

Open Ag Technology and Systems Group



James Krogmeier
Professor of Electrical and Computer
Engineering, Purdue University

Dennis Buckmaster
Professor of Agricultural and Biological
Engineering, Purdue University

Aaron Ault
Senior Research Engineer

Background: James Krogmeier

Farmer's Son
& Landowner



Wheat, irrigated and dryland corn, proso millet,
pinto beans, hay



Background: JVK



Research in statistical signal processing applied to:

- Software defined wireless communications and networking.
- Radar.
- Intelligent transportation systems.
- Agriculture.

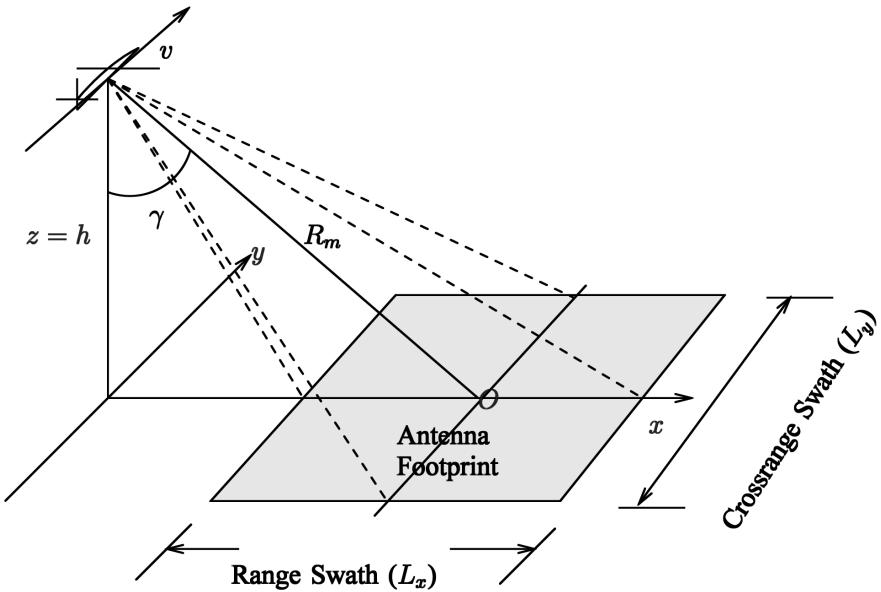
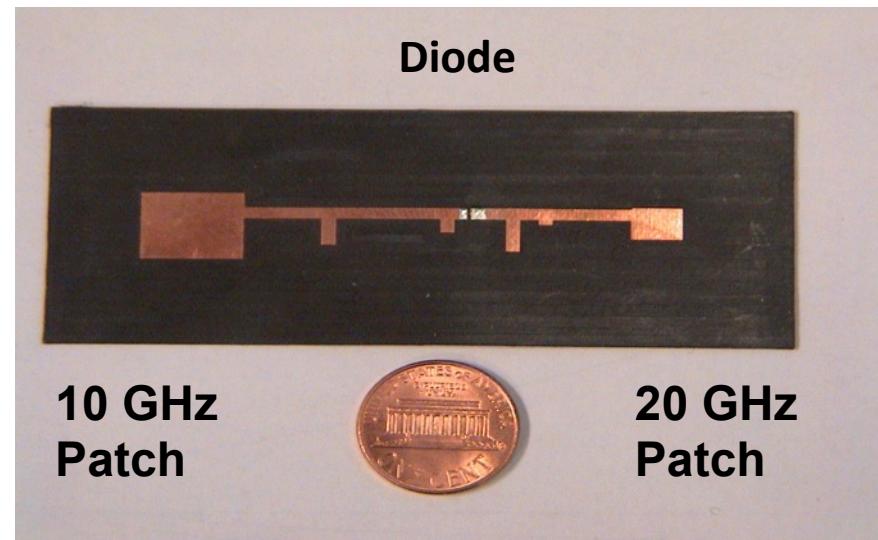


Fig. 1. Imaging geometry of side-looking airborne radar.

