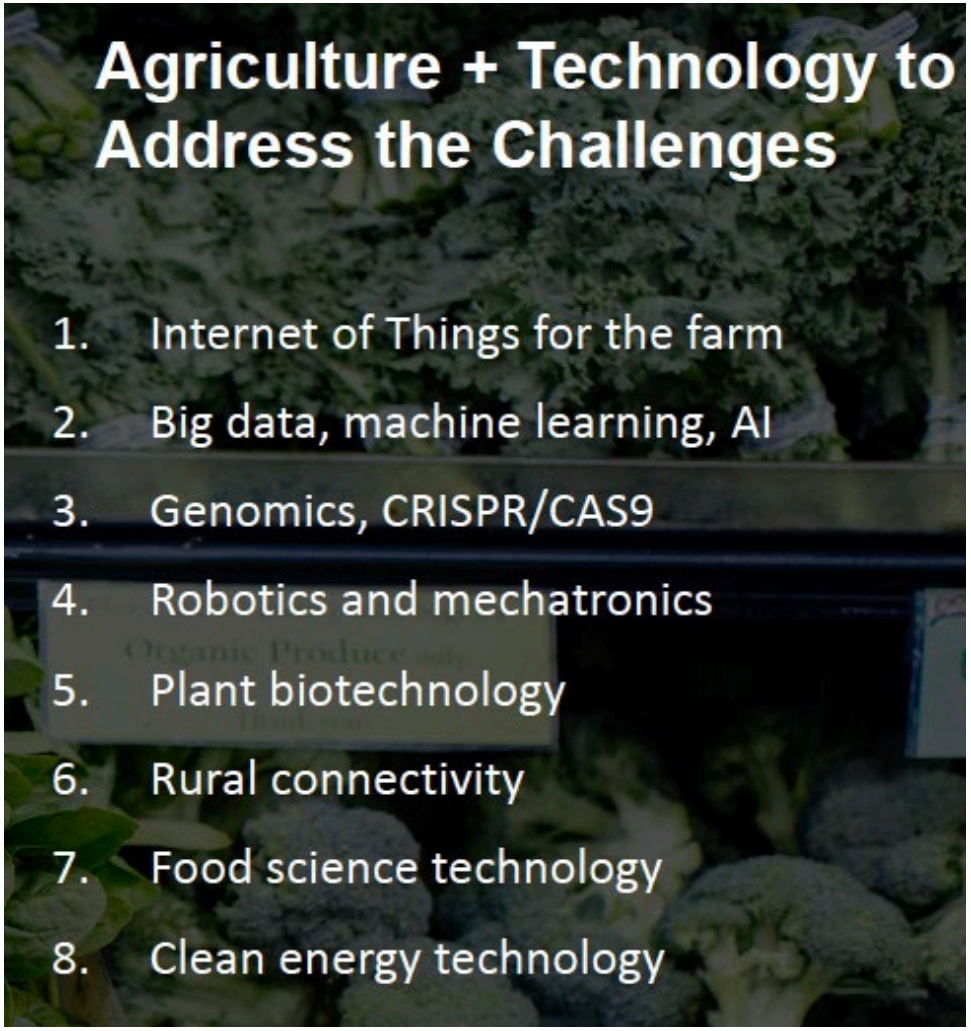
SIX LEVELS OF PRECISION AGRICULTURE ADOPTION

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



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

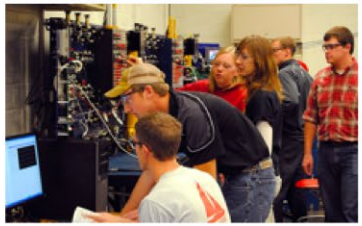
Co-Creation Under One Roof:

Startup Commercialization
Student Education
Corporate Innovation
Academic Research
Field Trials and Demonstration

