

A panoramic view of the Seattle skyline at dusk or dawn. The Space Needle is prominent on the left, and Mount Rainier is visible in the background on the right. The city buildings are silhouetted against a soft, orange-hued sky.

# Community Networking Initiatives at UW

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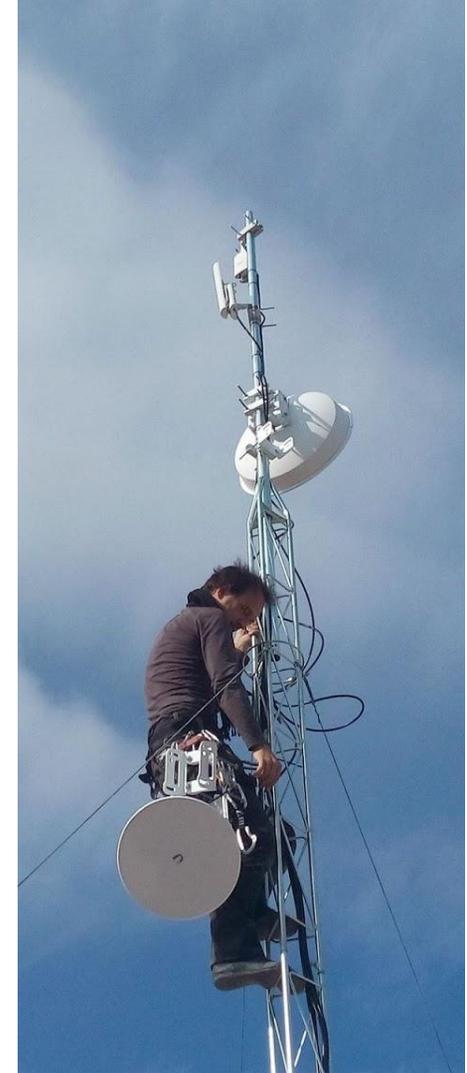
# ICTD Lab @ **W**

- <http://ictd.cs.washington.edu>
- Established research group focusing on technology and poverty (ICTD)
- Professor Richard Anderson
  - ~6 Students
  - Focus on health and financial services
- Professor Kurtis Heimerl (<https://kurti.sh>)
  - ~4 Students
  - Focused on Internet access and conservation



