



# Smart Agriculture: Increasing Productivity through Technology

NTIA Webinar Series

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*Conference Line: 800-593-7190 Passcode: 984-4951#*

June 20, 2018

# Helpful Information

## Questions

- Please type questions in the Q&A box on the right hand side of the screen. Questions will be taken after the final presenter.

## Presentation

- The presentation along with a transcript and recording will be available on the BroadbandUSA website within 7 days following this webinar under Events.
- (<https://broadbandusa.ntia.doc.gov/past-event>)

## Audio

- Please dial in to hear the webinar: [800-593-7190](tel:800-593-7190) Passcode: [984-4951#](tel:984-4951#)

# Participants

## Moderator

- **Don Williams**, Senior Specialist for Broadband Development, BroadbandUSA, NTIA

## Presenters

- **Mark N. Lewellen**, Manager of Spectrum Advocacy, John Deere
- **Aaron Ault**, Senior Research Engineer for the Open Ag Technology and Systems Center, Purdue University
- **John Selep**, President of AgTech Innovation Alliance

# Presentations

- **Mark N. Lewellen, Manager of Spectrum Advocacy, John Deere**
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# Smart Agriculture: Increasing Productivity Through Technology

## Our Cropland Needs Mobile Broadband

*June 2018*

*Mark N. Lewellen, John Deere*



# Megatrends & Key Drivers in Agriculture

Today & Tomorrow



Growing demand for more food, feed, and fuel



Global markets and more volatility



Farm size growth and specialization



Environmental sustainability and compliance



Reduced skilled labor



Precision agriculture

# Why Precision Agriculture?

## Yield & Cost Optimization



## Smart Use of Resources



## Challenge of Regulation



# Technology Evolution in Agriculture



Early 2000s  
Guidance  
Systems



2006-2011  
Precision  
Farming



2012 and  
Beyond  
Coordination  
Enabled by  
Telematics



# Today's Farming is Extremely Complex



Prepare

Plant

Nurture / Protect

Harvest

Analyze & Plan

- Tillage
- Nutrients
- Residue

- Seed Variety
- Depth
- Spacing
- Timing

- Pesticides
- Fertilizers
- Timing
- Accuracy
- Waste

- Weather
- Storage
- Commodity Prices
- Yield loss

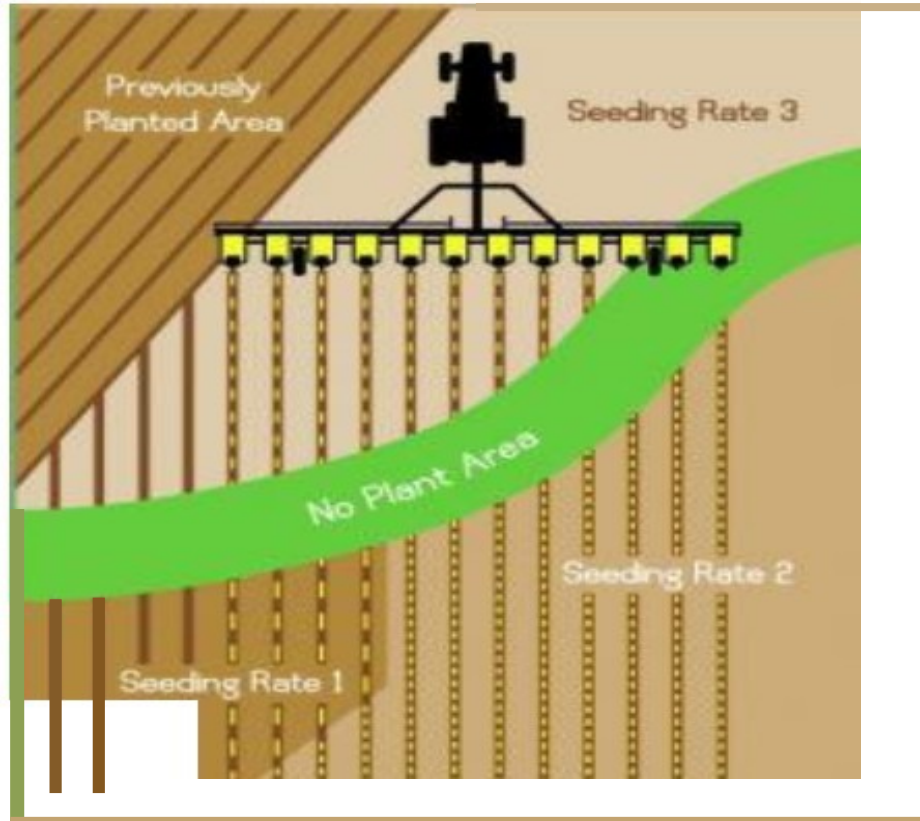
Did I make the right decisions?

# The Star of the Show: StarFire™

Guidance Systems    The “Precision” in Precision Ag Technology



# Precision Planting\* (and Spraying and Harvesting)



**\*Relies on High Precision GPS**

# Field Preparation – Every Inch Matters



# Water Optimization



# Production Efficiency



# Telematically Enabled Machines



7R Tractors



8R Tractors



9R Tractors



4940  
Sprayer



3G



4G



S-Series  
Combines



7050 Self-  
Propelled Forage  
Harvester

**Not to scale**

# What is Telematics Anyway?

- Provides previously unknown insights on how the machines are used
- Improved Dealer Services to customers especially in the area of machine availability/uptime through Expert Alerts
- Use the data to predict and prevent downtime
- Predict conditions which lead to fault and correct before fault occurs



**No unplanned downtime  
is one goal**



# Cellular

## Features (current and near-future):

- Remote Display Access – PC to In-Cab display anywhere
  - Highest data rate, pseudo real-time, ~1MB/sec preferred
- Wireless Data Transfer – File transfer to/from Deere host servers
  - Background transfers, ~20KB/sec
- Service ADVISOR Remote – Remote diagnostics
  - Background transfers, ~10-500MB payload size
- JDLink Telematics – Machine data (100's-1000's of parameters), breadcrumbing
  - ~2KB/sec, 8MB/hour
- DataSync/MapSharing – Coverage map sharing in field
  - Pseudo real-time, needed during active farming ops
  - ~2KB/sec, 8MB/hour
- Mobile RTK – RTK GPS corrections
  - Low data rate, high criticality
  - ~300B/sec, ~1MB/hour

Most of the features above work very well with the 3G speeds (100KB – 350MB). Our drive testing on 4G LTE indicated speeds of 125KB-1.25MB. There are higher protocol maximums for 3G/4G, but our drive testing rarely shows those rates in more rural areas. Very coverage dependent.

Need better coverage at 3G speeds at a minimum.

What Are We Doing About It?

**PROBLEM**



**SOLUTION**

# Relevant Federal Programs

## Universal Service Fund (FCC)

- Established to connected rural America to the landline telephone network in the 20th century
- Evolved to reflect advances in telecommunications and information services
  - Connect America Fund: revised USF framework to distribute funds to address communications infrastructure challenges of today and tomorrow, i.e., *rural broadband*
  - Mobility Fund: wireless component of CAF, provides support for the *expansion of mobile broadband networks* in areas that might otherwise not be served

## Rural Utility Service (USDA)

- Portfolio of loans, guarantees and grants to support telephone and (now) broadband infrastructure deployment
  - Long term loans not grants
  - Money must be repaid with interest
  - Funds must be used for Capital Expenditures, not Operations

# Agricultural Broadband Coalition (ABC)



\* Co-Chairs



# Agricultural Broadband Coalition (ABC)

Supports Policies to:

- Speed the deployment of broadband infrastructure and services to rural areas -- including croplands and rangelands -- where farming, ranching and other ag operations occur
- Ensure that the economic benefits of precision agriculture can be fully realized for U.S. farmers, rural communities and the national economy
- Improve U.S. ag productivity, efficiency, and sustainability

# ABC Engagement at the FCC

- Several active FCC dockets addressing USF reforms and RBB needs assessment:
  - Recognize needs of U.S. agriculture sector
  - Introduced “cropland” as an eligibility metric for assessing unserved, underserved areas
- Maintain, enhance Mobility Fund component of CAF
  - Support ‘middle mile’ facilities
  - Support M2M services
  - Revise RBB deployment assessments to go beyond “households”

