The Internet of Things & The Water Supply Chain

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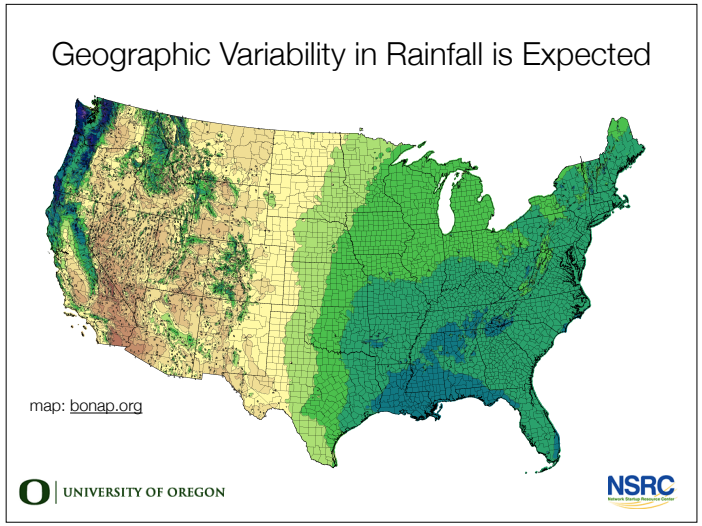
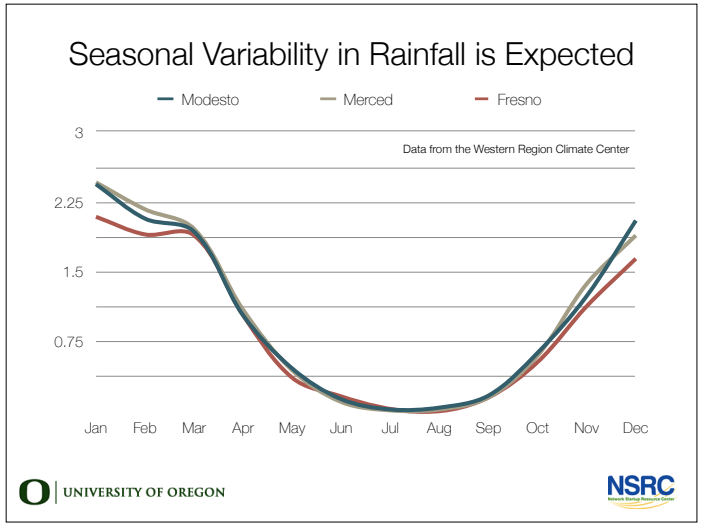
Water falls from the sky.

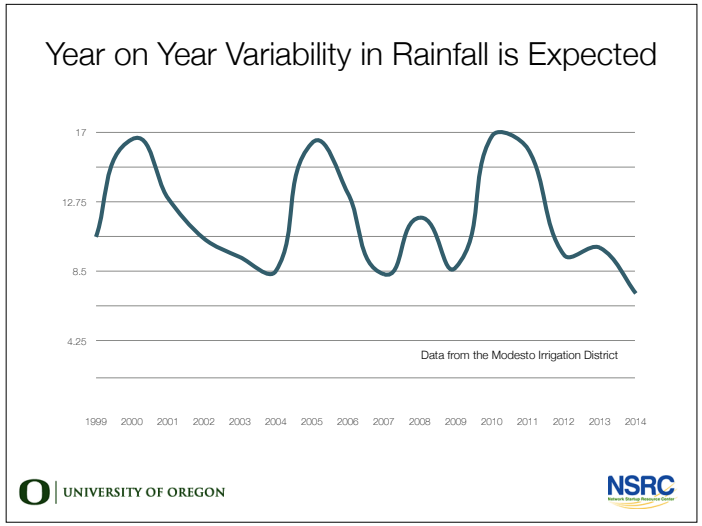
Until it doesn't.