# Brief Intro to Community Networking

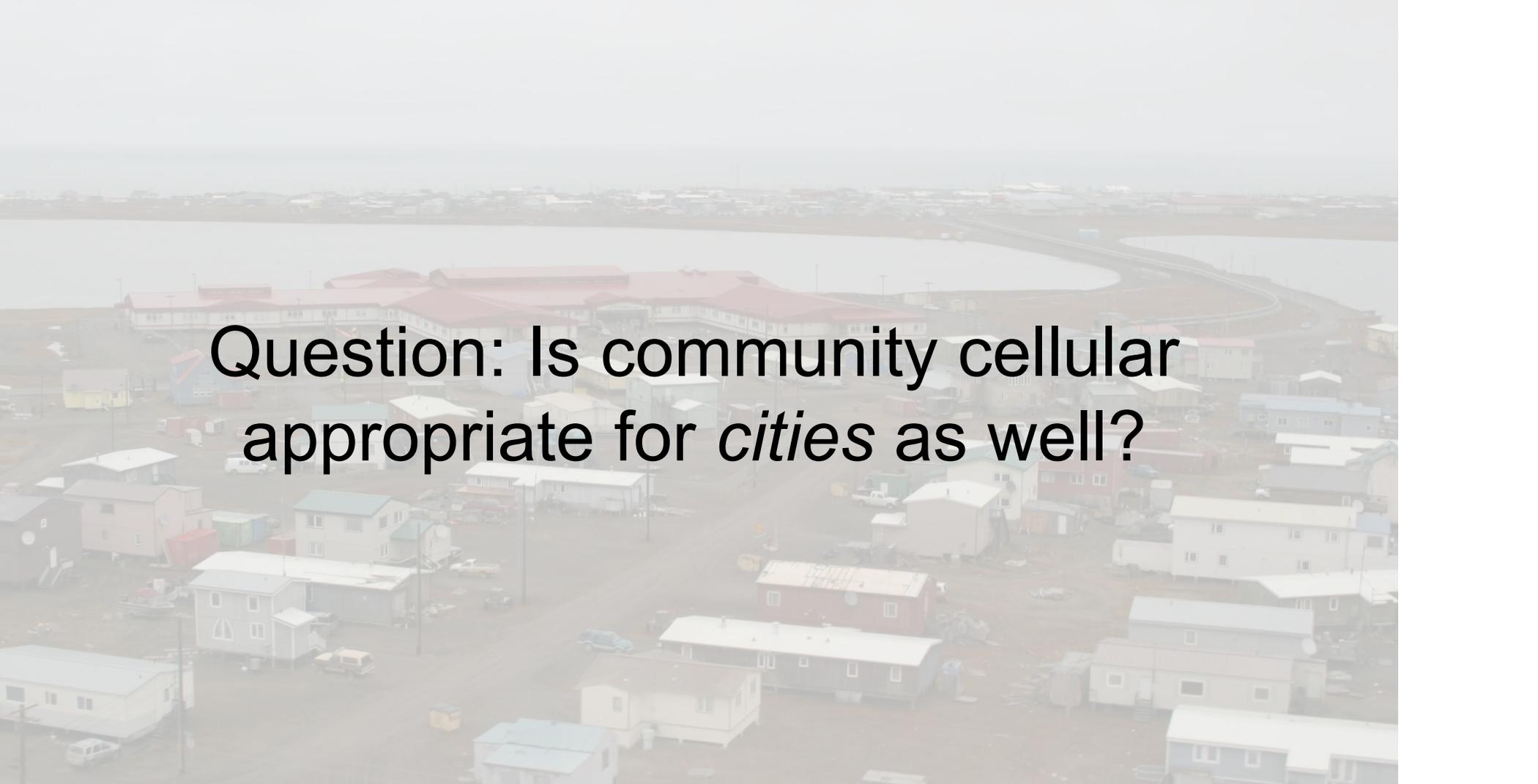
- Networks built, owned, and operated by citizens and users in a participatory and open manner
- Many examples throughout the world:
  - Guifi.net > 35,000 nodes
  - Freifunk, Altermundi, NYC Mesh, etc
- Distinct from “municipal networks” as they are not owned by the government but instead are cooperatives
- Largely built on 802.11 “mesh” protocols
  - Operate primarily in unlicensed spectrum (with some licensed backhaul)
  - Technology is understood by “networking professionals”