Research

Working & Meeting

Engineering Lab



AgTech Testing Fields

Indoor Agriculture

Wet Labs

Rural/Urban Settings

THE VINE

Create Agriculture Technology Testing at Field Innovation Centers

Precision irrigation

Ag robotics

Internet of Things

Big Data

Distance learning

Drones

Field days/conferences

Partnership for Precision Plant Breeding

Crop Genetic Gain and Resilience

Genomics
Plant, Animal, Human and Microbial

Gene and Trait Associations

Phenomics
Phenotype Reference Standards (Lab & Field)

High Resolution Crop Phenotypes

Sensors
Plant, Root, Soil, Microbial and Environmental

High Throughput Field Data Acquisition

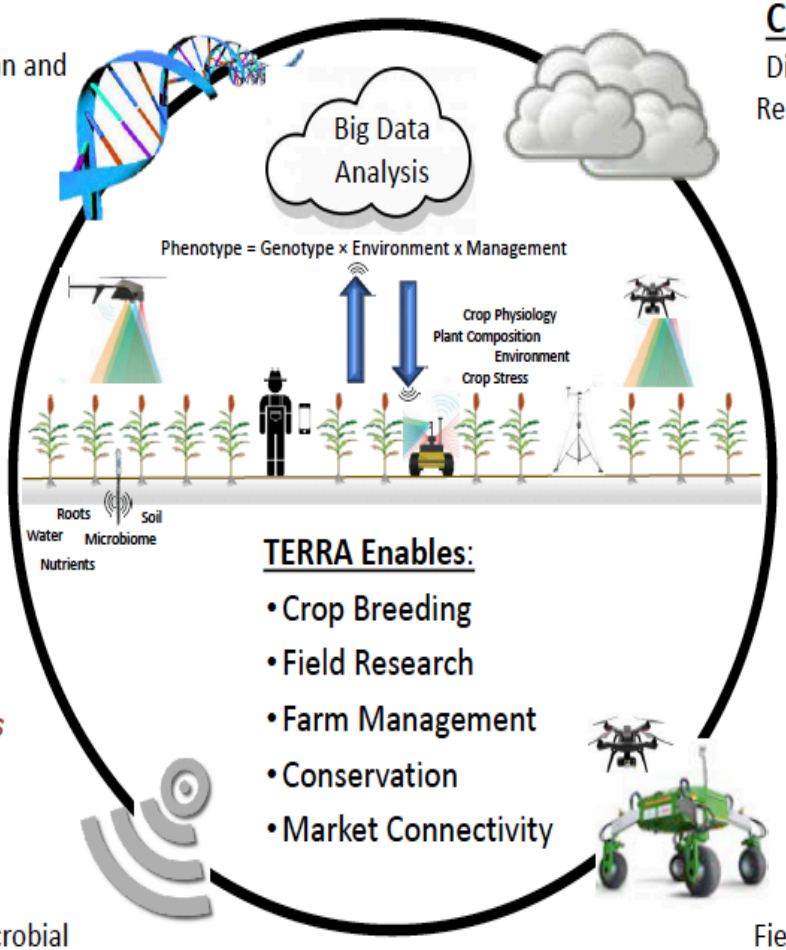
Robotics
Field Deployable, Scalable and Economical