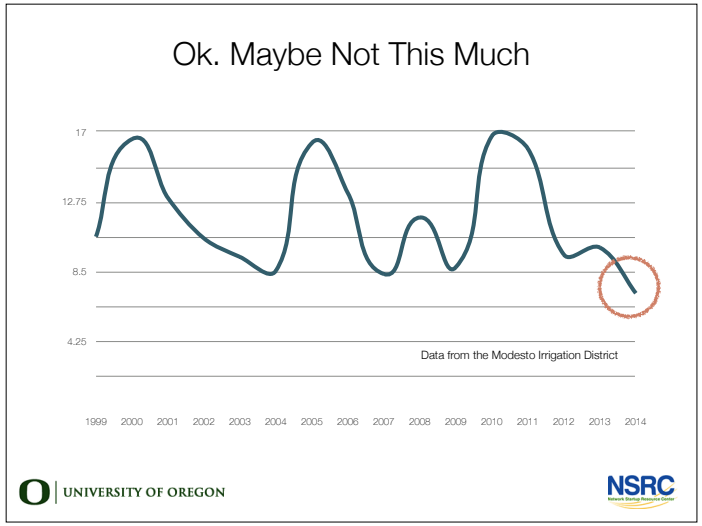
Geographic variability in rainfall is well understood. Across the US, rainfall varies from a few centimetres a year up to eight meters a year.



Seasonal variability is also well understood. It's dry in summer. If you weren't aware, the sky is also blue.



Even variability from year to year is an idea humanity has known about for a very long time. This data goes back more than a hundred years, and it looks pretty much the same.



Maybe this last little bit is something new, but this talk isn't about climate change.

Nature helps us with seasonal variations - storing water in snow and glaciers, releasing it through the summer months.

Nature also helps by storing water in the ground. Vast aquifers lie below ground level, storing the fresh water that's kept humanity alive and healthy in variable climates for at least 7,000 years.

More recently we've found that engineering can help with water storage too. Lake Mead can store three years of water outflow behind its dams, and flows are adjusted so a steady stream comes through all year.

We figured this out a couple of millennia ago. This cistern was built under Istanbul 1400 years ago. The oldest known river dam was built in Syria more than 3,000 years ago.

Transportation of water over long distances helps us get over geographic variability.

We figured out the transportation bit around two thousand years ago.

Water isn’t always clean - both before and after human use.

So we've developed techniques to clean it before use, and get rid of it after use.

Clean water techniques go back to ancient Egyptian and Indian civilisations.

Water Technologies

- Supply: Aquifer & River Management
- Storage: Dams, Cisterns, Tanks
- Delivery: Pumps, Pipes, Trucks
- Safety: Testing, Filtration, Purification

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Water is pretty much a solved problem. A lot of technology has been developed to keep humanity in water. So where does the IoT fit in?

IoT for Supply

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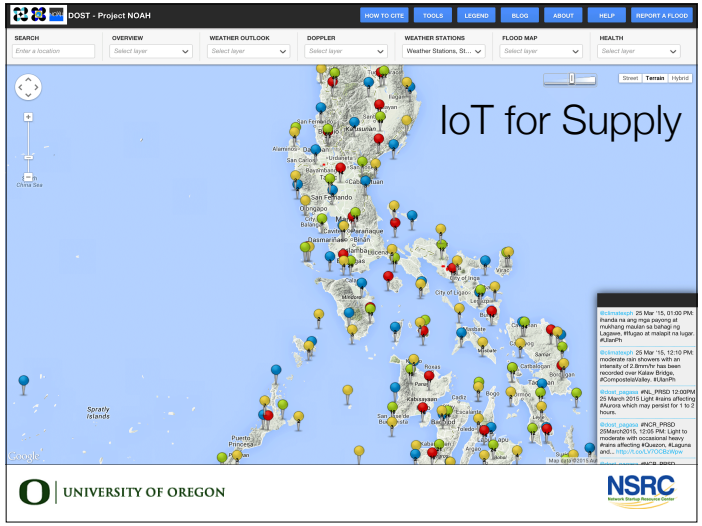
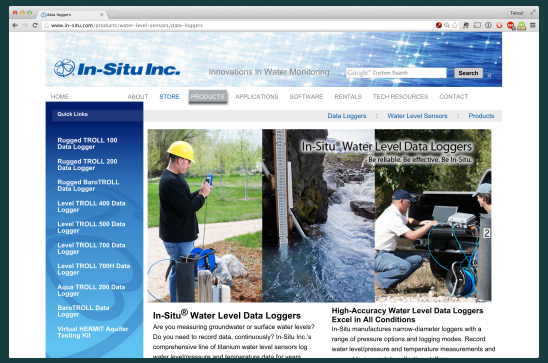
On the supply side, we've long used weather stations to give us an idea of what the weather has been like. New IoT technologies have dropped the cost of weather monitoring tremendously. These stations can help us predict requirements for use, and replenishment of aquifers.



