OATSCON23

ISOBlue

Edge-computing on the go

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OATS

IoT4Ag

PURDUE UNIVERSITY

Agenda

1. ISOBlue's History
2. What’s Inside ISOBlue?
3. ISOBlue Software Review
4. Research Leveraged by ISOBlue

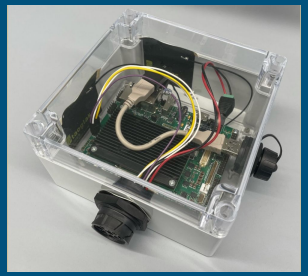
ISOBlue's History: What's ISOBlue?

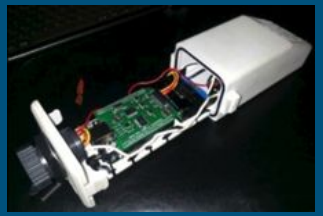
OATS' open-source edge-computer for rural telematics and communications research; built with off-the-shelf hardware.

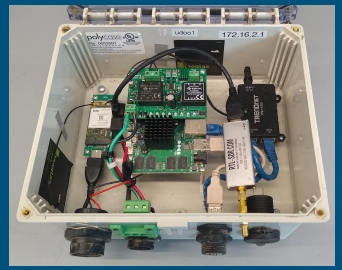
DATA SOURCES: CAN (SAE J1939), GPS, Bluetooth, Software Defined Radios (SDR), RFID tags, cameras, USB, Serial, and more coming soon.

Deployed

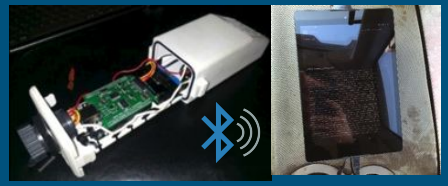
Indiana, Colorado, Nebraska, Pennsylvania, Ohio, Netherlands

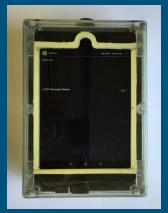


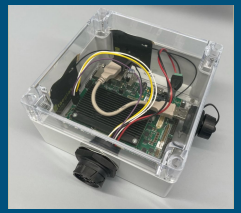


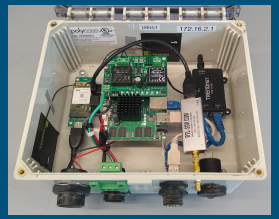


ISOBlue's History: Genealogy









Gen 0 (2014-2016)
Beaglebone black + CAN expansion board

- Forwarded ISOBUS data to Android tablet via Bluetooth
- Level DB-based local data storage

Gen 1 (2016-2017)
Android tablet with CAN-USB transceivers

- Kappa data streaming architecture
- OADA API-based pipeline for data interoperability

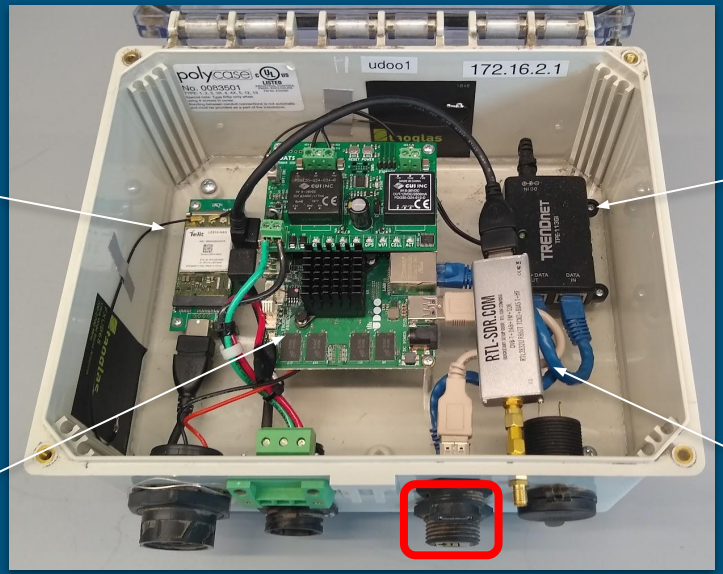
Gen 2 (2017-2020)
ARM Cortex-A9 SBC

- Apache Kafka data streaming pipeline
- Added PoE and cameras **(Gen 2.1 - ISOBlue HD)**
- Software is Avena based **(Gen 2.2)**

Gen 3 (2020-today)
Intel x86 SBCs and Avena

- Added PoE RFID readers and Software Defined Radios (SDRs)
- Hardware-agnostic design

What's Inside ISOBlue?



Cell Modem

PoE Injector

Single Board Computer (SBC)

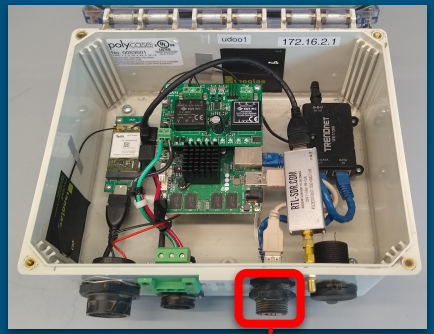
Software Defined Radio (SDR)

UDOO x86-based 3rd Gen. ISOBlue

What's Outside ISOBlue?