AI - Machine Learning

Data Analytics
High Performance Information Pipelines

Prediction Algorithms

Cloud Computing
Distributed Databases, Remote Access, Scalable



TERRA
Crops × Bots × Bytes

arpa·e

UC ANR

BLUE RIVER TECHNOLOGY

Integration of Biology x Engineering x Computer Science

THE VINE

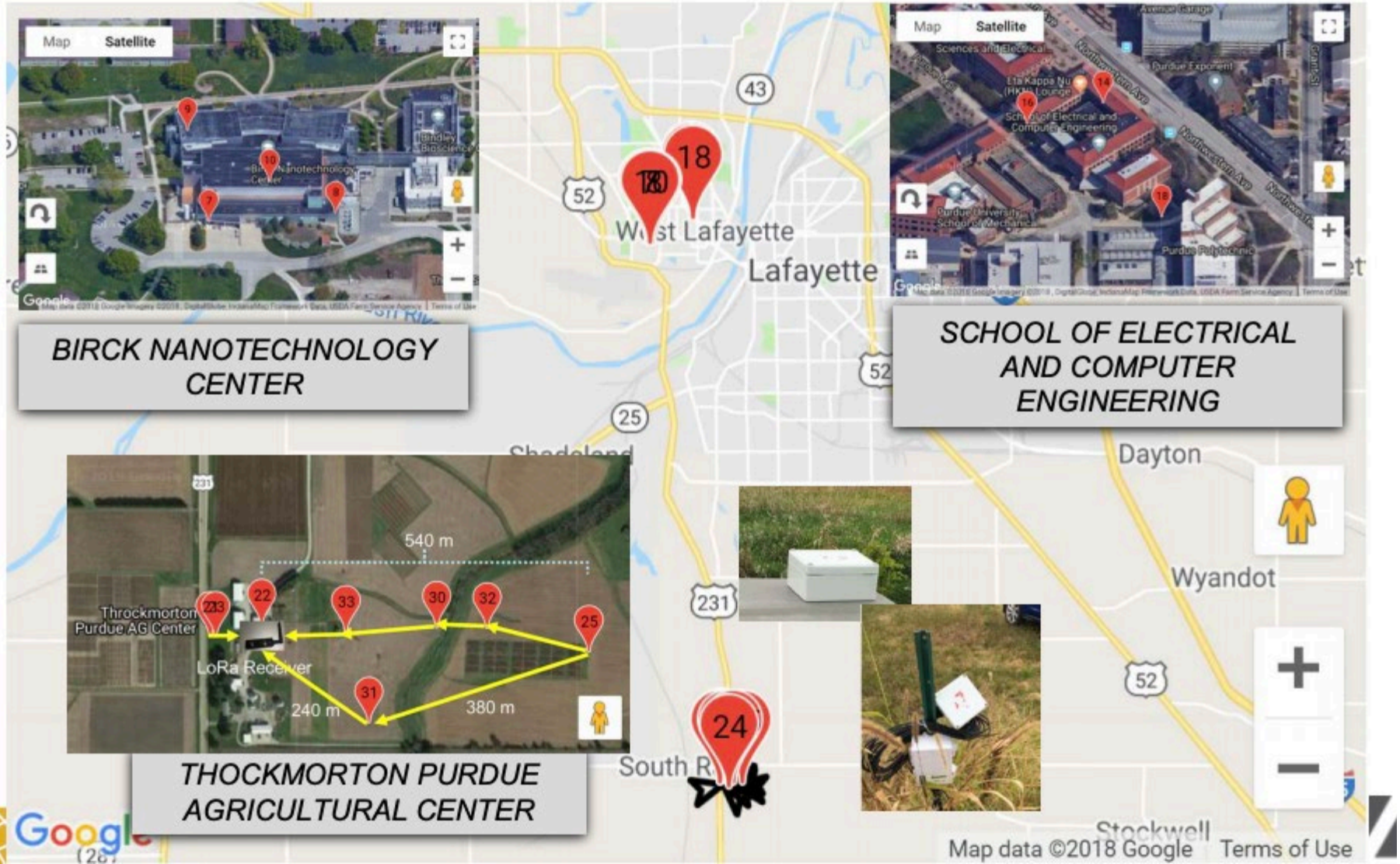
Purdue University Ag Research Centers

We achieved approximately 2 miles in a one hop LoRa communication