## Federal Advisory Groups under FACA

- FCC – Broadband Deployment Advisory Committee
  - Developing State and Municipal Model Codes
  - Some interesting insights came from the Navy
- NTIA – Commerce Spectrum Management Advisory Committee (CSMAC)
  - Advocating for rural 5G policies in addition to the capacity building ones in urban areas



# Iowa 2015 Rural Broadband Expansion



**Iowa Governor Terry Branstad signing Rural Broadband Expansion Bill into Law**





# “Connect Every Acre”

The signed bill includes the following initiatives :

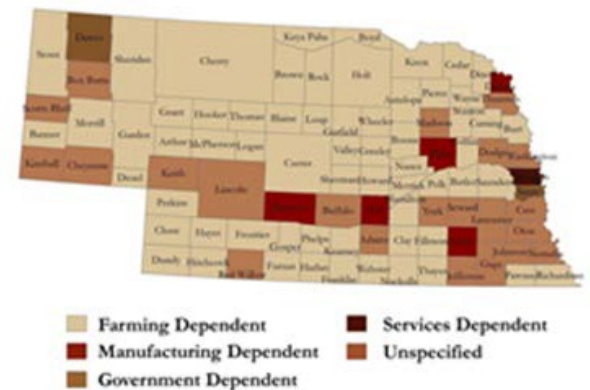
- Provides for the coordination and facilitation of broadband access in targeted services throughout the state
- Establishes a grant program to that prioritize connecting Iowa farms, schools, and communities
- 100% property tax exemption for 10 years for fiber optic infrastructure investment in targeted service areas
- Creates uniform rules and limitations for wireless communications facilities and infrastructure pertaining to cell towers
- Tasks the office of the Chief Information Officer to lead and coordinate the installation of fiber optic conduit where it does not currently exist

# New Nebraska Broadband Legislation

Nebraska Senator Curt Friesen introduced new legislation to:

1. Create a rural broadband task force
2. Allow the State's Public Service Commission to implement a reverse auction program for service providers in unserved or underserved areas
3. Establish and a registry of locations within the State of Nebraska for complaints about lack of wireless coverage
4. Instruct the Commission to annually prepare and publicize a report describing the areas of the state not receiving adequate wireless service

Map: Nebraska Counties by Economic Dependency



Source: USDA

**Nebraska is “All-In” on Agriculture**

# Precision Agriculture Connectivity Act of 2018

- Legislation introduced last Thursday afternoon in both the US House and Senate
- The bill creates a Task Force within the Federal Communications Commission to work with USDA, other government and private stakeholders:
  - to assess the unique broadband connectivity needs of ag producers
  - identify existing service gaps on croplands and ranchlands, and
  - make policy recommendations to improve broadband (wired and wireless) to address these gaps

**By its introduction, the bill signals to the FCC that Congress believes broadband connectivity for precision ag should be a priority**

# Precision Agriculture Needs Two Things:

1. GPS Technology and
2. Connectivity: Cell Towers over Cropland



Better Machine  
Performance



Better Job  
Performance



Better Agronomic  
Decisions



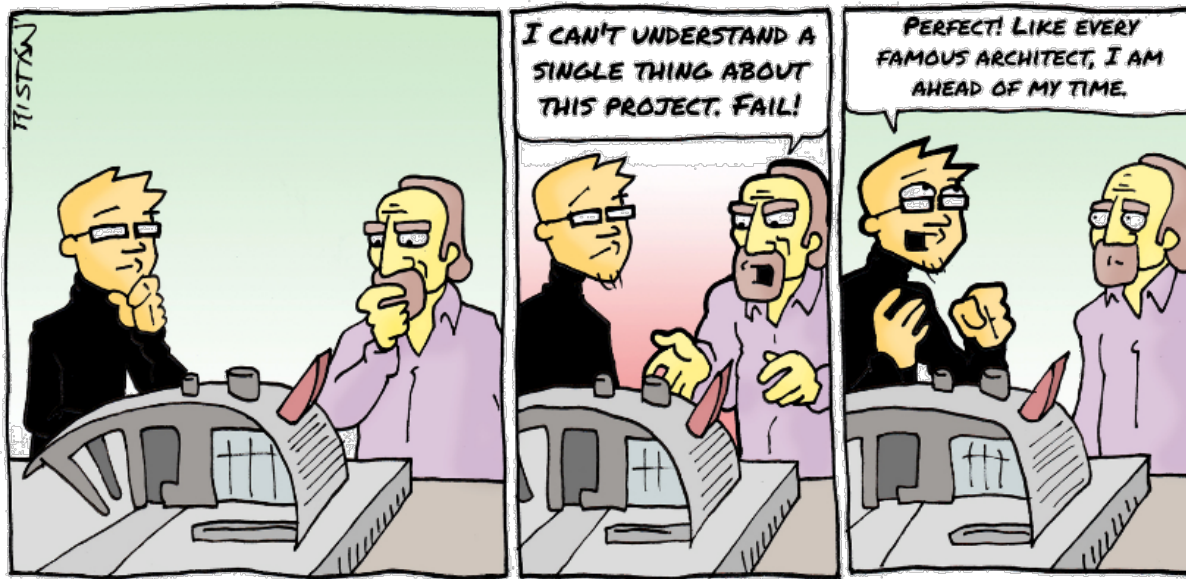
**JOHN DEERE**

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- **Aaron Ault, Senior Research Engineer for the Open Ag Technology and Systems Center, Purdue University**
- John Selep, President, AgTech Innovation Alliance

# Smart Ag: Tech and Data in Agriculture

# OATS



<http://oatscenter.org/>

<http://openag.io>

<http://trellisframework.org>

<http://isoblue.org>

Aaron Ault – [aault@purdue.edu](mailto:aault@purdue.edu)

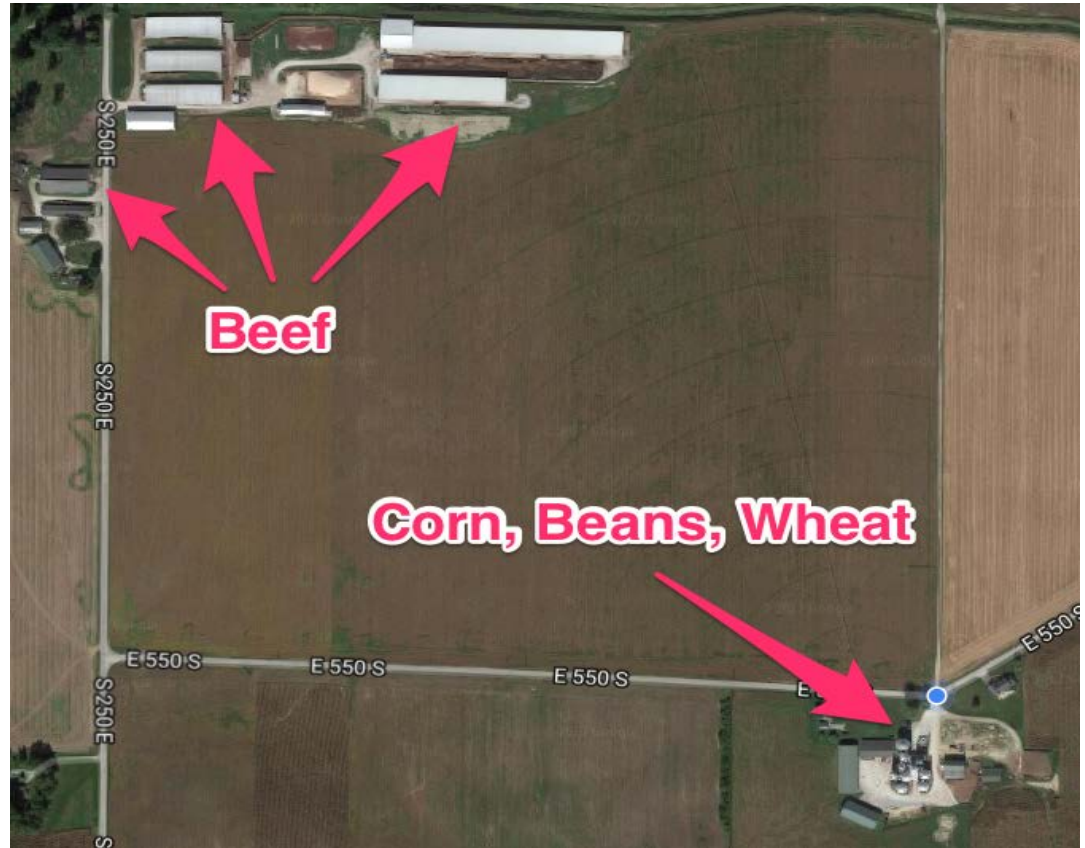
**PURDUE**  
UNIVERSITY®

# Background: Aaron Ault

Farmer

Computer Engineer

Purdue **OATS**





# OATS

Enable

Strategy

Conversation

Collaboration

NIH Vaccine

Provide

Marketing

Education

Administration

Research

Build

Projects

Talent

Community

Demand

# OATS

Many thanks to our generous supporters:

ADM, Ag Gateway, Centricity, CNH Industrial,  
Foundation for Food and Ag Research, Infosys, Purdue  
University, Produce Marketing Association, Primus Labs,  
Winfield United, Wilson Produce

# Open Source = Fast Innovation

## Livestock Treatments App

Code: <https://github.com/aultac/treatments>

Live: <https://aultac.github.io/treatments/>

The screenshot shows the app interface with a green message "Treatment record saved." at the top. The date is 11/13/2017 and the group is ZSDRMB. A table lists 6 heads with their tags and groups. A blue "SAVE TREATMENT" button is at the bottom.

	Date	Tag	Group	Dead
2017-11-13: 6 head total.				
1 head -	NoPxHt	BLACK186		
1 head -	NoPNt	MARTYELL50		
1 head -	ZNoLt	MARTYELL254		
2 head -	NoExLt	MARTYELL309 MARTYELL307		
1 head -	NoExNt	MARTYELL38		

1,400 lines of my code

20 hours of work

The screenshot shows the app interface with a red message "Treatment record not saved" at the top. The date is 11/13/2017 and the group is ZSDRMB. A table lists 6 heads with their tags and groups. A blue "SAVE TREATMENT" button is at the bottom.

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2 head -	NoExLt	MARTYELL309 MARTYELL307		
1 head -	NoExNt	MARTYELL38		

296,022 lines other people's code

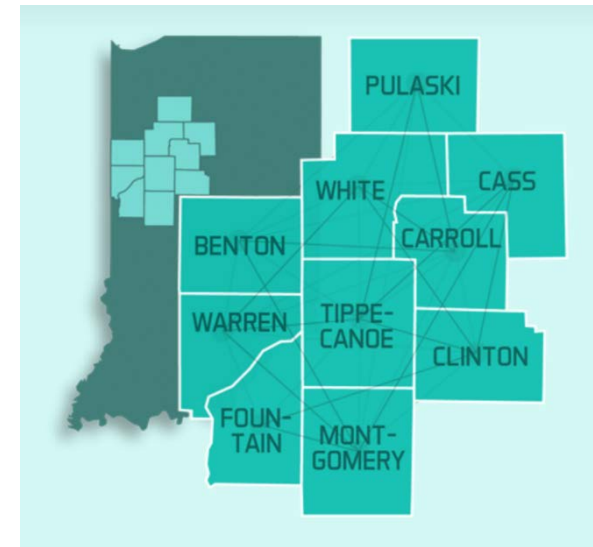
764 open source libraries



# WHIN

## WABASH HEARTLAND INNOVATION NETWORK

The Wabash Heartland Innovation Network is a consortium of 10 counties in north-central Indiana devoted to working together to fuel prosperity by harnessing the power of internet-enabled sensors to develop our region into a global epicenter of digital agricultural and next-generation manufacturing.



## Lilly approves almost \$40M grant to make the area global 'epicenter' in ag, manufacturing

Shannon Hall, Journal & Courier Published 6:36 p.m. ET Dec. 18, 2017

<https://www.jconline.com/story/news/2017/12/18/lilly-approves-almost-40-m-grant-make-area-global-epicenter-ag-manufacturing/960583001/>



## 3 Pillars for Ag and Industrial IoT



Next-Generation  
Manufacturing

The icon for Next-Generation Manufacturing shows a stylized teal factory with two smokestacks. To the left of the factory is a teal Wi-Fi signal icon, representing industrial IoT.

Digital Agriculture

The icon for Digital Agriculture features a teal silhouette of a bull's head on the right and a teal stalk of grain with three leaves on the left.

Regional  
Cultivation Fund

The icon for the Regional Cultivation Fund is a teal circular arrow, symbolizing a cycle or a fund.