# Community *Cellular* Networks

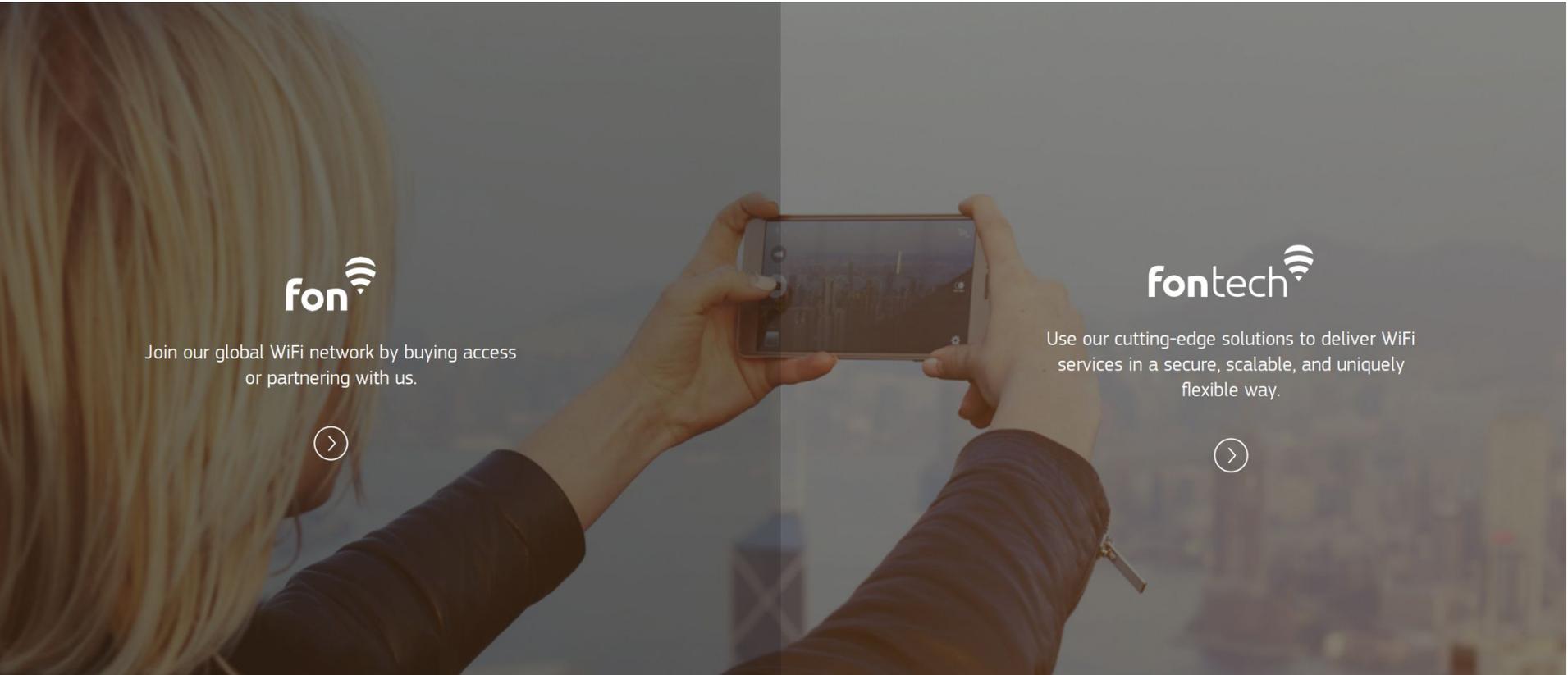
- Built off of software implementations of cellular protocols - OpenBTS, Osmocom, OAI
- Example deployments:
  - Rhizomatica - Oaxaca, Mexico
  - AirWave Missions - Papua, Indonesia
- **Long-term Evolution (LTE/4G)**
  - CommunityLTE (CoLTE) deployed in Indonesia and Oaxaca. More deployments planned.
- “Traditional” rural-focused installations
  - Limited backhaul
  - Local Services



An aerial photograph of a residential area, possibly a town or village, with a large, multi-story building in the center. The building has a red roof and is surrounded by smaller, single-story houses. A large body of water is visible in the background, and the overall scene is somewhat hazy. The text "Question: Is community cellular appropriate for *cities* as well?" is overlaid on the image.

Question: Is community cellular appropriate for *cities* as well?

# Example: City-scale Wifi





Why is city-scale wifi so hard?