BIRCK NANOTECHNOLOGY CENTER

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING

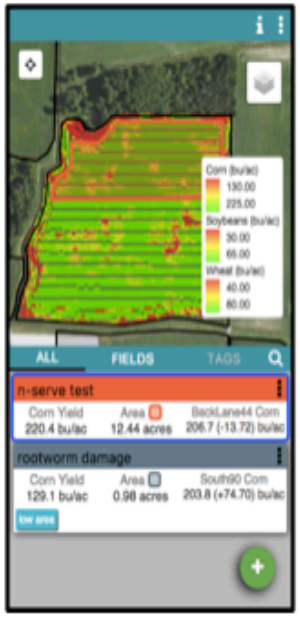
THOCKMORTON PURDUE AGRICULTURAL CENTER

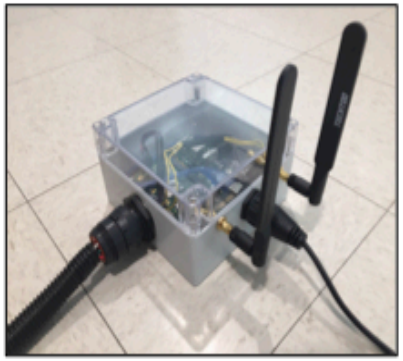


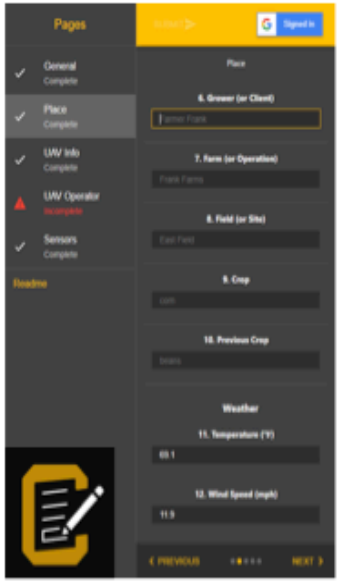
Purdue Open Ag Technology & Systems Center Developments

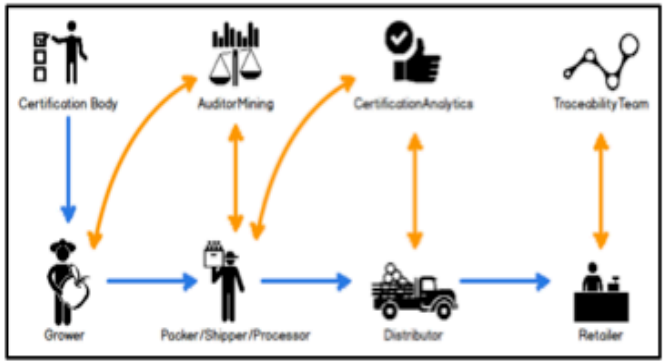
OATS
Open Agriculture Technologies and Systems