Testbeds, Education, Research, Adoption

# What Farmers Want from Data

Data should **flow**

**from whatever source** a farmer has

**into whatever tool** a farmer wants

**without manual intervention**

# What ~~Farmers~~ Want from Data

**Ag Researchers**

Data should **flow**

**Ag Researchers**

**from whatever source a farmer has**

**Ag Researchers**

**into whatever tool a farmer wants**

**without manual intervention**

# ~~What Farmers Want from Data~~

Ag Researchers

Statisticians

Data should flow

Ag Researchers

Statisticians

from whatever source a farmer has

Ag Researchers

Statisticians

into whatever tool a farmer wants

without manual intervention



# What **EVERYONE** Wants from

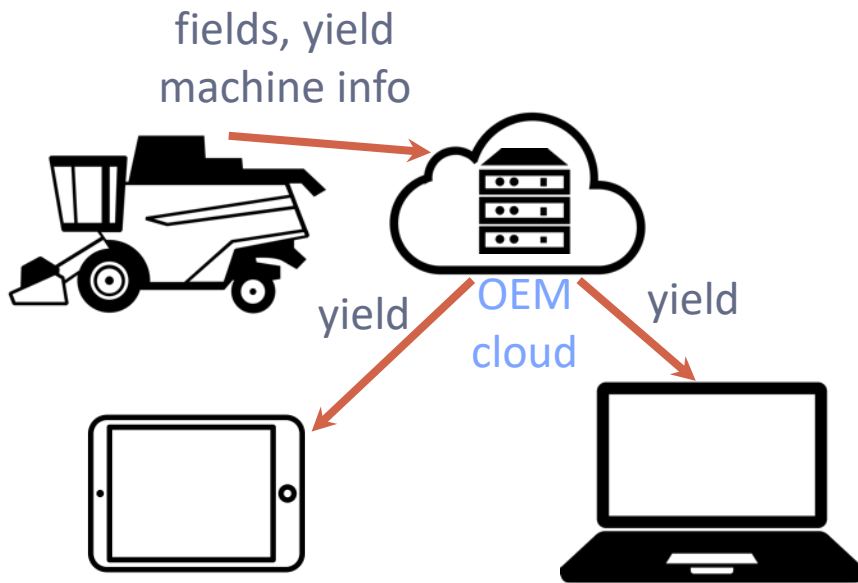


**without manual intervention**

What **EVERYONE** Wants from  
Data

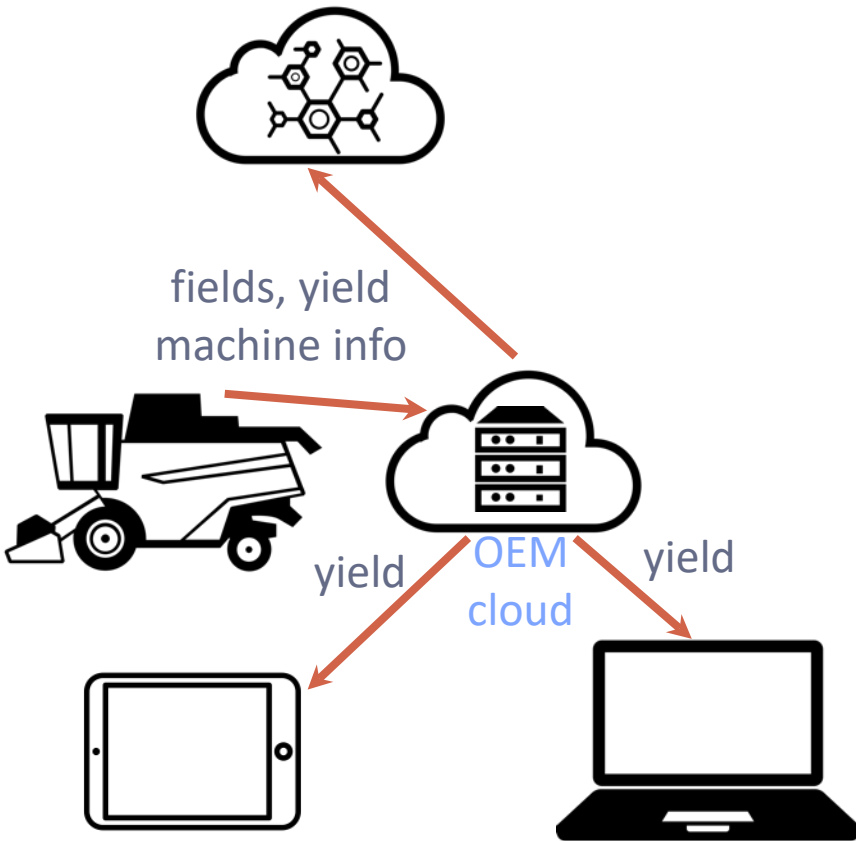
automation

# Connection-based Architecture for Automated Data



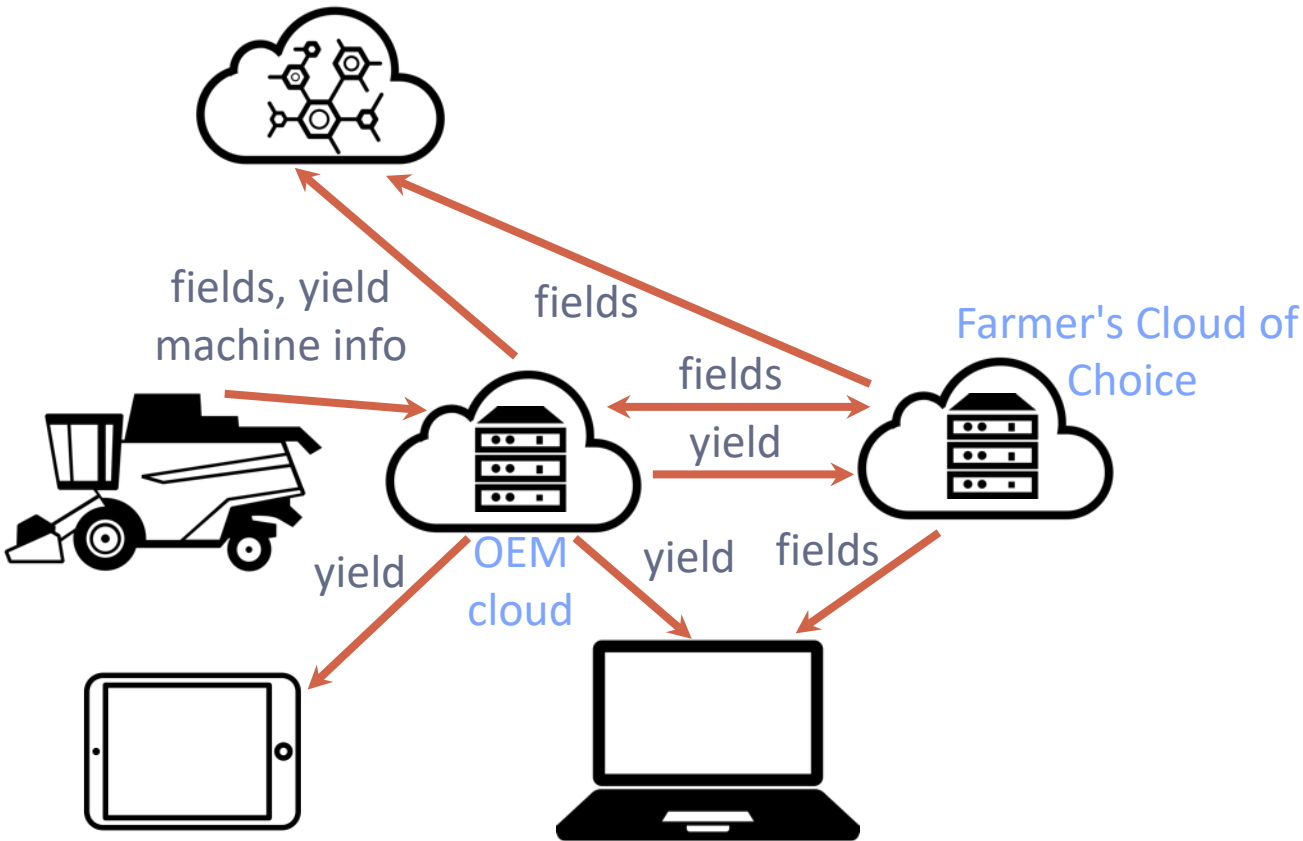
# Connection-based Architecture for Automated Data