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Background: JVKE



Travel time estimation by anonymous signature re-identification



I-70 Data Collection Site



Mile Marker 66.6

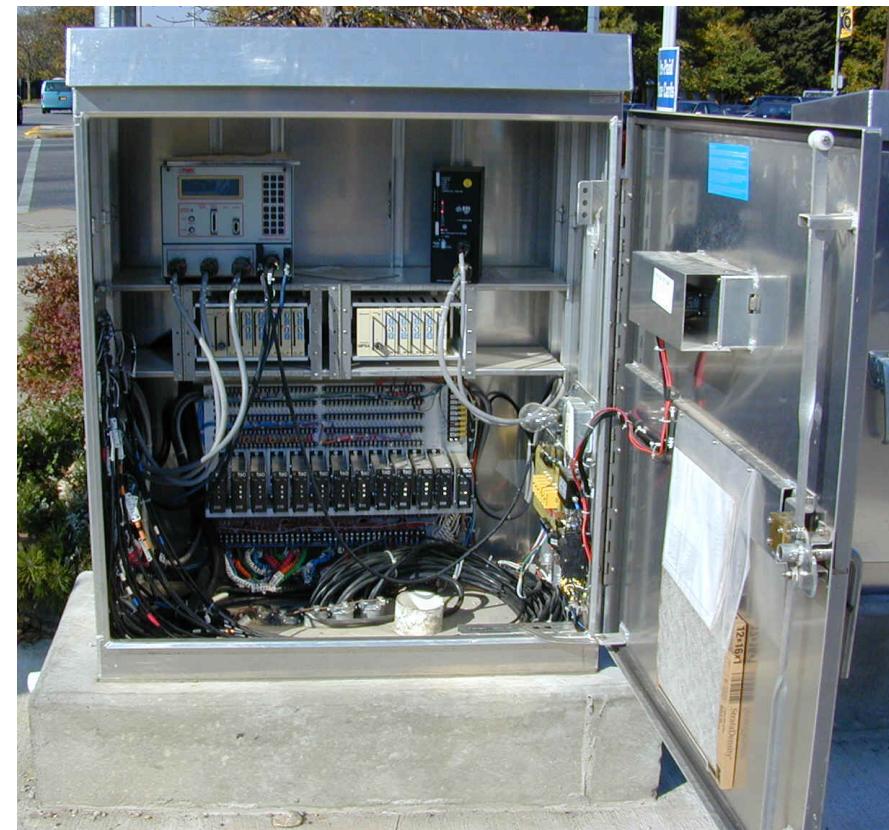


Mile Marker 67.3

Background: JVKE

Research in statistical signal processing applied to:

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Ag Research Areas

- ↗ Modeling, Signal Processing, Data Mining, and Visualization
- ↗ Wireless Sensor Networks
- ↗ Mobile Apps
- ↗ Wireless Communications
- ↗ Embedded Systems
- ↗ Aerial Drone Imaging
- ↗ Autonomous Robotic Agriculture

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Open Ag Tech Group: Open Ag ToolKit

<http://openagtoolkit.org>



Rock



Field Work



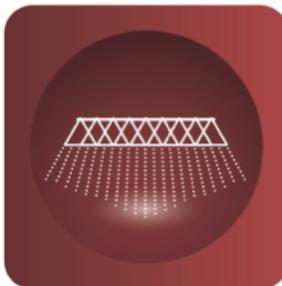
Trello Sync



Elevations



Watershed
Delineation



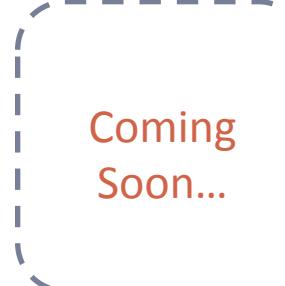
Spraying



Planting



Field
Notebook



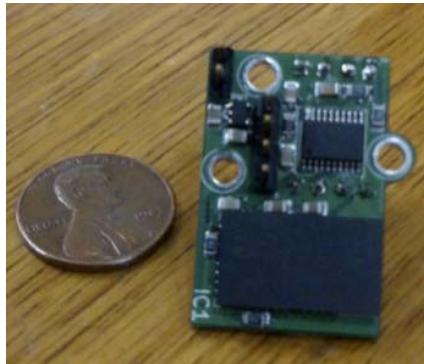
Machinery



OADA Sync

Ag Research Areas

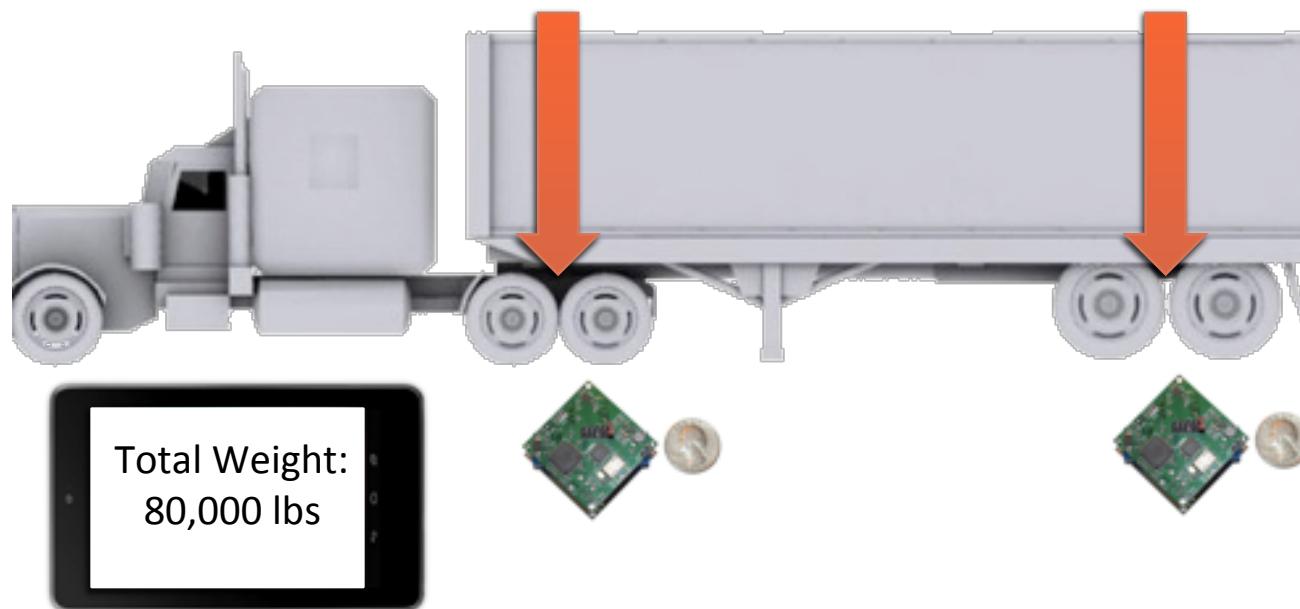
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- ↗ **Wireless Sensor Networks**
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- ↗ **Embedded Systems**
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Open Ag Tech Group: Semi Weight