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



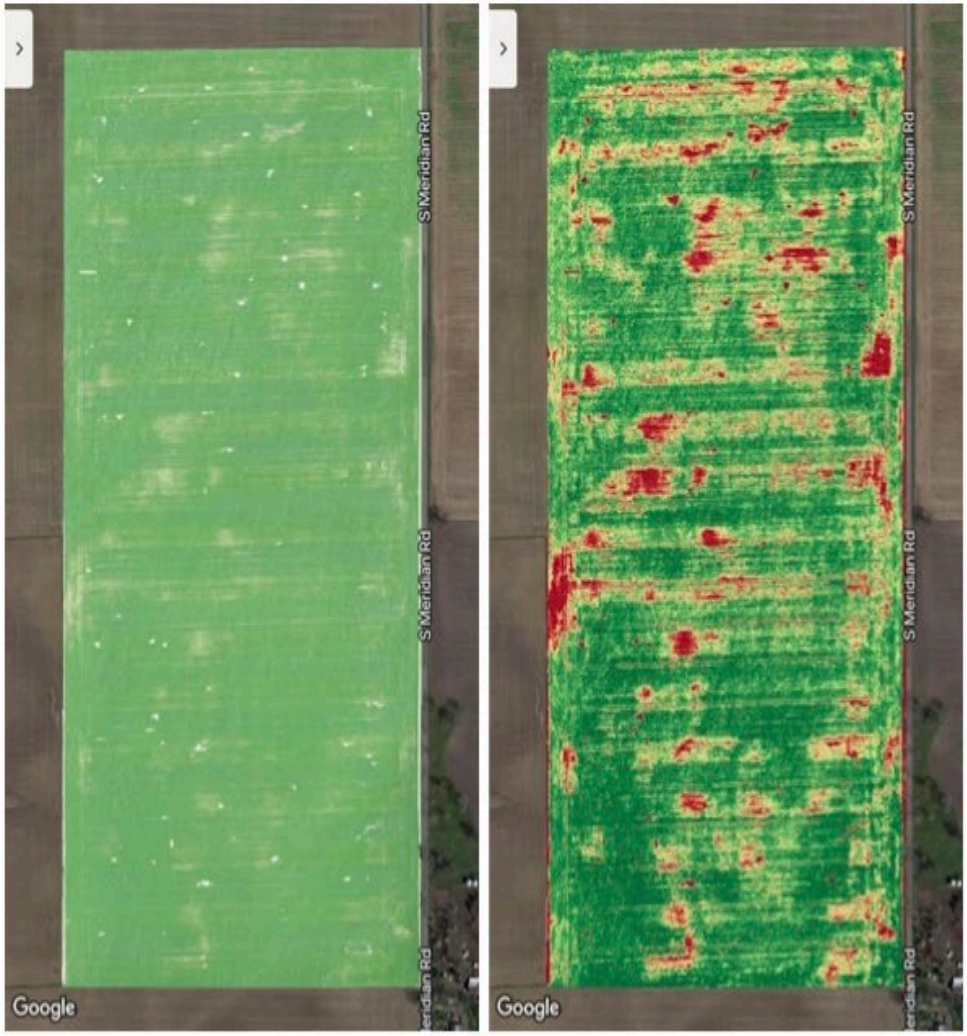






Real time connection is often critical

- 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 …

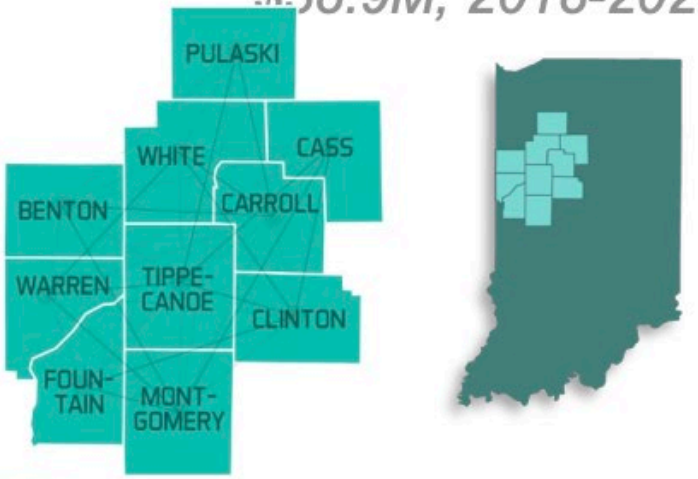


Impact of sulfur deficiency – easily corrected if you know in time.