MachineHealth.com

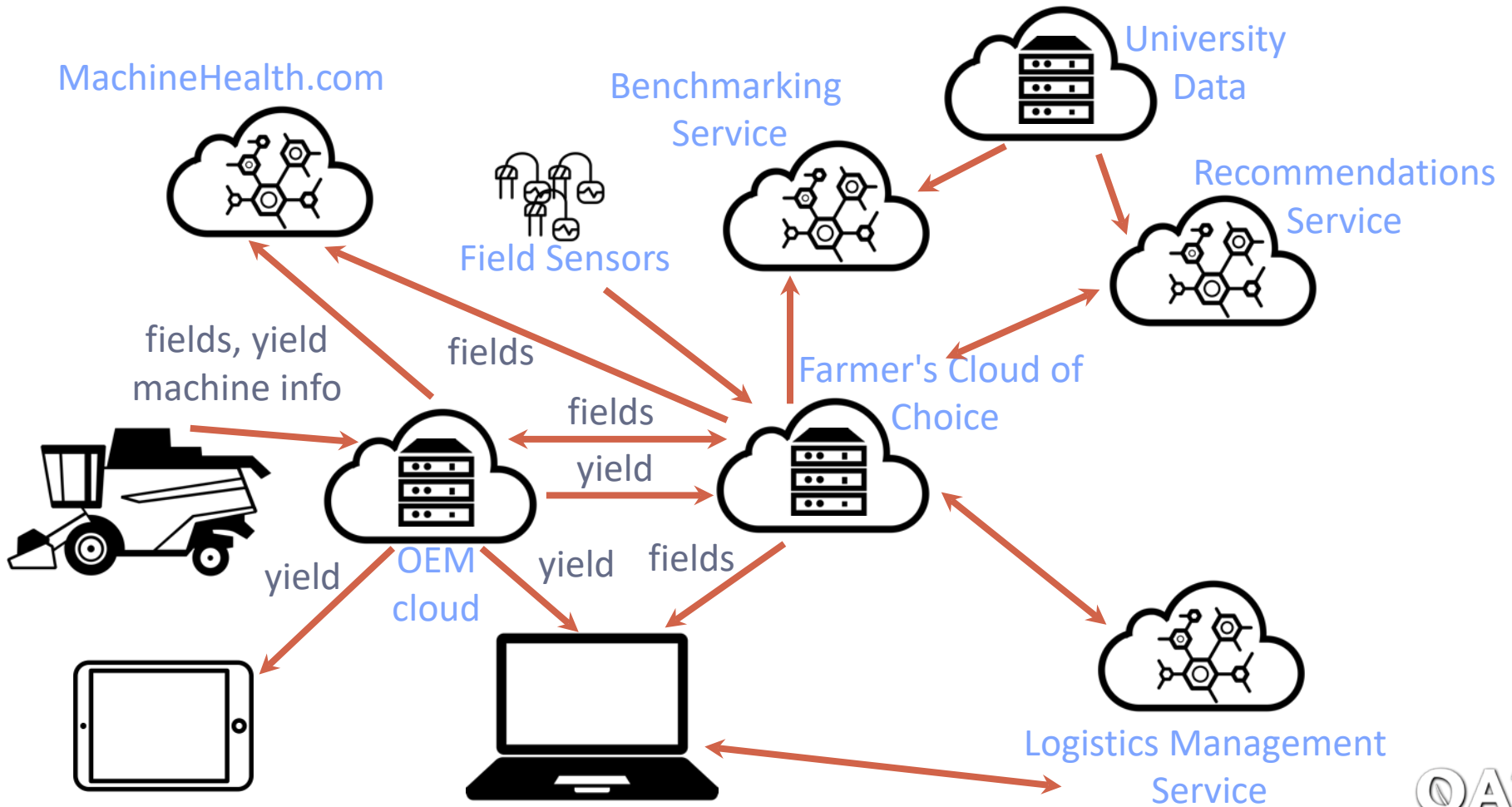


# Connection-based Architecture for Automated Data

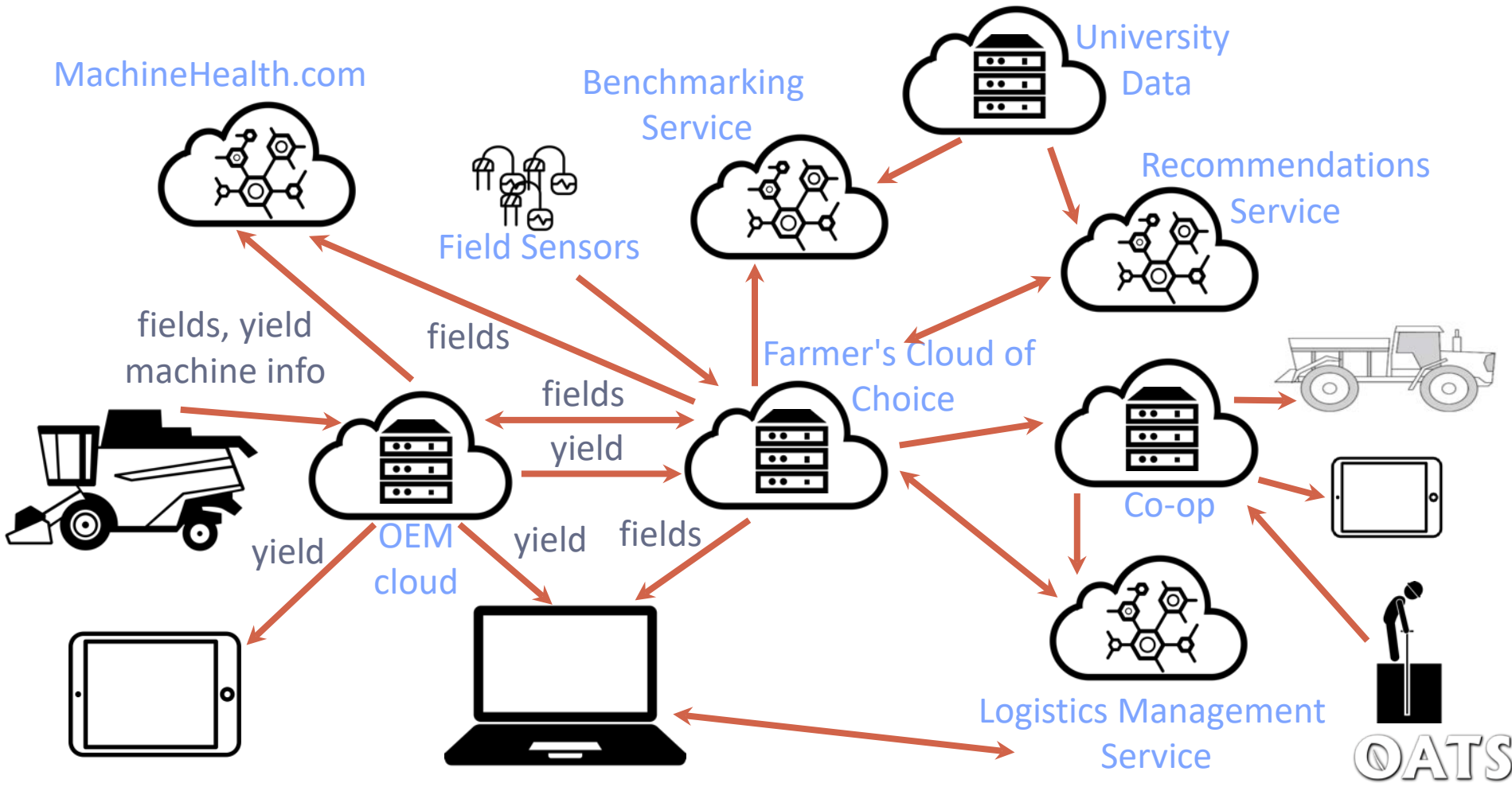
MachineHealth.com



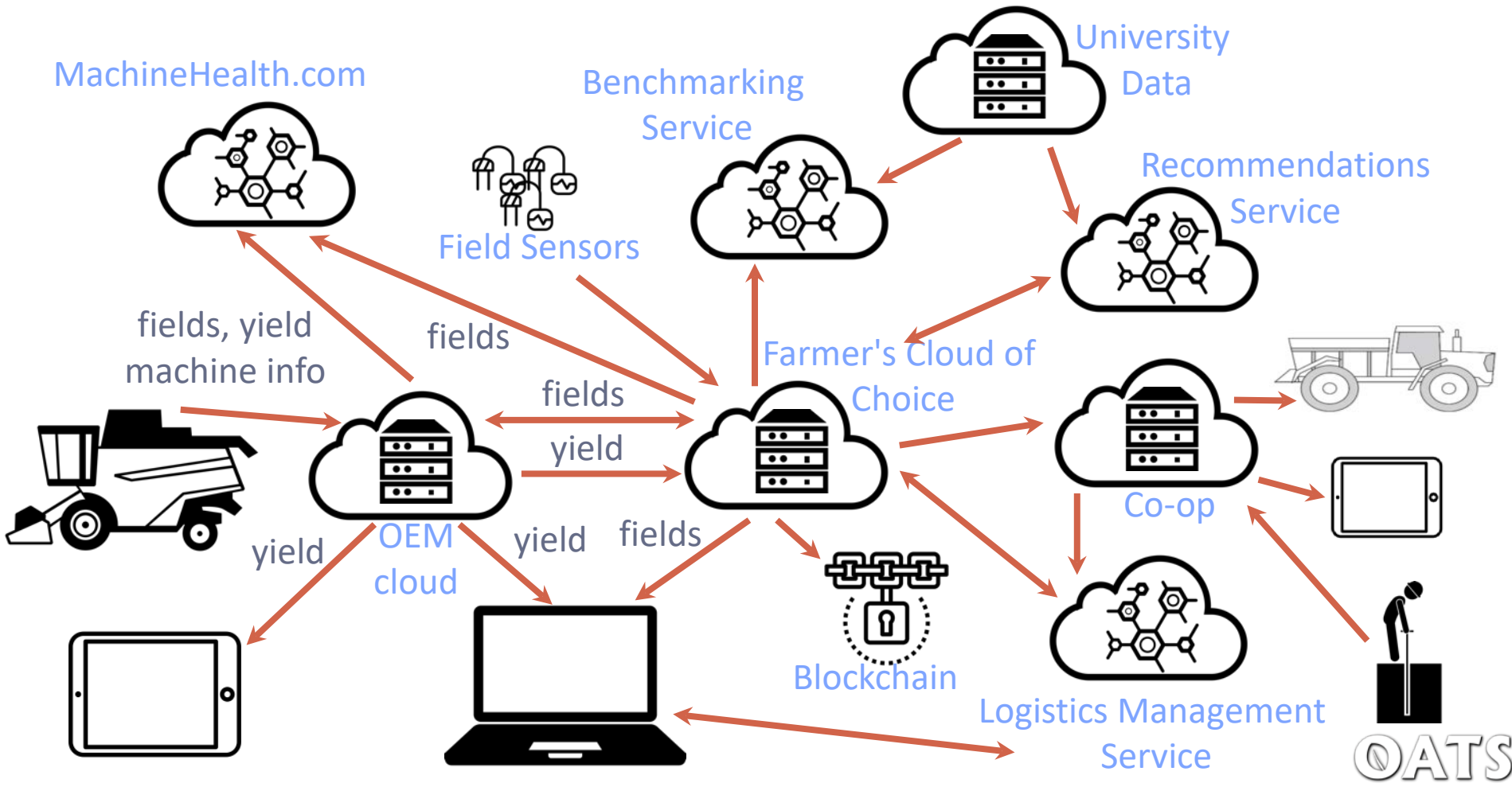
# Connection-based Architecture for Automated Data