65 psi = 38,000 lbs

72 psi = 42,000 lbs



>> Automatic combine calibration, silage tonnage maps

Ag Research Areas

- ↗ **Modeling, Signal Processing, Data Mining, and Visualization**
- ↗ Wireless Sensor Networks
- ↗ Mobile Apps
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Sustainable Engineered Agronomic Systems (SEAS)

The vision of ERC-SEAS is to lead the research, development, and proof of concept experimentation in sensing, networking, computing, data analytics, and agronomy needed to optimize the engineered agronomic system and sustainably double production of major food and feed crops over the next 50 years.

Farm Data is “Big” Data

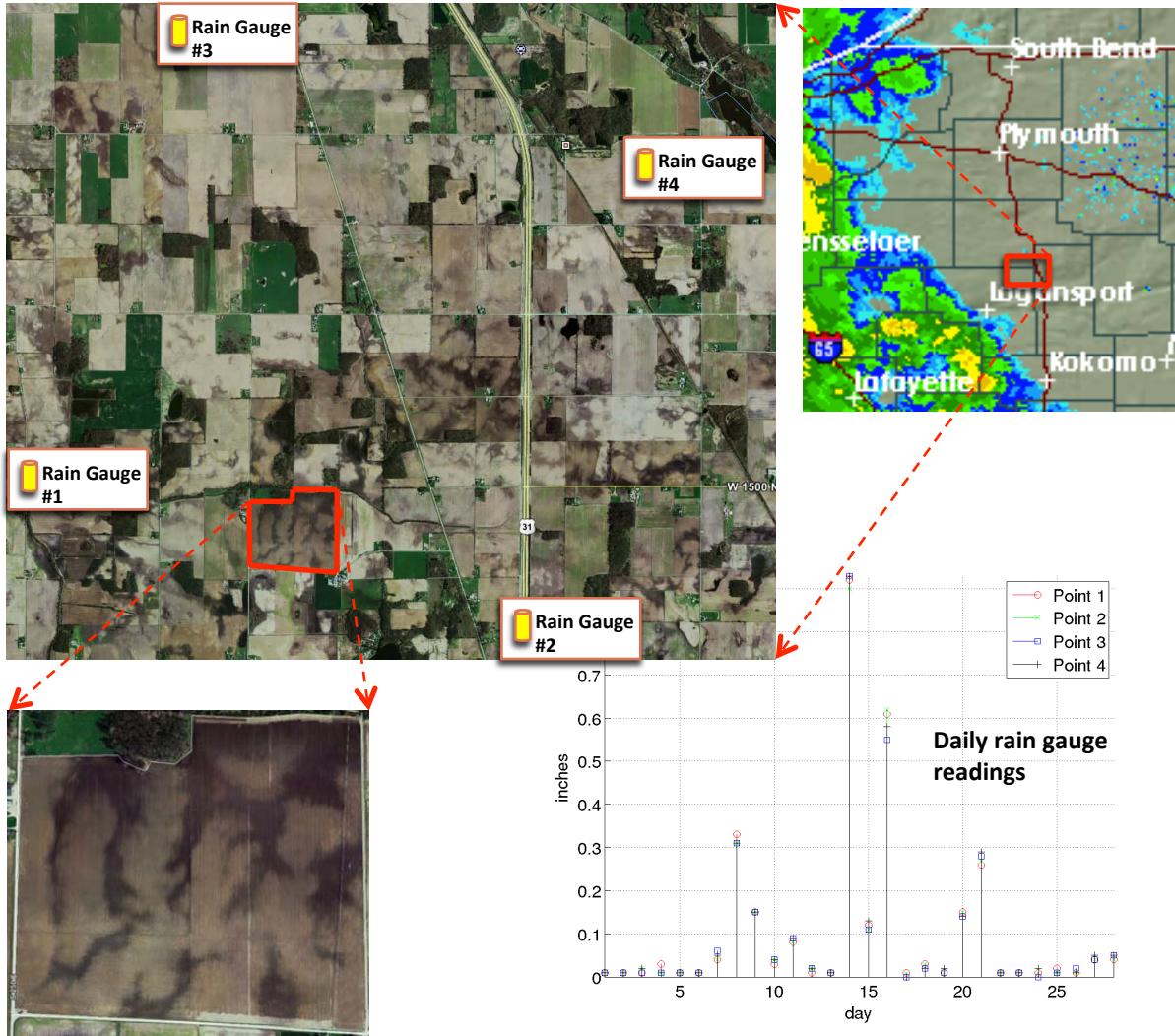


Table 1: Estimates of machine/implement data produced. The lower bound was created by adding the rate of RTK GPS data at 5 Hz to that of some simple low rate sensors. The upper bound was created assuming logging of all ISOBUS (Stone et al., 1999) traffic at its maximum rate of 250Kbps.