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.*

LILLY ENDOWMENT INC

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

WHIN

Purdue – Birck Center

Roll-to-roll nanomanufacturing

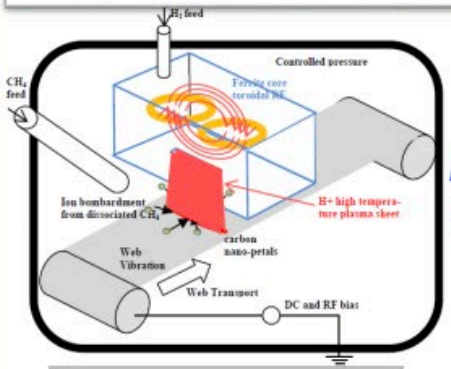
PURDUE UNIVERSITY Discovery Park

R2R Inkjet/Laserjet

Installed June 2015; April 2018

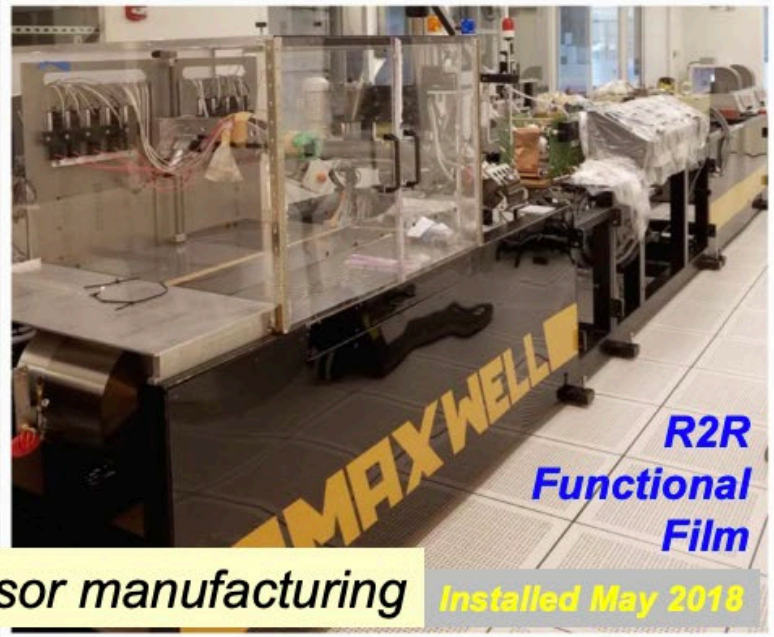
Microgravure Slot Die

Installed Sept. 2013



Plasma CVD

Installed Dec. 2014



R2R Functional Film

Installed May 2018

SMART scalable manufacturing of aware & responsive thin films

Low cost sensor manufacturing

Low Cost Sensor Manufacturing – Purdue University

Flexible substrate
(PET, PLA, Paper)

Chiu (ME)
Cheng (IE)

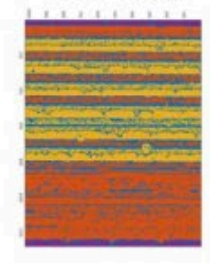
Electrodes (Ag/AgCl)
Inkjet, Screen Printing, Evaporation, Laser

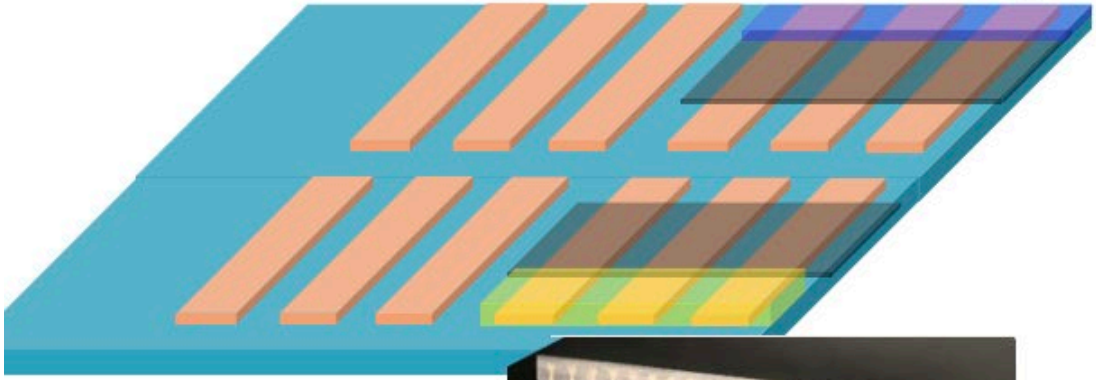
Cakmak (MSE/ME)
Wei (Chemistry)

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

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

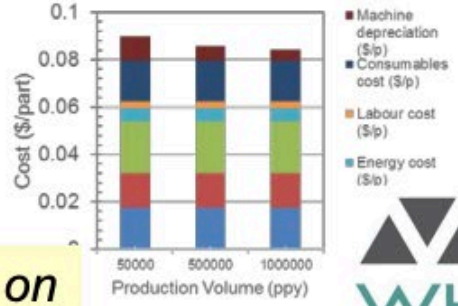
Imaging quality control





Mansson (MSE/ChE)

Technical cost analysis



Coordination:
Glassmaker (BRK)
Telesnicki (BRK)

