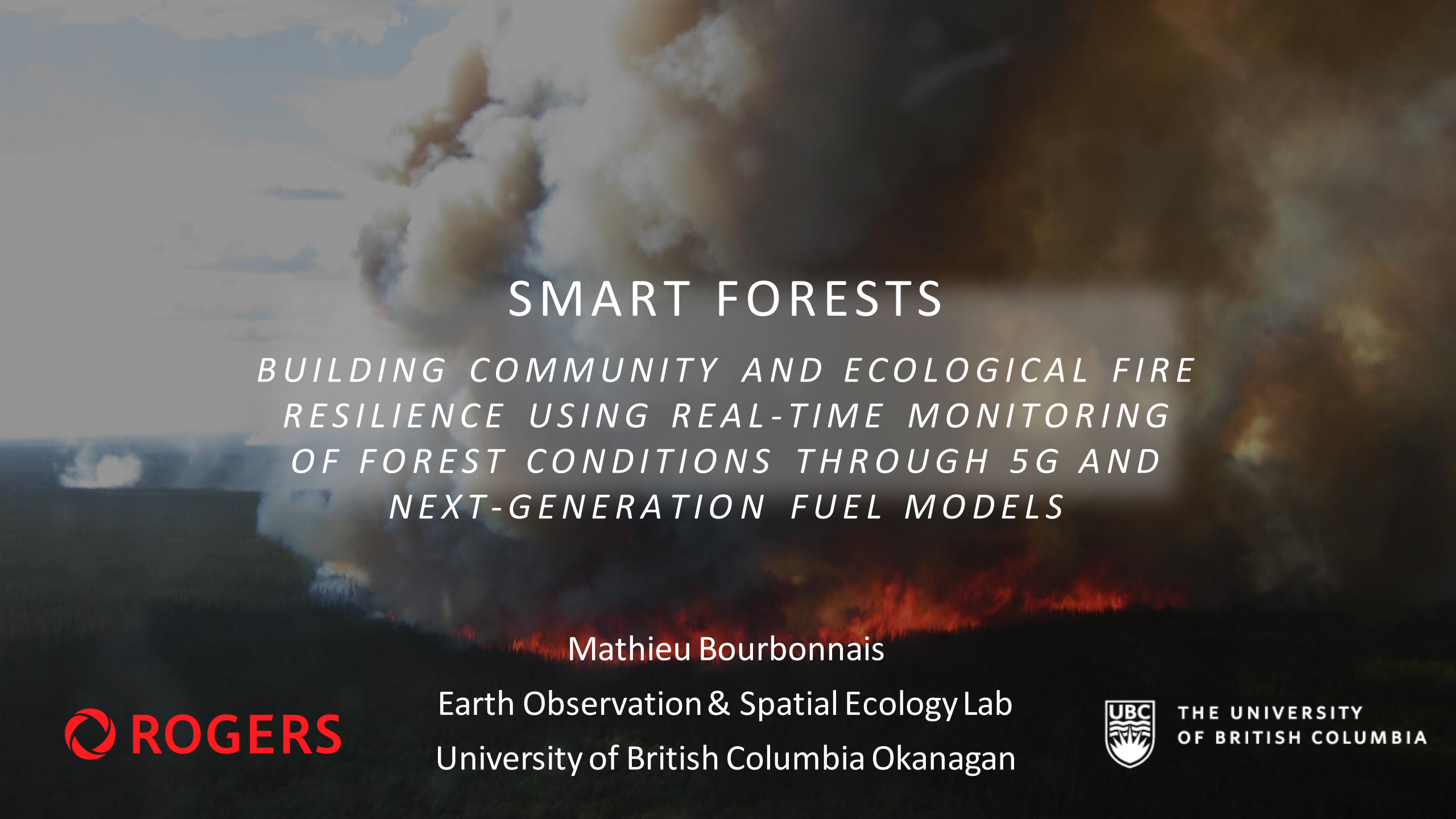


# SMART FORESTS

## *BUILDING COMMUNITY AND ECOLOGICAL FIRE RESILIENCE USING REAL-TIME MONITORING OF FOREST CONDITIONS THROUGH 5G AND NEXT-GENERATION FUEL MODELS*