Machine and Operation	Data rate (Kbytes/sec)		Map data produced in 12 hour day (Mbytes)		Map data per acre @ 20 acres per hour (Mbyte/acre)	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Tractor + Tillage Implement	4	30	173	1296	0.7	5.4
Combine	4	30	173	1296	0.7	5.4
Tractor + Planter	15	30	654	1296	2.7	5.4

Farm Data is “Big” Data



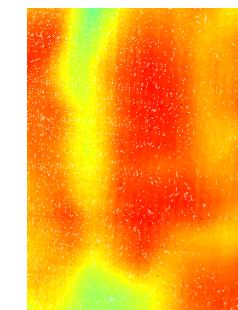
**Soil Parent
Materials Map**



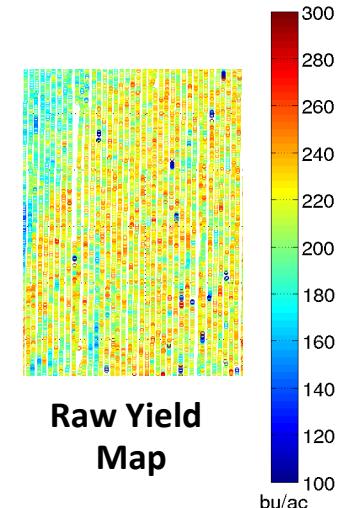
**Soil Drainage
Class Map**



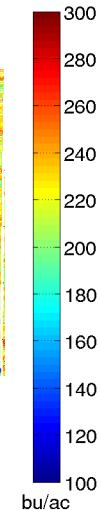
**Soil Orders
Map**



**LiDAR Elevation
Map**



**Raw Yield
Map**





orn Production Machine

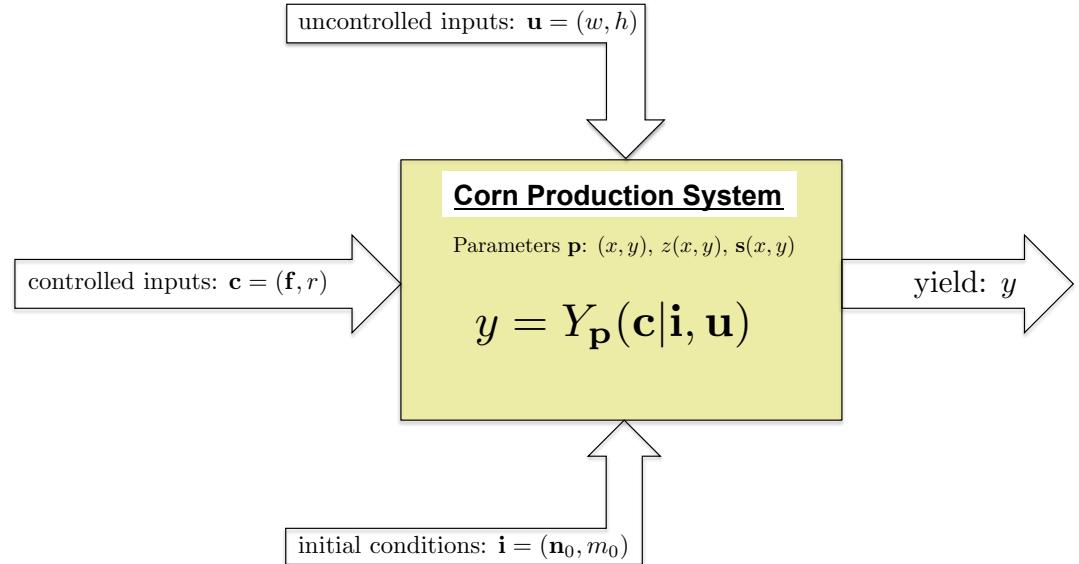