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1. Wifi is bad at city-scale
  - Transmit power (and thus coverage range) is inherently low
    - Operates at spectrum poorly suited for propagation
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## 3. Wifi is bad at spectrum coordination

- Network too dense? Spectrum congestion
- Network too sparse? Can't do handover

# Example: City-scale Cellular

[For the home](#)

[For business and public sector](#)

[For global business](#)



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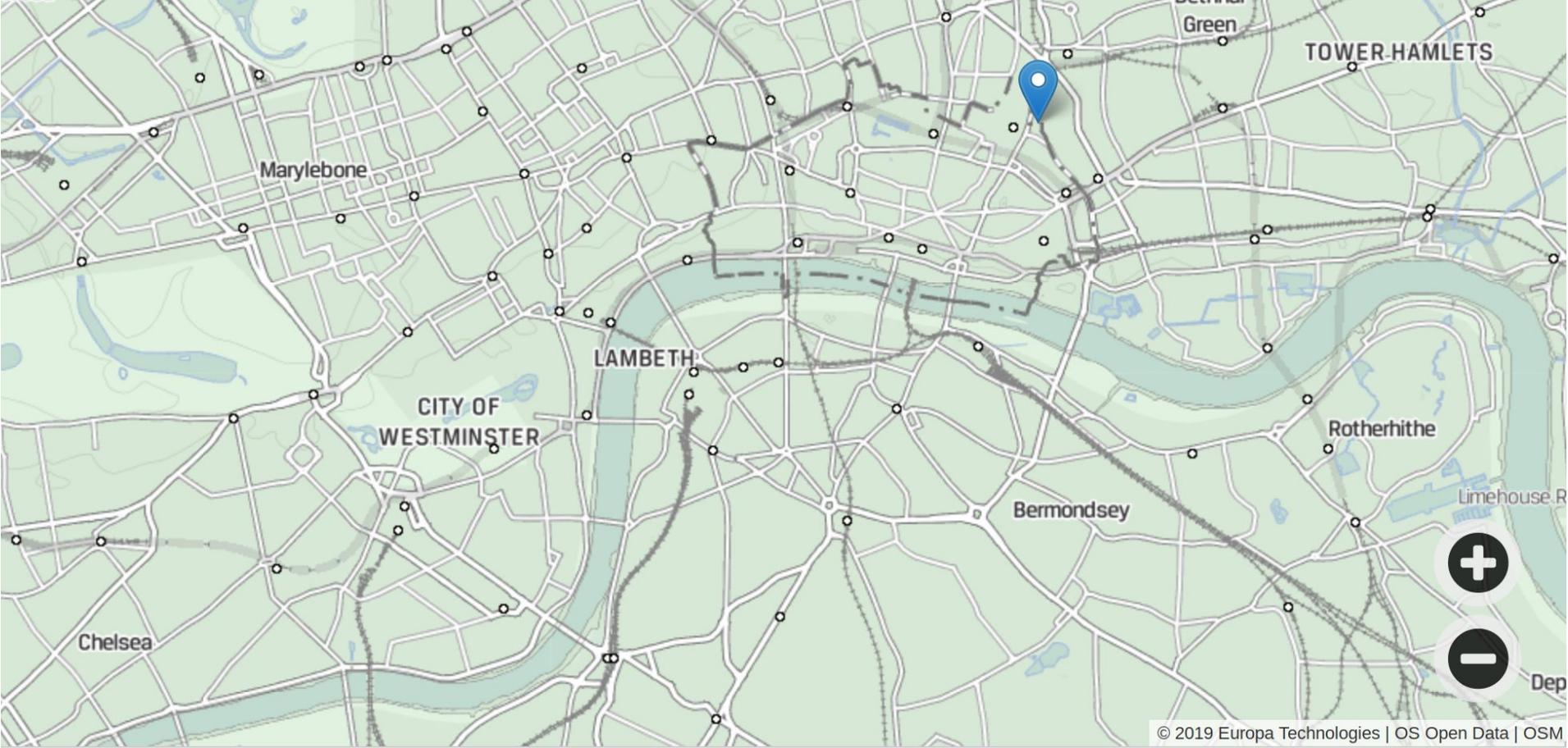
We use  
commu  
make a

Fi

[2019 Annual report](#)

[Latest results](#)

Share price: **187.02p** -1.96p (-1.04%)  
2019



Likely to have good coverage

You may experience some problems

Reliable signal unlikely

You should not expect to receive a signal

Why is city-scale cellular so common?