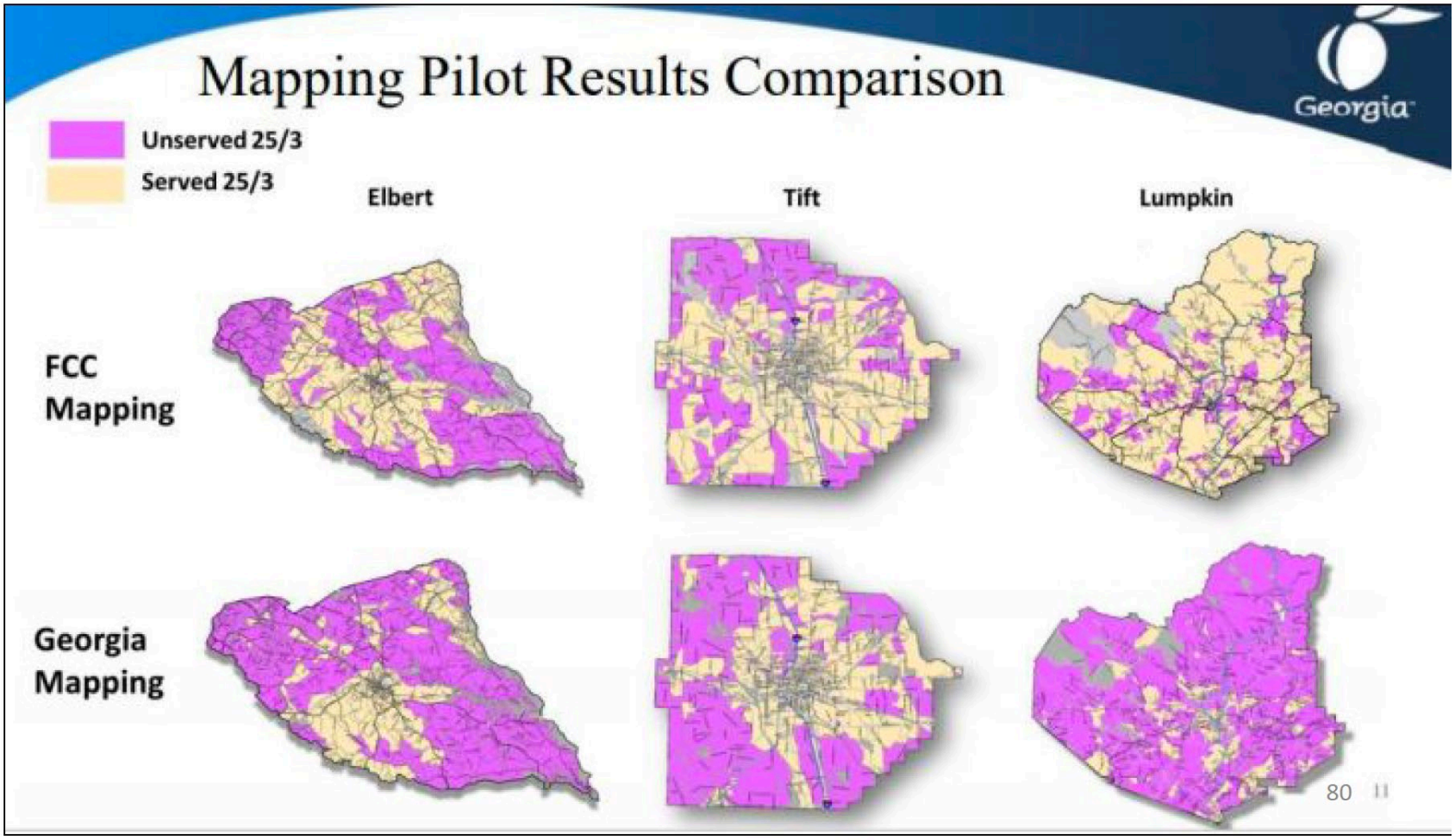
SMART
scalable manufacturing of aware & responsive thin films

Teams (Faculty/ Dept.) working on sensor manufacturing

WHIN
WABASH HEARTLAND INNOVATION NETWORK

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)