orn Production Machine

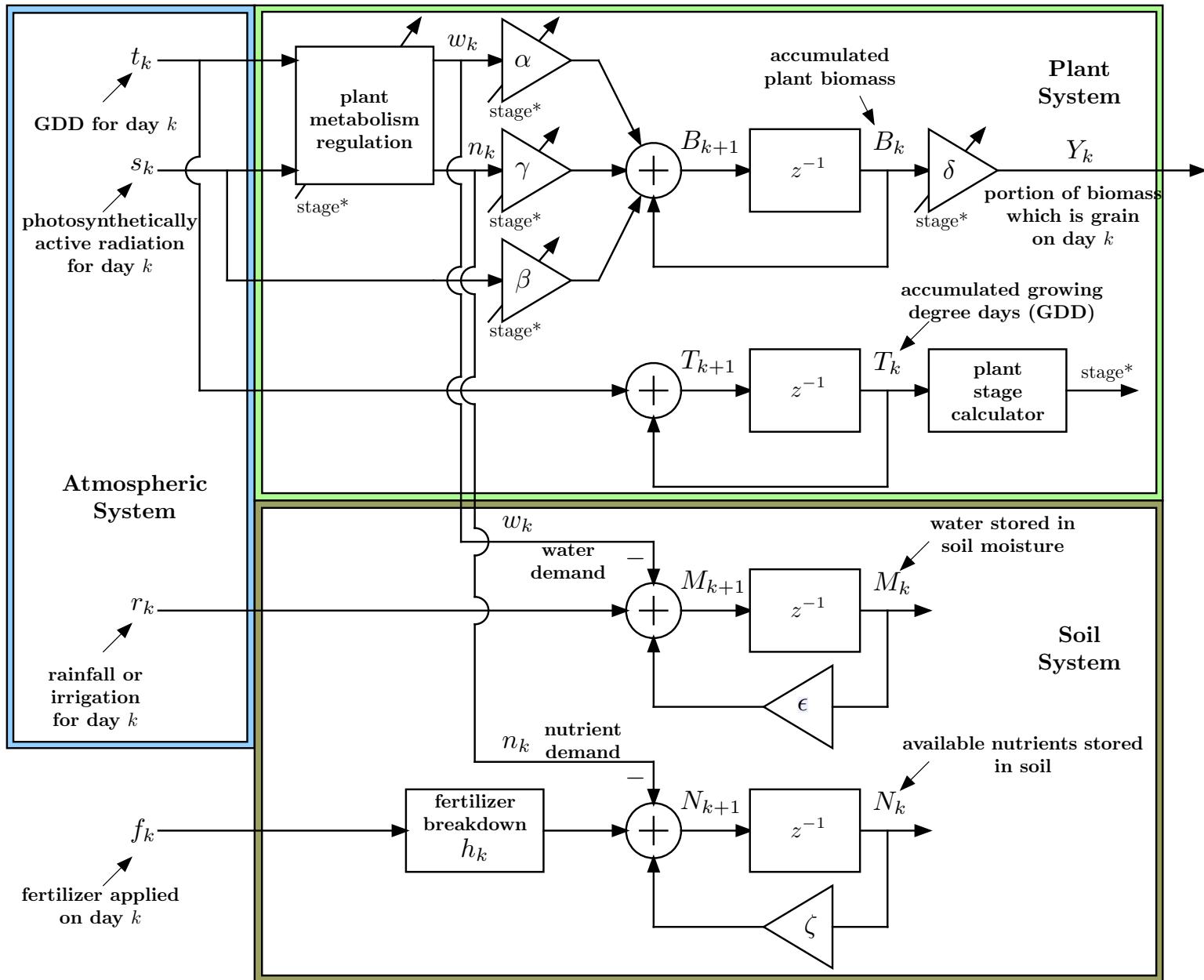


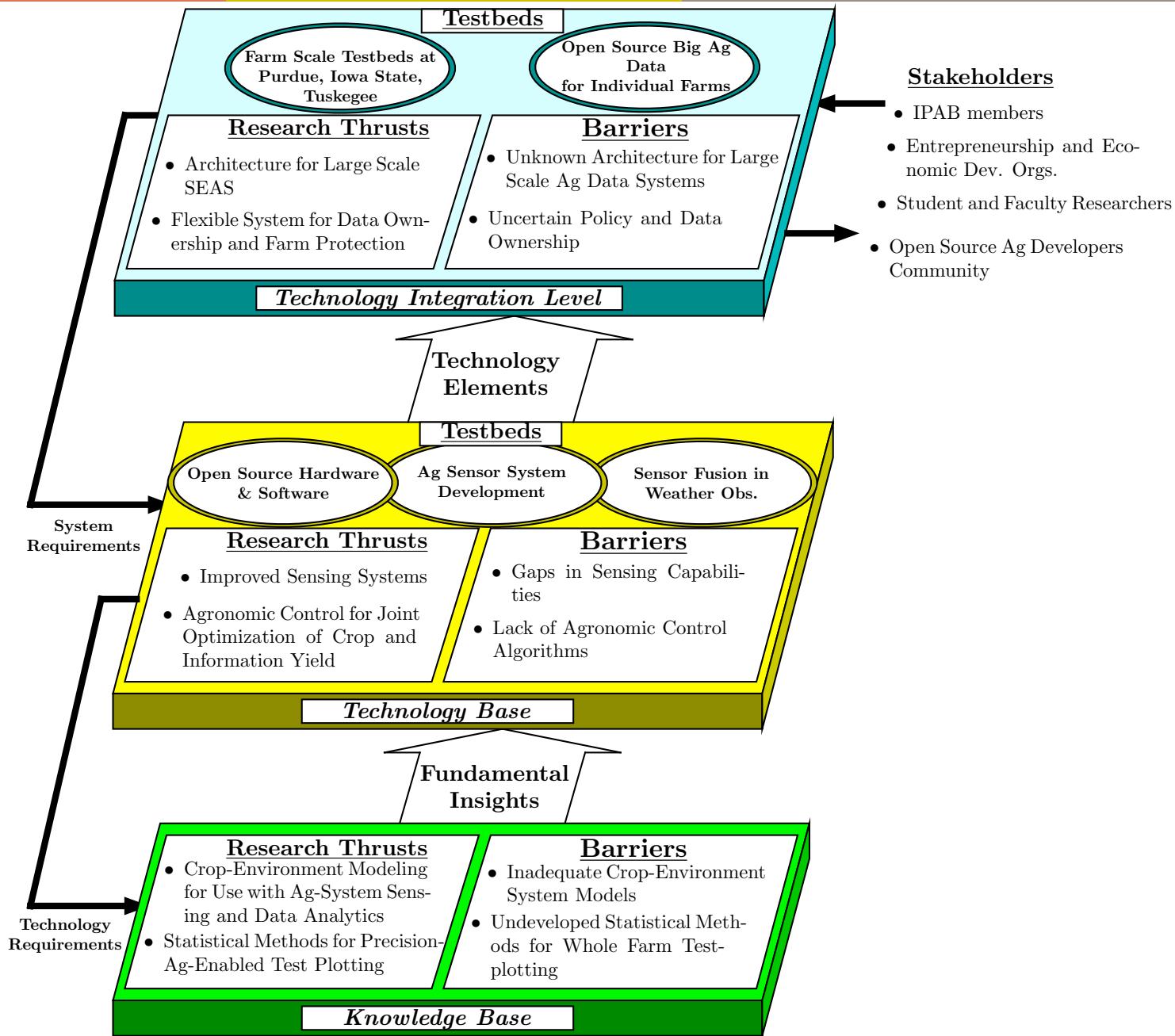
Corn Production Machine

- Pixel parameters:
 - Pixel spatial position: (x, y)
 - Elevation: $z(x, y)$
 - Soil type (a vector): $\mathbf{s}(x, y)$
- Controlled inputs:
 - Variety/Genetics (a discrete variable): $g(x, y)$
 - Applied fertilizer map (a vector): $\mathbf{f}(x, y)$
 - Seeding rate map: $r(x, y)$
- Initial conditions:
 - Initial available soil moisture: $m_0(x, y)$
 - Initial available soil nutrients (a vector): $\mathbf{n}_0(x, y)$
- Uncontrolled inputs:
 - Rainfall map: $w(x, y; t)$
 - Heat unit map: $h(x, y; t)$
- Output yield map: $y(x, y)$

