Precision irrigation is increasingly data-driven, relying on data sets from multiple sources. Effective irrigation applies the right amount of water at the right time in the right place, and requires inputs such as weather data, soil water content, and plant-based sensors. Scaling this up requires a lot of accurate, interoperable data, but the multiple incompatible formats used by different manufacturers and organizations have been a key barrier to farmers adopting precision irrigation technologies.

AgGateway’s PAIL (Precision Ag Irrigation Language) project addressed this problem. The deliverables of PAIL Phase 1 were approved by the American Society of Agricultural and Biological Engineers (ASABE) and the American National Standards Institute (ANSI), and are now U.S. National Standard S632 for data exchange in irrigation field operations. PAIL provides key benefits for participants and adopters:

- **For those companies looking to grow their precision irrigation market**, you’ll gain greater compatibility across the irrigation ecosystem, reduce the need for your customers to learn multiple data formats, and accelerate your development of new data-driven products and services.

- **For FMIS companies**: you’ll save time and effort by not having to write multiple application programming interfaces (APIs), and you will be automatically compatible with a greater hardware base.

- **For those interested in irrigation water traceability**: PAIL gives you a standardized format for tracking when, where, and how much water was applied.

PAIL’s vision for data flow in precision irrigation. Data sent by the grower is shown in blue; data going to the grower is shown in orange.
What’s in PAIL / S632 – featured content

**Field Observations:** This body of work is an agricultural implementation of ISO 19156. It standardizes observations and measurements from instruments and other data sources in the field: readings from soil moisture monitors and sensors, probes, weather stations and weather forecasts for regional weather stations, as well as scouting data, variety trials, and many other sources of decision-making inputs that are not necessarily irrigation-specific.

**Irrigation Recommendations and Work Orders:** Once observations data is analyzed, an advisor can send a Recommendation to the grower in standard PAIL format; the grower or irrigator can then send a Work Order to a controller or equipment control system, where an OEM’s proprietary commands can execute the request.

**Irrigation Work Records:** PAIL also provides a format for recording the amount of water, chemicals and fertilizers applied on a field or through a piece of equipment, as well as when and where that happened.

**ADAPT Compatibility:** Versions 2.0 and above of AgGateway’s ADAPT are PAIL-compatible, so you can exchange irrigation data with other ADAPT-enabled systems. For more specifics see www.adaptframework.org.

**Data Exchange Schemas:** PAIL deliverables include XML schemas for encoding Operations and Observations data sets. Look for these and other resources at https://aggateway.atlassian.net/wiki/x/1gATB or scan the QR code at left.

**The Standards:** Get them from ASABE. Start with Part 1 by following the QR code at right or the URL https://elibrary.asabe.org/abstract.asp?aid=49749.

**Developers, PAIL / S632 gives you:**

- XSD schemas that describe observation data sets as well as recommended, planned, and actual irrigation operations.
- Sample XML instance documents covering common use cases.
- Recursive data structure; accommodates many temporal / spatial arrangements.
- A very efficient “shorthand” for representing radial center pivots coverages; static and dynamic polygon representations for other kinds of systems.
- High-level, abstract model of irrigation systems, irrigated area, and equipment properties. Stays away from OEMs’ proprietary domain.

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**Questions?**
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