Project Noah uses a low-cost Arduino based IoT system to monitor environmental conditions at more than 1,000 locations in the Philippines.

Tracking water levels - in rivers, lakes, and dams, is a key part of managing supply. Some places it's still done with a measuring stick like this.

IoT for Supply



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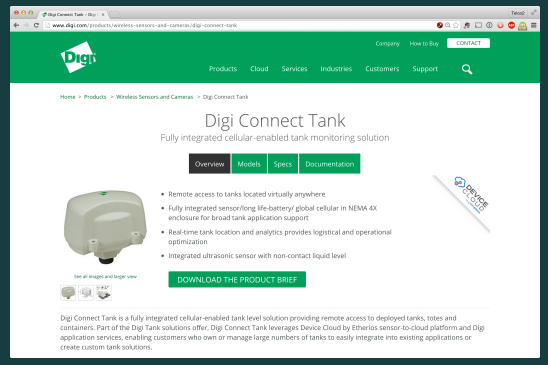
More advanced methods involve pressure transducers and suit-case sized data loggers. IoT technologies can get rid of the data loggers, and couple pressure transducers to wireless sensor networks for under a hundred dollars.

IoT for Supply



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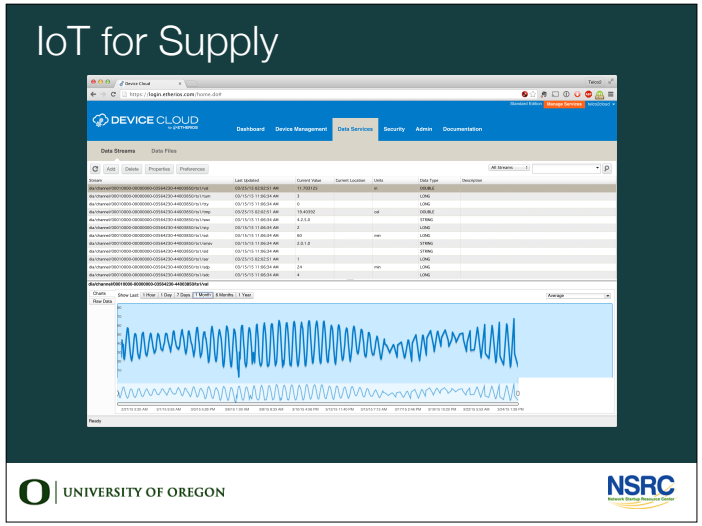
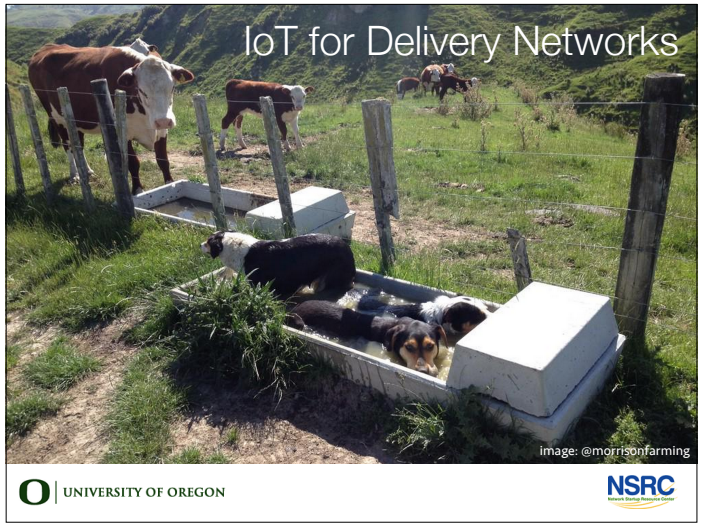
An alternative approach is using an ultrasonic sensor above the water to measure its levels - like this IoT device from Digi. It comes with a built-in lithium battery and 3G modem.