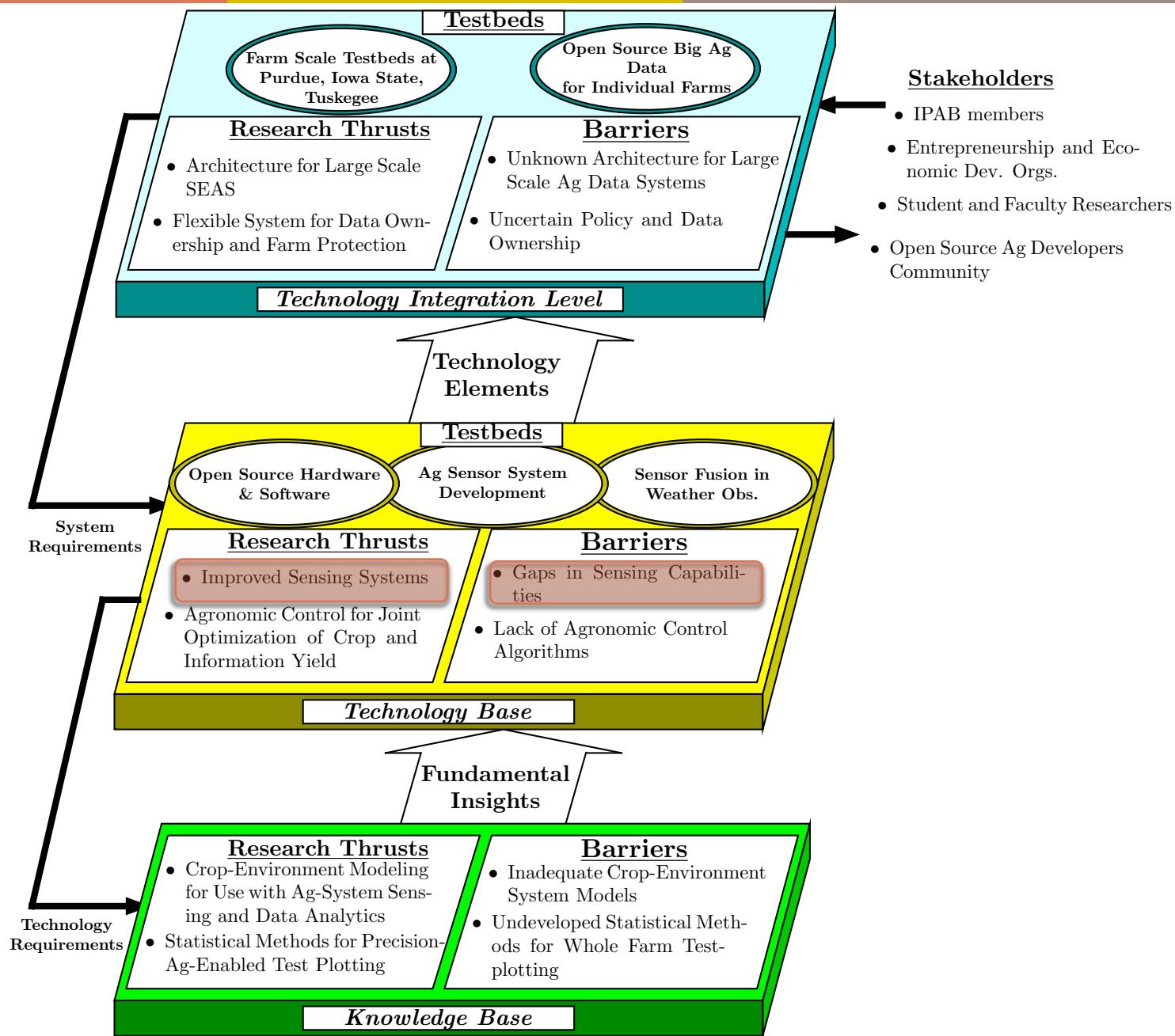


Corn Production Machine

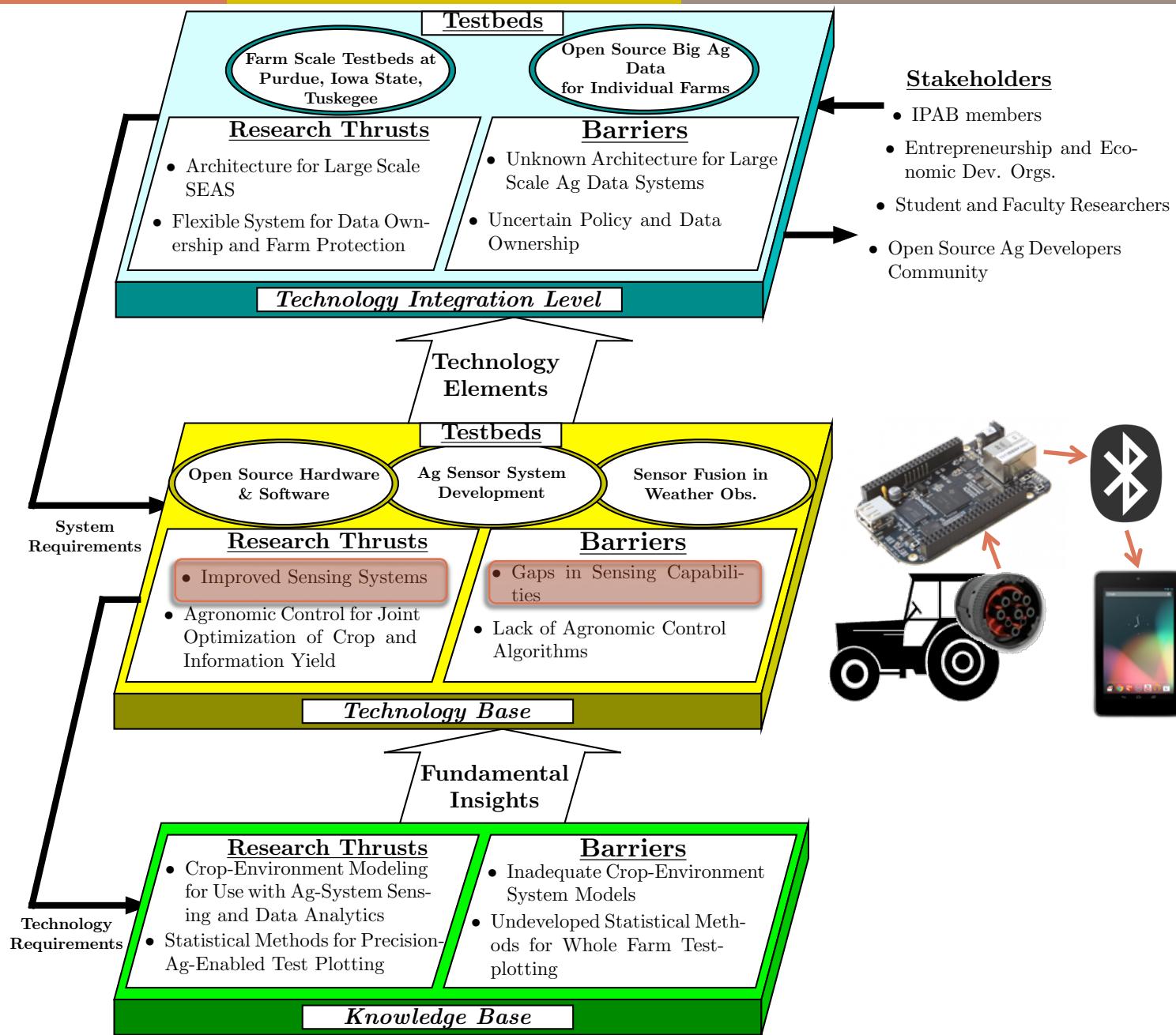




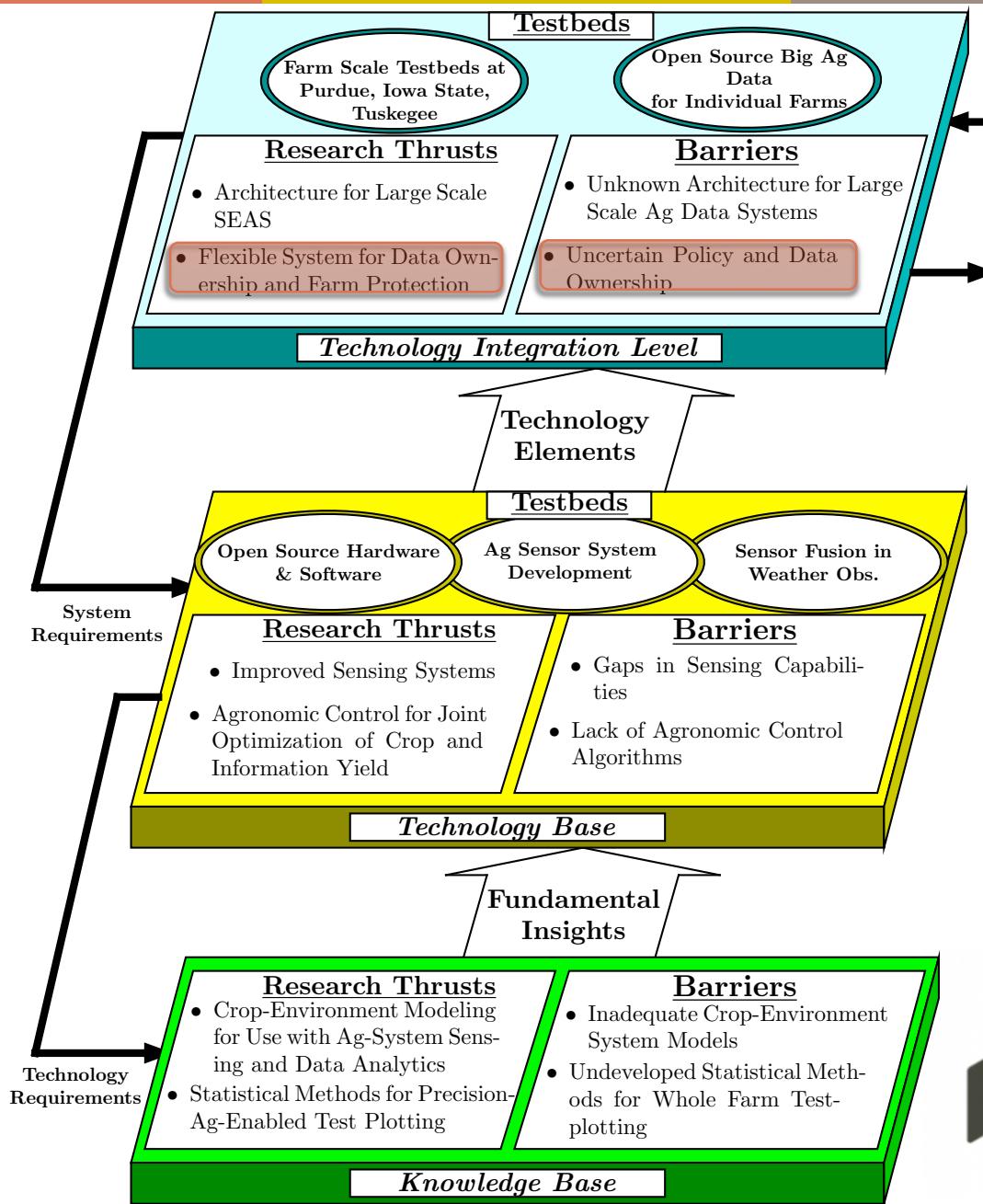