# Connection-based Architecture for Automated Data



# Connection-based Architecture for Automated Data





# Basic Abstractions For Data Automation



**API Connection**



**(micro)service**

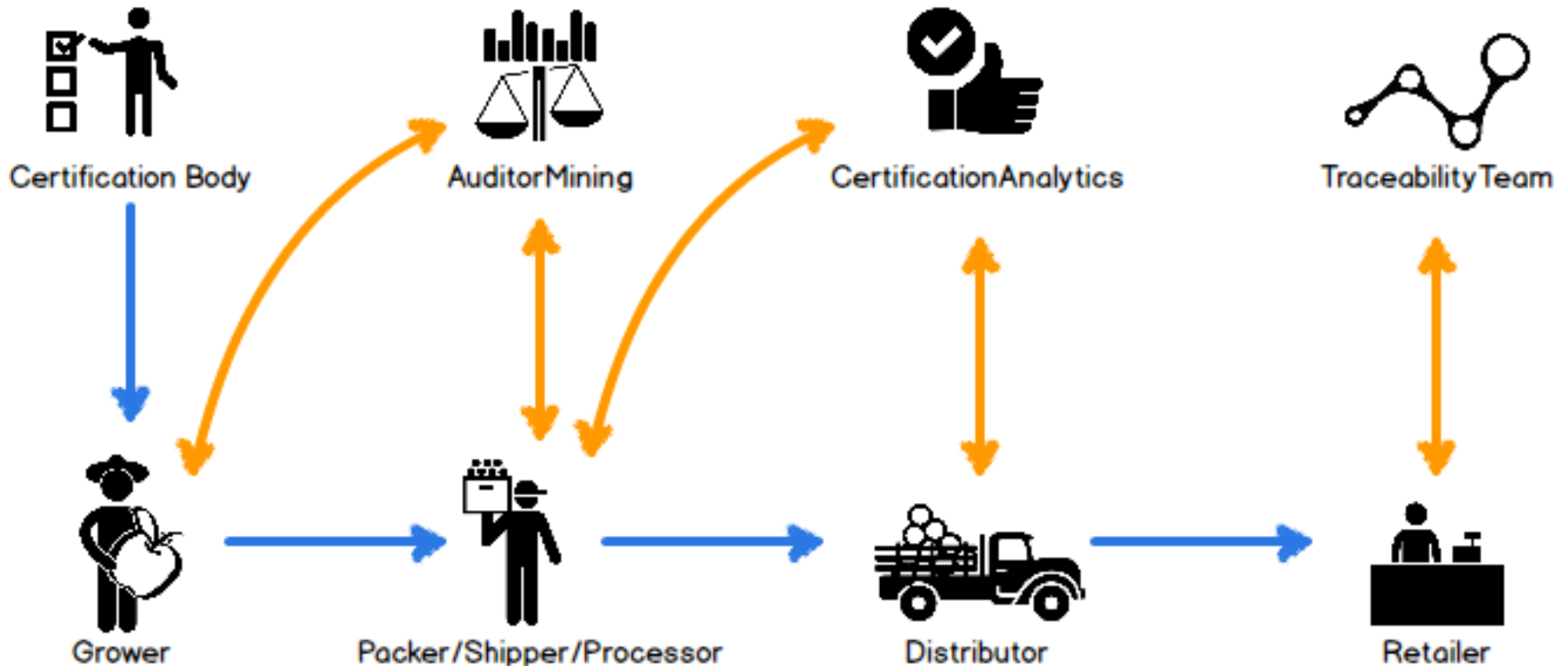


**Storage/Cache**



**Open Source Libraries**

# The Trellis Landscape



<http://trellisframework.org>

OATS

# OATS

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Open Ag Technology and Systems Center

**Thank You!**

Aaron Ault [aault@purdue.edu](mailto:aault@purdue.edu)

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# THE VINE

THE VERDE INNOVATION NETWORK  
FOR ENTREPRENEURSHIP

## Rural Broadband Connectivity & Precision Ag Technology

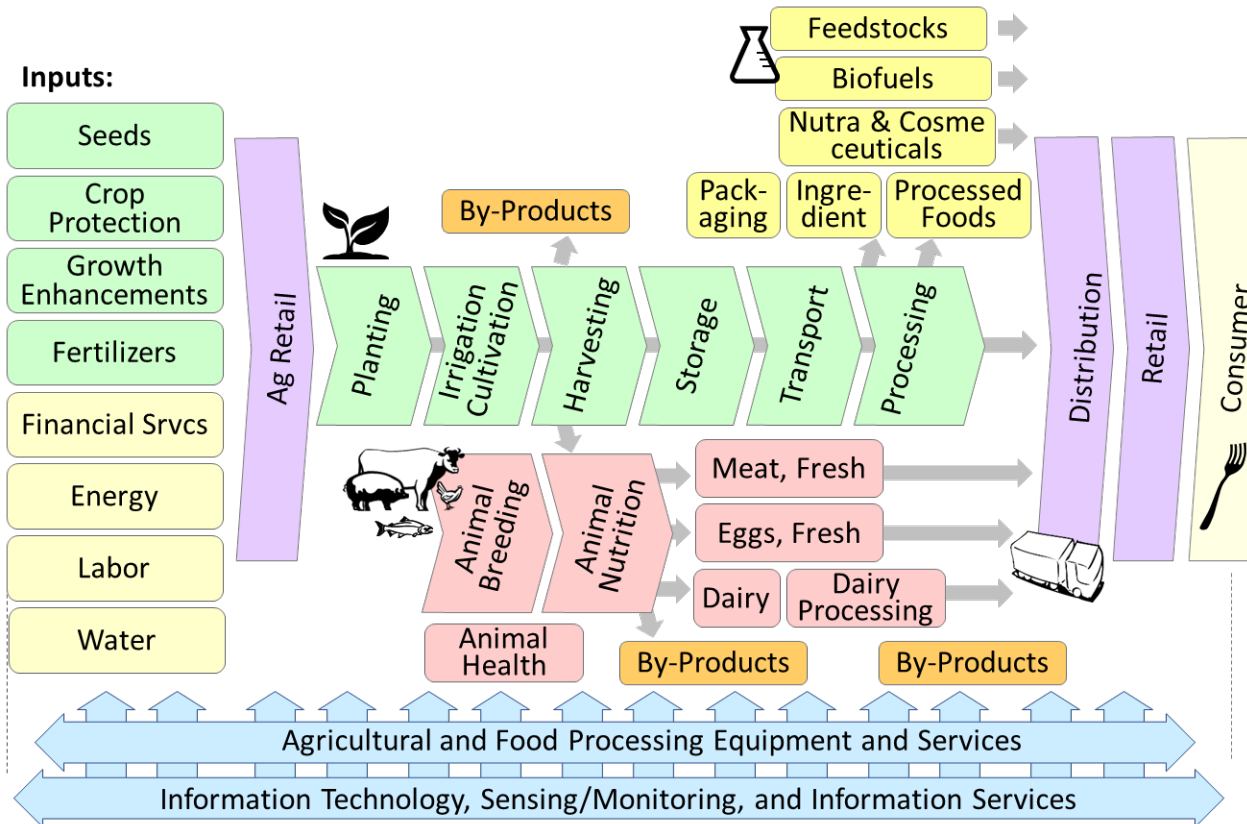
**John Selep**

*Co-Founder, Strategy & Business Development; The VINE Community  
Founder and President, AgTech Innovation Alliance (AgStart)*