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**Lots of business reasons**

We'll skip those for now

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3. Cellular is good at spectrum coordination
  - This is the whole point of "cellular"
  - Variety of spectrum technologies such as self organizing networks (SONs)

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  - C
  - L
3. Cellular is good at...
  - T
  - V

**What's stopping **us** from building these networks?**

# Issues with Community Cellular

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- a. Yes but they've started creeping in on other unlicensed bands
- b. Citizen's Broadband Radio Service (CBRS) is a dual licensed regime going live in April
- c. LTE-U and LTE-LAA are both protocols for operating cellular gear in Wifi bands

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  - a. Not since LTE. A reasonable LTE access point (eNB) costs ~\$2500USD, about half of a 2G radio.
  - b. This will continue to shrink as more manufacturers enter the NR space as they're "small cells"

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3. **Interconnect - Telecoms don't play ball.**
  - a. Still true, but as LTE is entirely IP-based, that's fine. We can peer at the IXP.
  - b. OTT services (e.g., WhatsApp, Messenger, etc) are dominant anyhow!

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  - a. This has shifted dramatically. One point is the Wireless ISP market, with many operating LTE networks from BaiCells or TelRad. So the hackers can do it.
  - b. “Private LTE” is rapidly gaining traction. These are small companies or building running their own.
  - c. “Carrier Aggregation” is another important shift. Building owners will install their own network and allow their users to “roam” onto *multiple* MNOs for a cut.

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There is a great opportunity for urban  
community cellular networks



What's the plan?

BURK

# Technology agenda - Federated 4G LTE and 5G NR

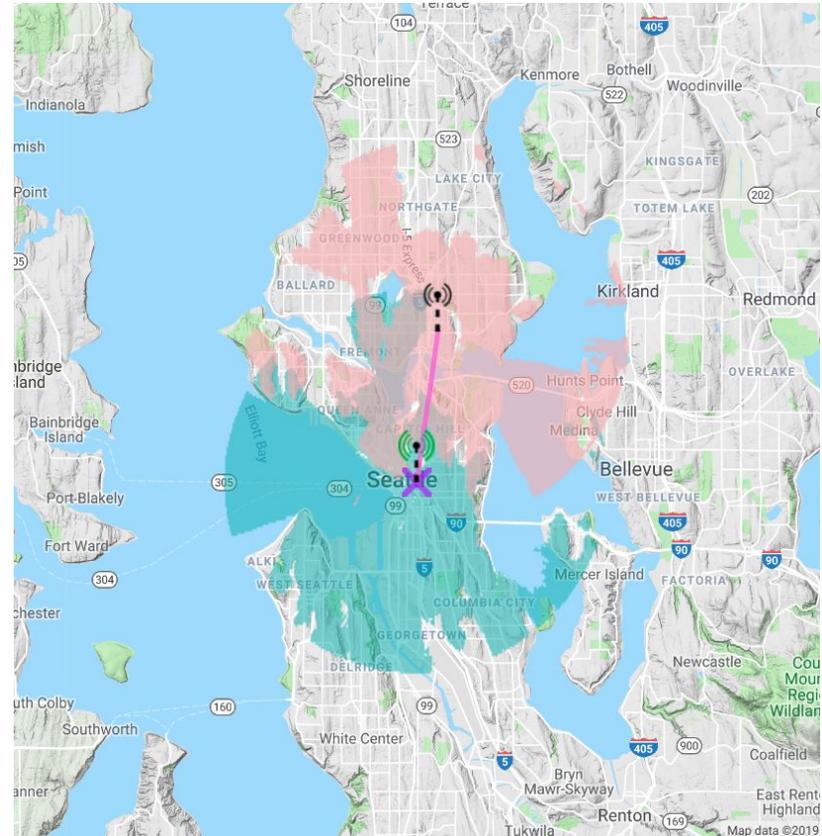
1. Goal: Allow **anyone** to run their own cellular network
2. Create a way for new network nodes (wide area transmitters) to dynamically join a single nation-scale telecom