Important Missing Links



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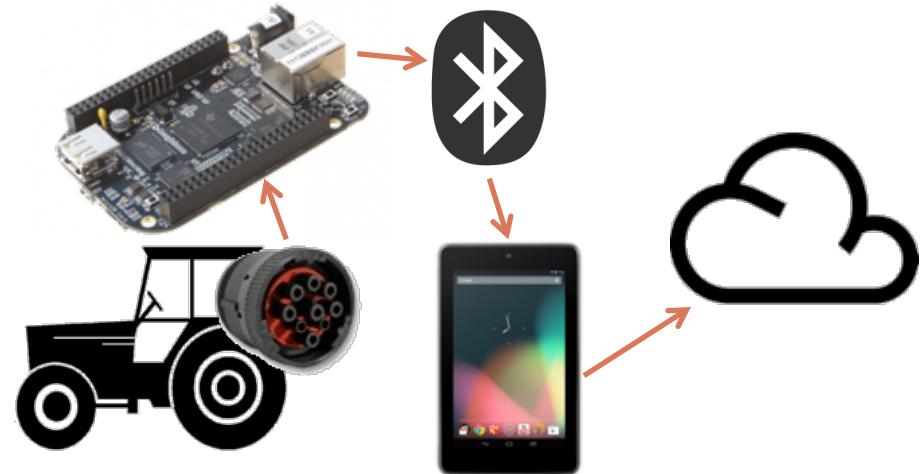