Digi's IoT device sends all data to a cloud platform that provides built-in analysis tools and API access. This data is water levels in a harbour - I'm using the device as a tide gauge in New Zealand.

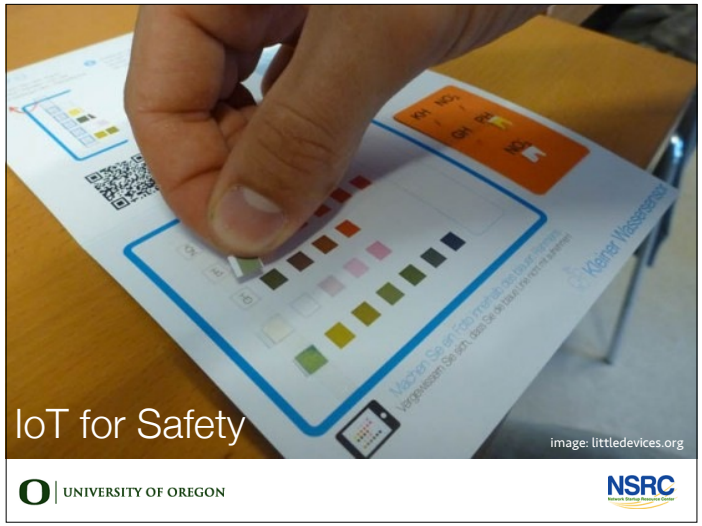
Windmills are often used to pump water from aquifers into holding tanks like this one. A simple Reid switch on the windmill could alert a farmer if the windmill stops turning. A flow meter could alert a farmer if the aquifer is running slow, or dry.

Where we don't have windmills, we might have diesel powered pumping stations, like this one at MangaRa Farm in New Zealand. What could IoT help with here?
(water levels, engine data, fuel levels, pump operation, vibrations, pipe system pressure)



Here's the other end of that system - supplemental water for cattle. What could we monitor here? (valve state at the trough, water sensor at the bottom of the trough, flow rates from the pump station) Could we use IoT to detect a break in the system? Is that an important thing to know? We'll come back to delivery in a bit.

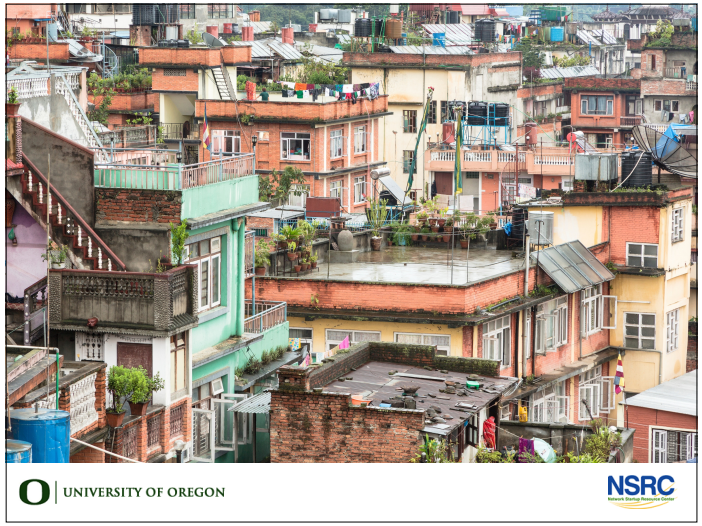
Testing the safety of water used to be the domain of large water systems. IoT technologies and sensor networks mean that real-time monitoring of water properties is now available to the smallest of water supplies. Here I'm testing a pH sensor that is later installed in a fish pond at AIT in Bangkok. Thanks for the great pic Marco!



IoT doesn't have to be entirely electronics based. The Little Water Sensor, a project from MIT, is a paper kit that's dipped in water. Different squares turn different colours depending on properties of the water. Testers use a smartphone app to take a photo of the paper after they dip. The app captures kit data, a URL via a QR code, and time coordinates of the sample based on smartphone GPS data.

In Australia and New Zealand, more than a million households rely on collecting rainwater for some or all of their home water use. Monitoring stored water can help these homes use their supplies in a more intelligent way.