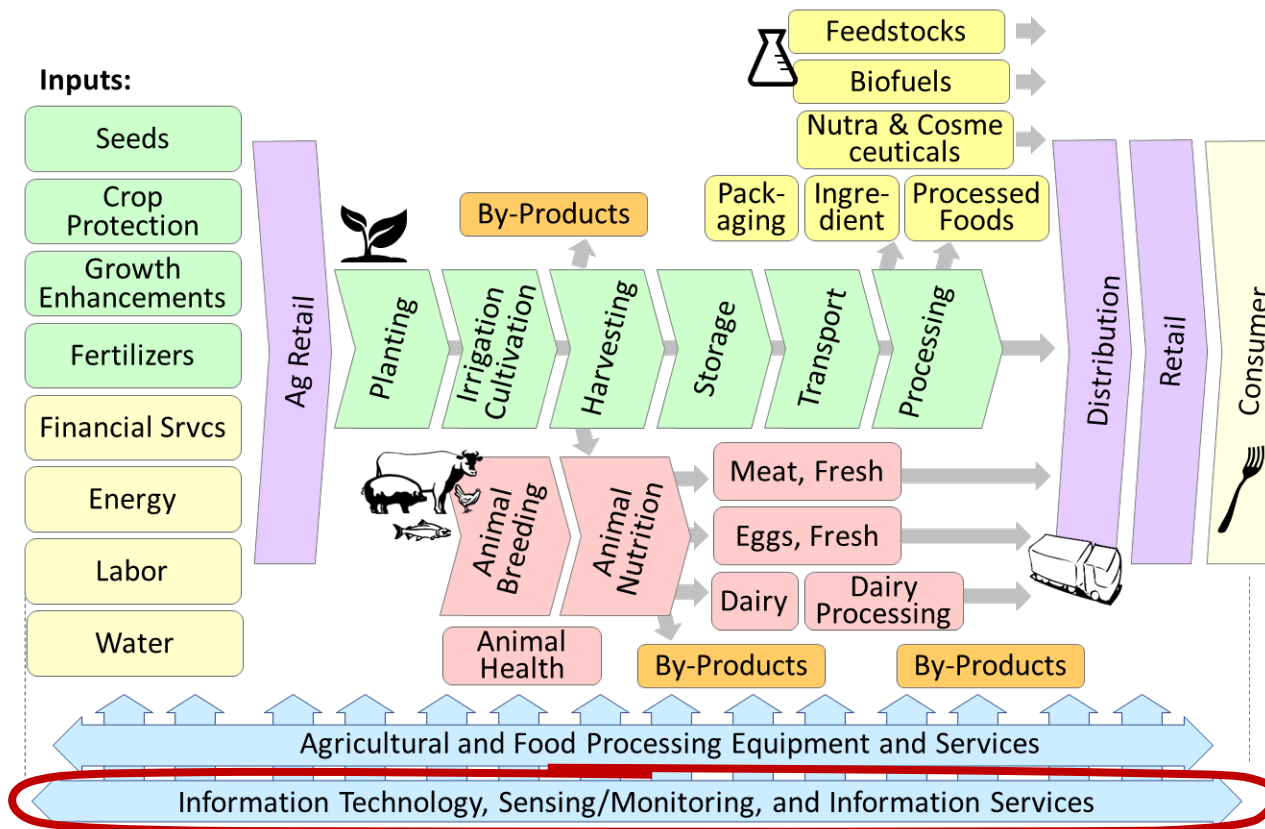
THE VINE

# Ag-&-Food Value Chain – Farm to Fork



Our global food system is a **Multi-Trillion-Dollar** enterprise, spanning an extremely diverse array of crops, cultivation practices, climate environments, and cultures.

# Information Technology underlies our entire food chain



## Insight:

Information Technology, and the connectivity that it requires, spans the entire length and breadth of our food system.

Connectivity is key to enhancing the productivity, efficiency, and sustainability of our global food system.

# Critical Issues Threaten America's Ag Leadership





# Labor Shifts Crop Selection, Spurs Innovation

Labor



## California's challenges bring berry business to Mexico

IMMIGRATION ISSUES,  
LABOR SHORTAGE  
SEND CROPS SOUTH

By TIM JOHNSON  
*McClatchy Foreign Staff*

CIUDAD GUZMAN, Mexico - Mexico, already the world's third-largest exporter of blueberries, raspberries, blackberries and strawberries, is searching for ways to get U.S. consumers to throw more fresh blueberries into the pancake batter and heap more raspberries onto their fruit salads.

As long as U.S. and other foreign consumers wolf down berries, Mexican proponents of the industry say, the surge will continue. And that's more than just an agricultural oddity in a land better-known for fields of blue-green agave and patches of cactus. The growth of the berry industry has had major consequences on regions long afflicted by high unemployment and drug-related violence.

The industry, which didn't exist less than two decades ago, employs more than 100,000 people and reaps nearly \$1 billion a year. And it's still



Toting a tray of berries, a worker at the Sunbelle farm in Ciudad Guzman, Mexico.

emerging from a labor shortage. "We're starting to see a shortage," said Javier Trujillo, a senior federal official. "It's been spectacular." "It's likely the 200,000 people who work in the National Agave Porters, a trade



## TECHNOLOGY

✉ MANDERSON@BIZJOURNALS.COM

📞 916-558-7874

🐦 @MANDERSONS

### CONNECTING THE DOTS

## The future of farming: robots

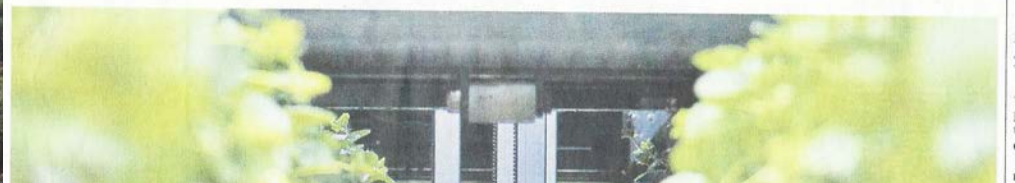
### LABOR COSTS DRIVE MOVE TO AUTOMATE

Two efforts are underway locally to help automate farming operations. A group of researchers in Davis is developing a robot to help kill weeds. And an Australian company is building an automated olive press in Woodland that will produce olive oil more quickly and with less labor than other



## Goodbye Field Hand, Hello Fruit-Picking Robot

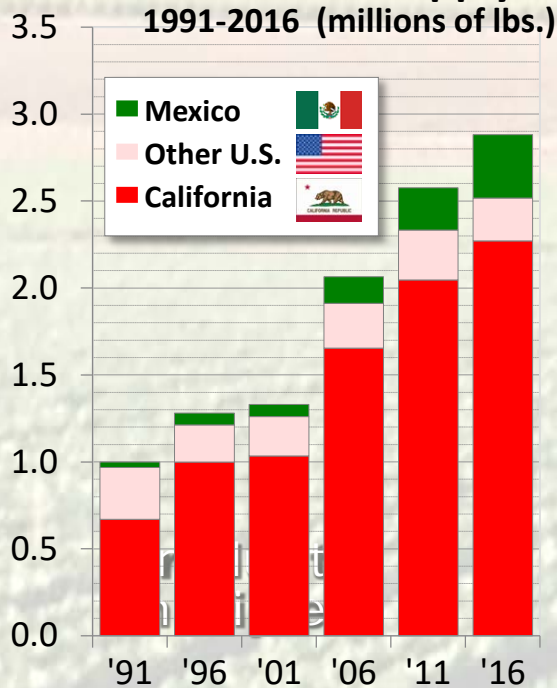
Labor shortage spurs farmers to use high-tech machines for handling delicate tasks; 'They don't take breaks'



THE VINE

# U.S.-Wide Strawberry Source of Supply

## U.S. Fresh-Market Strawberry Source of Supply



U.S. Fresh-Market Strawberry consumption **nearly tripled** over the past 25 years, with California producing over 80% of U.S. supply.