# Technology agenda - Federated LTE/NR

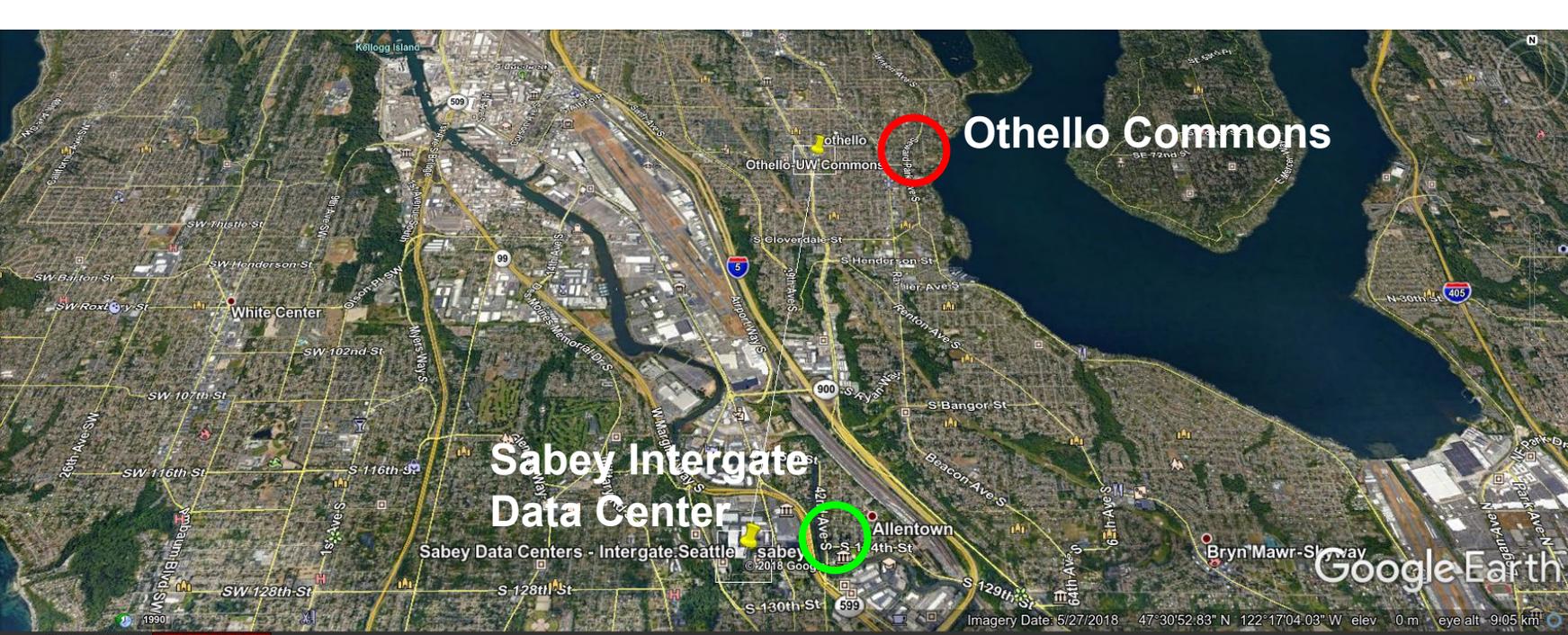
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# Deployment agenda - Community LTE in Seattle

- Deploying first urban cooperative cellular network in the fall of 2019
- Two networks federated together:
  - Campus (north) network
  - Hospital (south) network
- Eventually high points will be used to provide backhaul
  - Instead of transmitting
- You can join too!
  - We have SIMs to share!