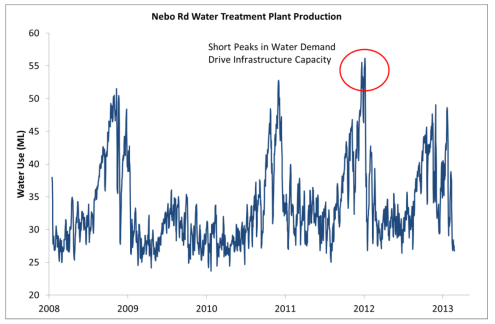
Here water tanks are used to store city water - from a supply that may not come on all the time. City water across much of South Asia and Africa isn't on 24 hours a day, 7 days a week. In some cities, each neighbourhood only gets water a few hours a week - and when they do, they pump it into storage tanks on their roofs.



This idea of storing water in tanks on the roof isn't limited to dry climates - even in cities with heavy rain for some or all of the year, water supplies are not able to operate full-time, due to underinvestment in distribution networks and rapid urban growth.

One way to solve water distribution problems is to regulate the distribution network through metering. Knowing where your heavy water users are, and what they're doing, can help network managers provide a better service.

IoT for Delivery Networks



Data: Taggle Whitepaper on Mackay Regional Council Water Network

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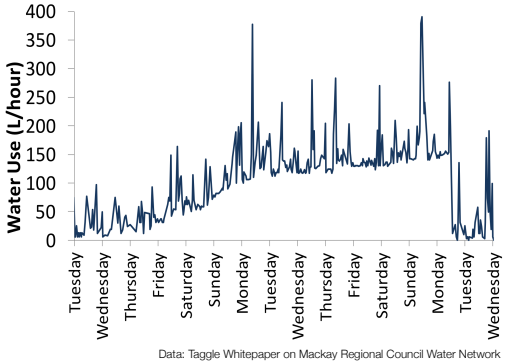
Real-time metering allows water network operators to plan their networks appropriately. These were areas where all houses already had meters, but the operator didn't have good information on where all their water was going.

IoT for Delivery Networks



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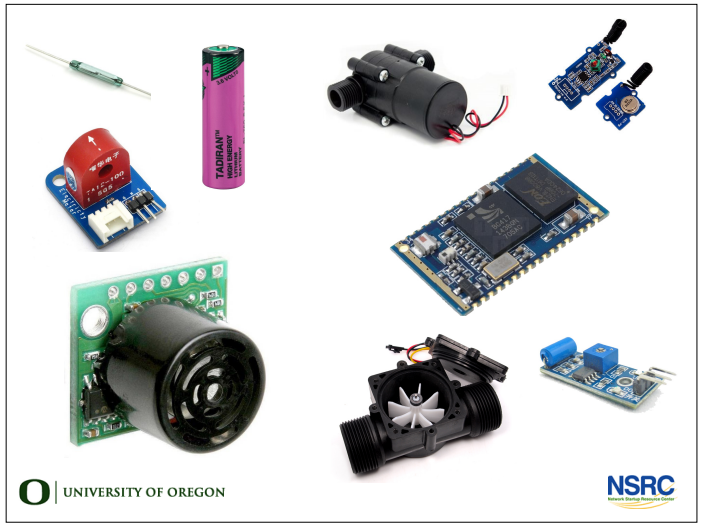
Here we see the algorithmic identification of a pipe leak which could have cost the customer hundreds of dollars in extra water fees. In less than two weeks it was identified and repaired. Similarly, network operators can determine leaks in their own infrastructure by comparing net meter readings from their clients with information from their main distribution network.

Trucks are also a delivery network.

Running out and water delivery is a fact of life for hundreds of millions of people. With an awareness of how much water is in tanks around a city or countryside, water delivery trucks be proactive with their deliveries. They can also can plan their routes intelligently.

With IoT tank meters like this one, water tank data can be made available not just to tank owners, but to cities - to help them with water capacity planning, with firefighting, and with arranging water deliveries to neighbourhoods and houses that are going to run out.

Any technology that can inexpensively improve such delivery situations will be a benefit to its users.



All these applications are possible at large scale due to the emergence of the Internet of Things. Small microprocessors, low power communications, and new battery technologies are enabling what will soon be humanity's next step in improving water technology.

Thanks for your time today.

I'll leave you with a photo of New Zealand's Lake Taupo.

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