However, import competition remains strong, with imports from Mexico growing **over 10x** in the same period.



source: USDA Fruit & Tree Nuts Outlook March 2018; California CDFA, 'California Agricultural Statistics Review 2016-2017' (2016 data)



**By 2022, California strawberry production costs are expected to rise 30-40% as \$15 minimum wage and 40-hour workweek (before overtime) takes effect.**

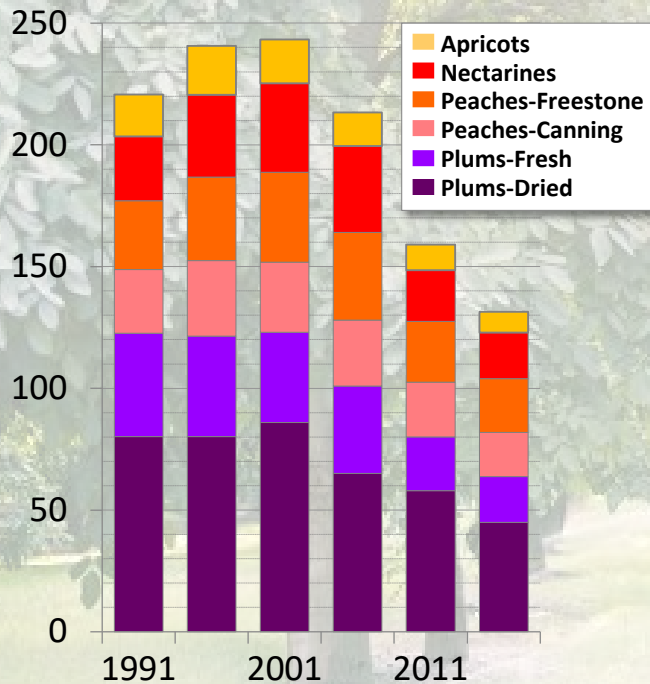
**Robotics & automation are needed to boost productivity.**



**THE VINE**

# California: 45% Drop in Stone Fruit Acreage


California Stone Fruit Acreage  
1991-2016 (000's Acres)



California stone fruit acreage has **dropped 45%** in 15 years driven by uncertain harvest-labor availability and changing consumer preferences.



sources: USDA NASS Quickstats; California CDFA, 'California Agricultural Statistics Review 2016-2017' (2016 data)



**Once a 'Top-20' California crop, peaches and other stone fruit could diminish further, unless a harvest labor solution is found.**

**Robotics & automation are needed to boost harvest productivity**

## Feds' water cutoff slams Valley

DRY WINTER ADDS TO FARMS' DROUGHT WOES

By MATT WEISER  
mweiser@sacbee.com

Hundreds of farmers in the Central Valley were told Friday they can expect zero water deliveries this year from the federal government, the latest fallout from what is likely to be a fourth straight drought year in California.

## CALIFORNIA'S DROUGHT

As rural regions struggle with epic dry conditions, lawmakers propose building a major new reservoir

# Farmers face a bleak year

STATE ECONOMIC IMPACT IN BILLIONS OF DOLLARS LIKELY

By DALE KASLER  
dkasler@sacbee.com

COALINGA - When spring arrives, the Central Valley farm fields owned by Harris Ranch normally come to life with tomatoes, lettuce and watermelons. This year, much of the land has been left dry and bare.

California's epic drought is being felt all over rural California, from small farms to large agribusinesses. The drought has affected just 5, is idling thousands of acres of cropland. It plans to use its same water. "The drought has affected just come out of this ground."

## Farms: Drought takes toll on Valley residents

FROM PAGE A14

call if there is an emergency?" Seasonally limited jobs of pruning trees, spraying fungicide or preparing fields for harvest are shrinking more this winter. And, in Mendota, an increasingly anxious crowd of laborers swells in the predawn hours and again at dusk in the parking lot outside the Lavandería Sonora laundry and the Sonora Department Store, an old art deco building converted to a market and *taquería*.

"I get here between 3 and 4 a.m. and wait in the cold," said Carlos Quintero, an undocumented immigrant from El Salvador who has been



Water



Sunday, February 22, 2015 | The Sacramento Bee A15

# California: 80% of Global Almond Production

## 2014 Global Almond Product Value (US\$ B)



California produces **80%** of global almonds by value, with almost a **million acres** in production.

Mechanization has enabled dramatic growth in tree nut acreage, avoiding labor constraints



source: U.N. Food & Ag Organization, [fao.org/faostat](http://fao.org/faostat) (2014 data)  
California Cdfa, 'California Agricultural Statistics Review 2015-2016' (2015 data)



**Mechanization has enabled dramatic tree nut industry growth, but water availability may constrain further growth.**

**Precision agriculture is needed to stretch a finite water supply.**



**THE VINE**



# The VINE – A large Action Cluster for AgTech Innovation



**THE VINE**  
THE VERDE INNOVATION NETWORK  
FOR ENTREPRENEURSHIP

**The VINE represents a collaboration of the University of California, AgStart, and a range of incubators and accelerators across California. Like a grapevine, The VINE will connect clusters of innovation resources, making it easier for innovators and entrepreneurs to identify and access the resources they need.**

Mentorship  
& Connection



Co-Working  
Space



Maker  
Spaces



Wet  
Labs



Green-  
houses



Growing  
Fields



**THE VINE**



# THE VINE

THE VERDE INNOVATION NETWORK  
FOR ENTREPRENEURSHIP

## A Collaborative Statewide Network of Resources for Ag-and-Food Entrepreneurs



# THE VINE

# Thank You!



## THE VINE

THE VERDE INNOVATION NETWORK  
FOR ENTREPRENEURSHIP

To learn more about the VINE  
programs, events &  
opportunities, please visit:

Facebook: @TheVINE.io

LinkedIn: The VINE Community

[www.TheVINE.io](http://www.TheVINE.io)

Reach out to me directly:

John Selep

[John@TheVINE.io](mailto:John@TheVINE.io)

Thank our Sponsors:



## THE VINE

# Don Williams, Senior Specialist for Broadband Development, BroadbandUSA, NTIA



# Global Cities Team Challenge

- GCTC brings together
  - industry
  - universities
  - nonprofits
  - local and state governmentto work on projects to share knowledge and best practices on smart community technologies
- National Institute of Standards and Technology leads GCTC , in partnership with NTIA, Dept. of Homeland Security, National Science Foundation, International Trade Administration and others



# Ag & Rural Supercluster – Objectives



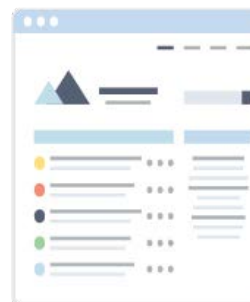
## Farmers & Ranchers

Help farmers and ranchers improve water efficiency, produce higher quality crops and raise healthier livestock, while making it easier to meet federal and state reporting requirements.



## Rural Communities

Focus on projects to bridge the digital divide and close the homework gap, improve healthcare and the ability to age in place, improve economic development and spur innovation.



## Results

Set of best practices and a replicable blueprint for other communities and partners to use.

If you are a community, city, company or university interested in participating in the Ag & Rural Supercluster, join us!

# Ag & Rural Supercluster – Action Cluster



## Agriculture

Looking at ways to streamline food sheds (supply chain, i.e., farm to table) and increase smart ag (crops, livestock).



## Rural Communities

Potential collaborations to streamline and improve government services, education, workforce development and deploy regional approaches.



## HealthCare

Collaborating on telehealth projects (wearables, data analytics, remote monitoring), telemedicine (physical and mental), blockchain, and cybersecurity.

## Contacts:

Don Williams, Sr. Specialist for Broadband Development, BroadbandUSA, NTIA, [dwilliams@ntia.doc.gov](mailto:dwilliams@ntia.doc.gov)

Jean Rice, Sr. Program Specialist, BroadbandUSA, NTIA, [jrice@ntia.doc.gov](mailto:jrice@ntia.doc.gov)

# Smart Agriculture: Increasing Productivity through Technology

## Questions and Comments

- Please type your questions in the chat or Q&A box.
- Slides and transcript will be posted on the BroadbandUSA website within 7 days after the webinar.

<https://broadbandusa.ntia.doc.gov/past-event>



# Broadband USA

Thank you for attending.

Tune in for the next Practical Conversations Webinar

## Statewide Strategies for Rural Digital Inclusion

July 18, 2018

2:00 pm EST

Registration is required for each webinar:

<https://broadbandusa.ntia.doc.gov/event>

# BroadbandUSA is available to help communities with their broadband access and digital inclusion efforts

## BBUSA Resources:

- [Implementing a Broadband Network Vision: A Toolkit for Local and Tribal Governments](#)
- [Community Broadband Roadmap Toolkit](#)
- [Guide to Federal Funding of Broadband Projects](#)
- [Using Partnerships to Power Smart Cities](#)

## For General Information:



202-482-2048



[broadbandusa@ntia.doc.gov](mailto:broadbandusa@ntia.doc.gov)



<https://broadbandusa.ntia.doc.gov/resources>

## To Request Technical Assistance (TA):



Broadband TA Request Form

<https://broadbandusa.ntia.doc.gov/ntia-common-content/how-we-can-help>