GPS modules

ISOBUS



802.11s WiFi Mesh radios

LTE/5G modems

IP Cameras

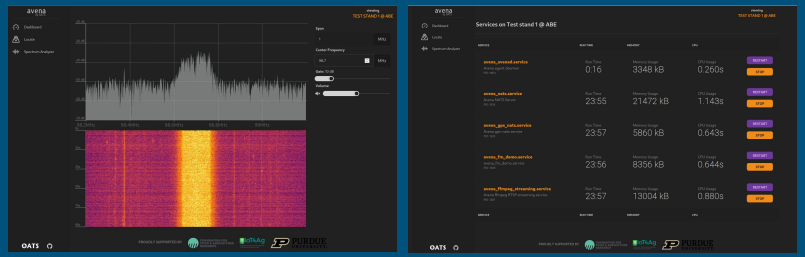
UHF RFID readers

LoRaWAN gateways

ISOBlue Software Review: Avena

Avena is an open-source framework for:
abstracting machine details and **easy computing…**

Made possible by exchanging **avena messages**: standardized JSON objects sent through a messaging system called **NATS.io**



The Avena dashboard as featured on the IoT4Ag Year 2 annual meeting, showing live data from a software defined radio (SDR), and showing service status from an ISOBlue edge-computer

Built upon open-source

GNU/Linux

Docker

NATS.io

Wireguard

Goals:

1. **Empower** the operator by granting the right of choice for both hardware and software
2. **Simplify** application development and distribution with OCI containers
3. **Encourage** compatibility through an open software ecosystem

Don't miss out our Avena workshop! (Tomorrow 9:30 am)

Research Leveraged by ISOBlue

ISOBlue HD: an open-source platform for **collecting context-rich agricultural machinery datasets**

Made possible by **integrating** data sources and leveraging AI developments through comprehensive datasets

ISOBlue HD successfully collected CAN, GPS, and video data from a combine harvester during a 2019 wheat harvest. Video data captured header status and operator actions.

Built upon ISOBlue 2.0

GPS track data, paired with contextual labels, can reveal information that cannot be easily obtained from GPS track only. For example, header position contexts provide a clear separation between harvest and non-harvest area.

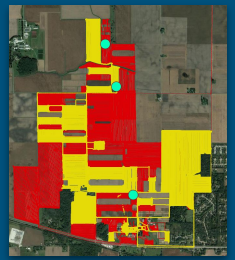
Work by Yang Wang, He Liu, James Krogmeier, Amy Reibman

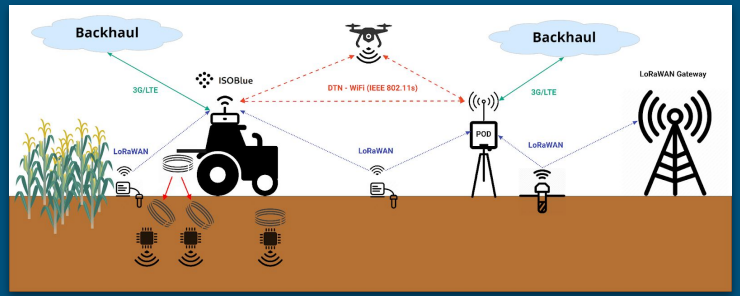
Research Leveraged by ISOBlue

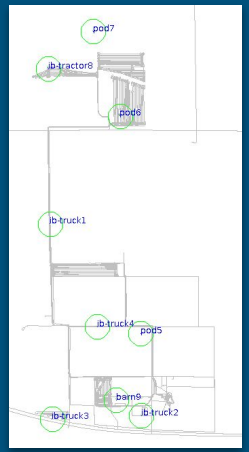
Delay Tolerant Networks (DTNs)

Computer networks for applications where mainstream **communication channels** are **not available** or work with low performance.

Made possible by **exploiting the movement** of vehicles equipped with edge-computers to establish **peer-to-peer wireless links**







Scenario	Delivery Rate η	Avg. Latency (s)	Avg. Hop Count	Overhead Ω
Trucks	0.64	3566.93	1.73	6.38
Tractor	0.347	7040.24	1.26	2.44
All Assets	0.70	3179.11	1.86	8.07

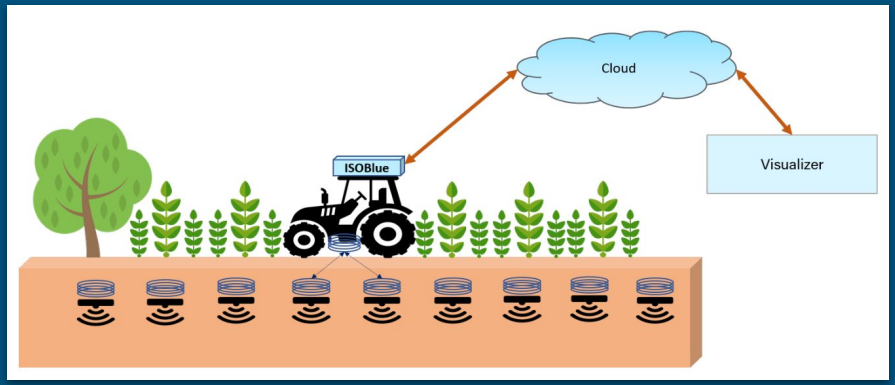
- DTNs are able to **transport data** from field sensors to other nodes without relying on mainstream channels
- Better **suited for low-rate** variables
- Performance highly **depends** on vehicle **operations** and **interactions** with other nodes

Research Leveraged by ISOBlue

Underground Sensing via RFID

Radio Frequency Identification (RFID) can be used as a communication link for sensors buried underground for transferring data to ISOBlue

Sensors buried underground are energy limited and RFID provides information transfer via backscattering



Goals:

1. **Create** a communication channel for underground sensors to reach the cloud
2. **Build** the system on commercially available hardware that encourages an **open source** software ecosystem

- Passive RFID is battery less - Set and forget equipment
- Very inexpensive compared to powered communication techniques


THANK YOU!
QUESTIONS?