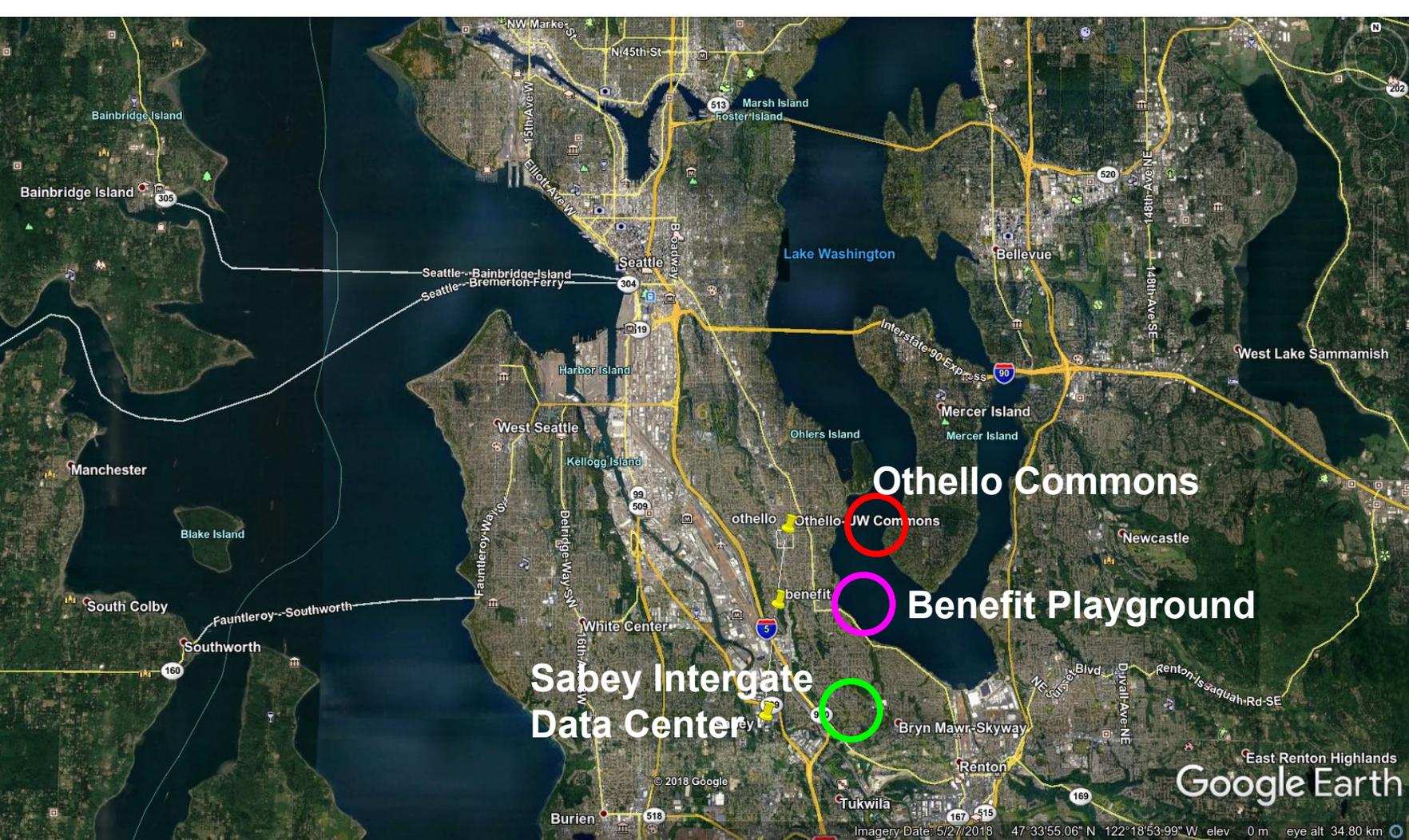






Graph: Min. Avg. Max. Elevation: 4, 28, 79 m  
Range Totals: Distance: 5.19 km Elev Gain/Loss: 178 m, -144 m Max Slope: 48.7%, -49.7% Avg Slope: 5.5%, -5.1%