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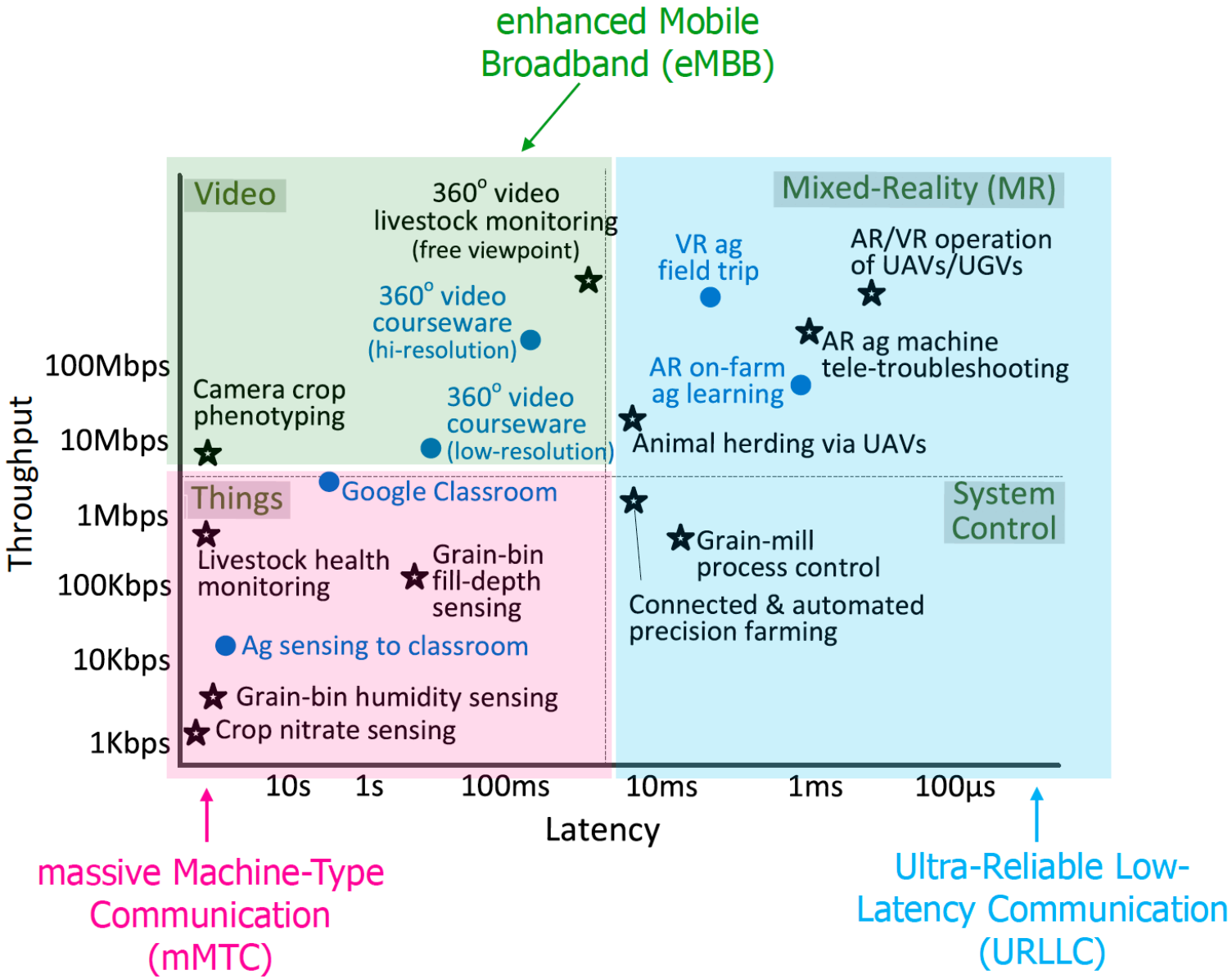
Wireless Requirement (Connectivity versus Broadband)



Dr. Mo Shakouri
Shakouri@jointventure.org
+1.408.482.3850 cell