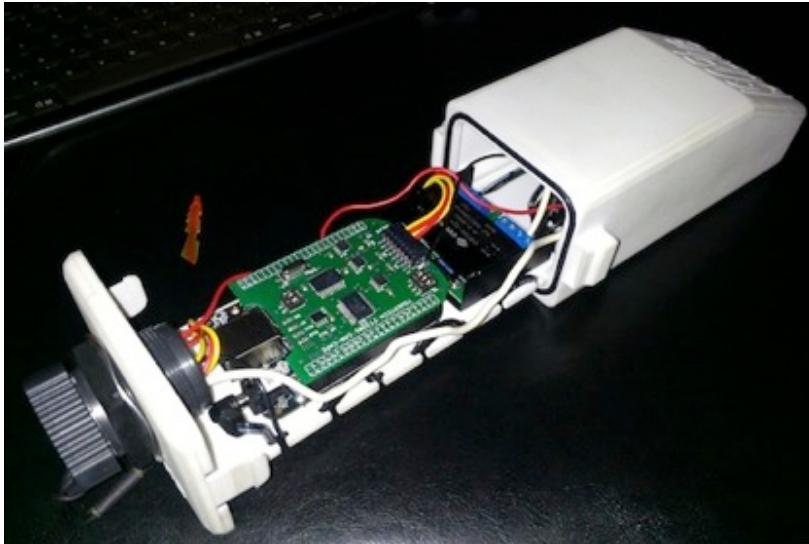


APACHE
HTTP SERVER



Open Ag Tech Group: ISOBlue

<http://isoblue.org>



>> Now with RTK GPS for under \$200!