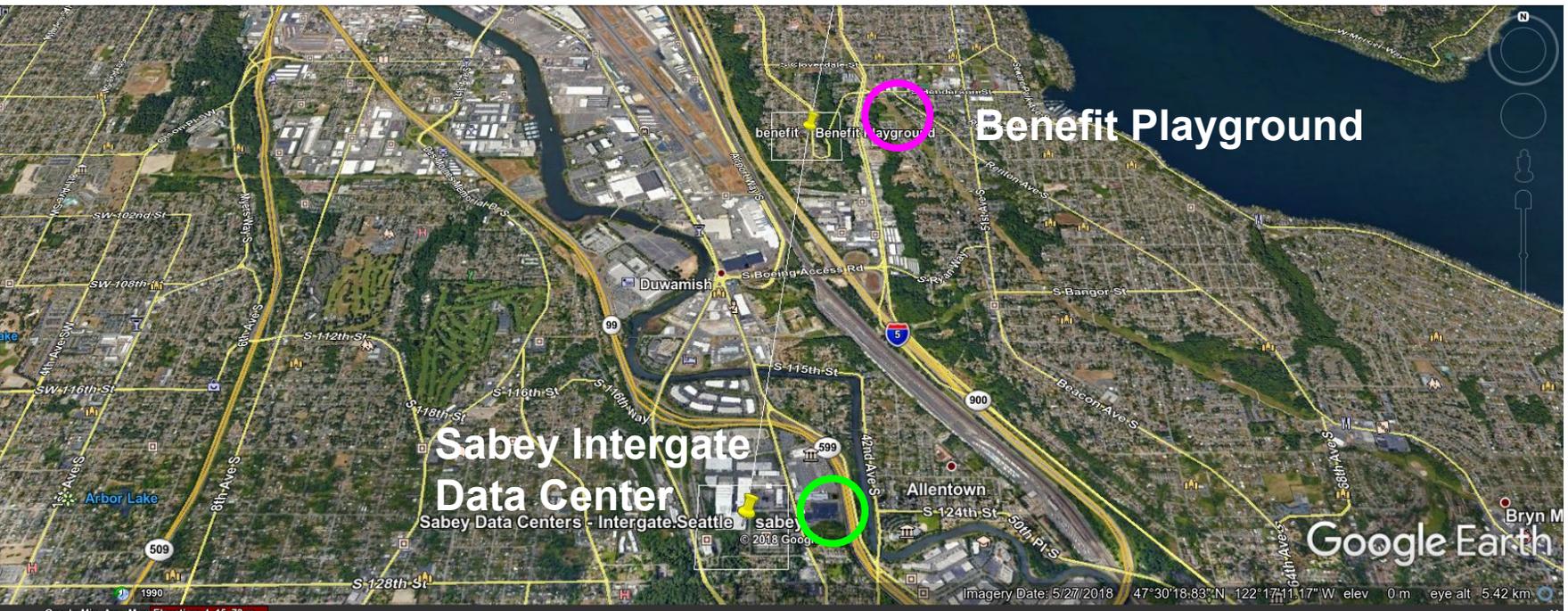
Othello Commons

Benefit Playground

Sabey Intergate Data Center

Google Earth

Imagery Date: 5/27/2018 47°33'55.06" N 122°18'53.99" W elev 0 m eye alt 34.80 km



Graph: Min. Avg. Max Elevation: 4, 15, 73 m  
Range Totals: Distance: 3.1 km Elev Gain/Loss: 137 m, -70.2 m Max Slope: 52.8%, -39.8% Avg Slope: 7.8%, -4.2%





A large crowd of people is walking on a green lawn, surrounded by many white cherry blossom trees. In the background, there are several large, multi-story buildings with Gothic-style architecture. The scene is bright and festive, suggesting a spring event or festival.

**Thanks!**

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