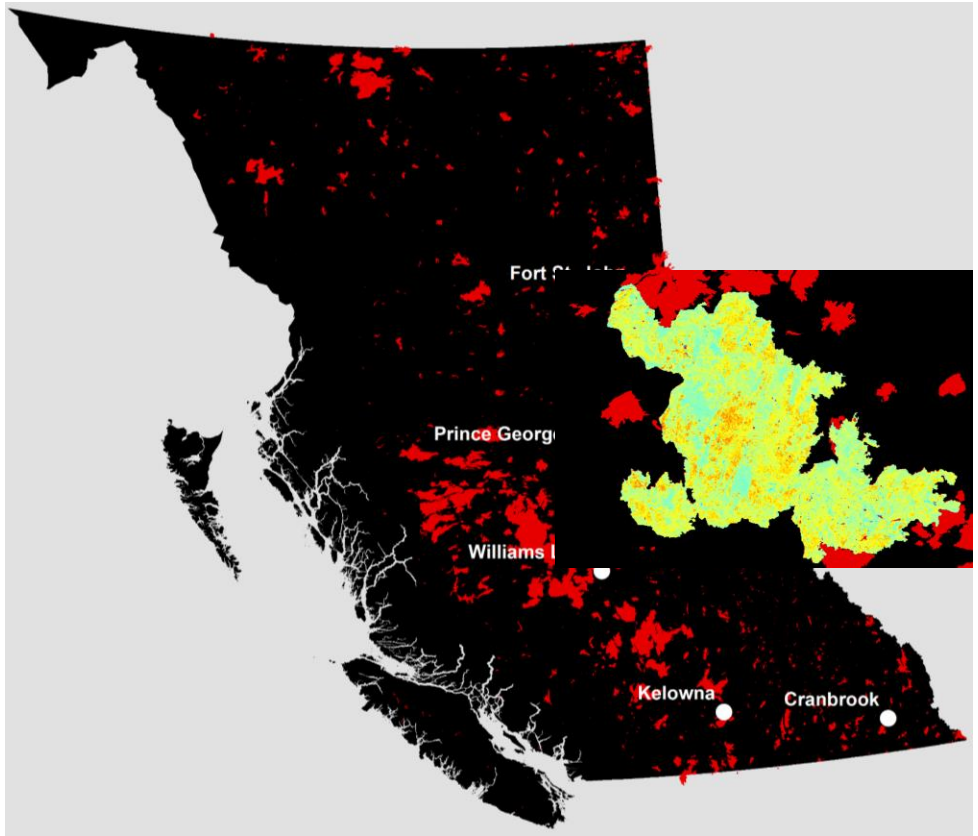

Mathieu Bourbonnais

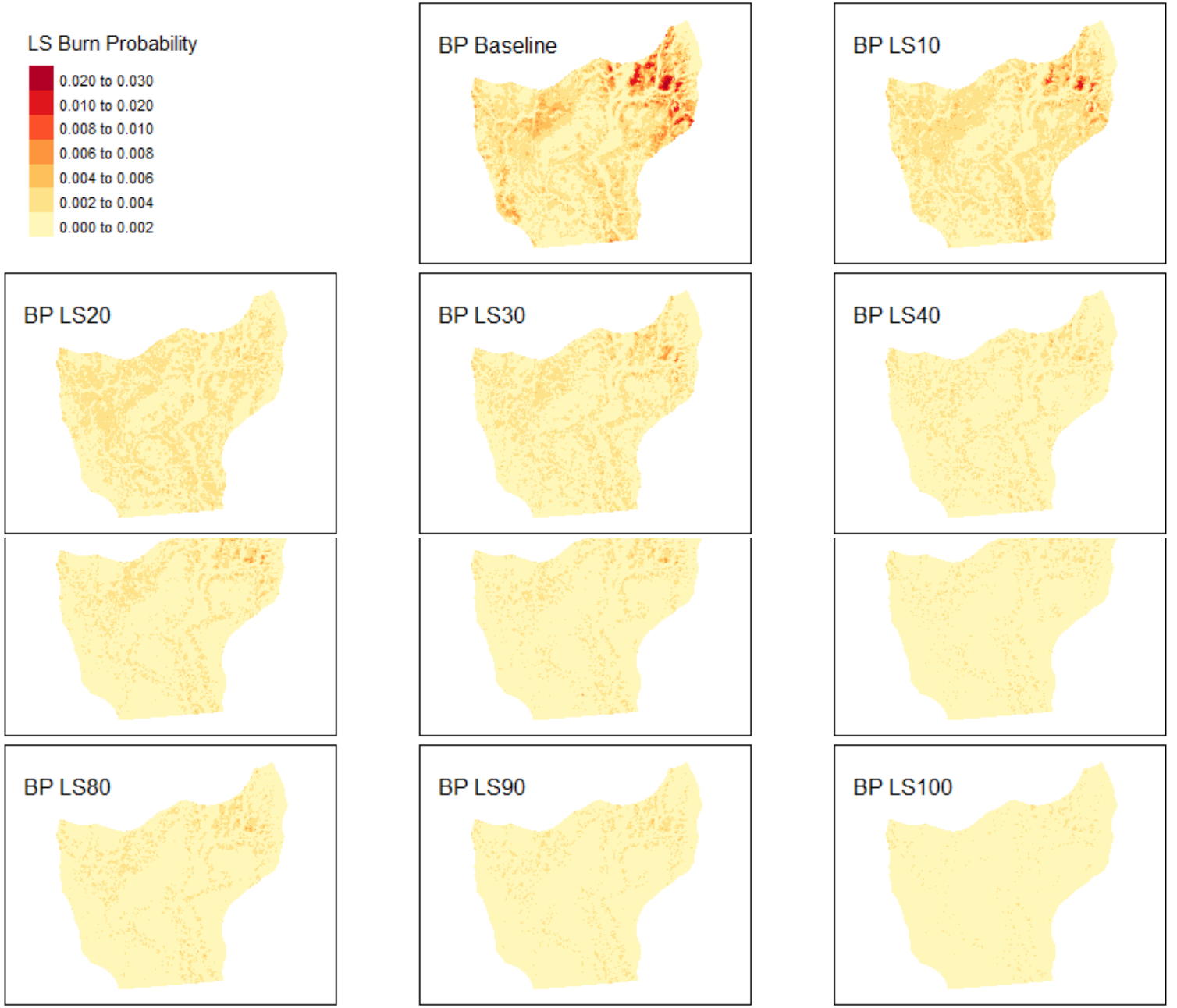
Earth Observation & Spatial Ecology Lab

University of British Columbia Okanagan


ROGERS

THE UNIVERSITY OF BRITISH COLUMBIA


Prince Georg
Williams
Kelowna
Cranbrook


LS Burn Probability
0.020 to 0.030
0.010 to 0.020
0.008 to 0.010
0.006 to 0.008
0.004 to 0.006
0.002 to 0.004
0.000 to 0.002
BP Baseline
BP LS10
BP LS20
BP LS30
BP LS40
BP LS80
BP LS90
BP LS100


2021-10-10 18:12:58 M 1/1


2021-10-04 16:14:31 M 1/1
CHILKO GBEAR 00

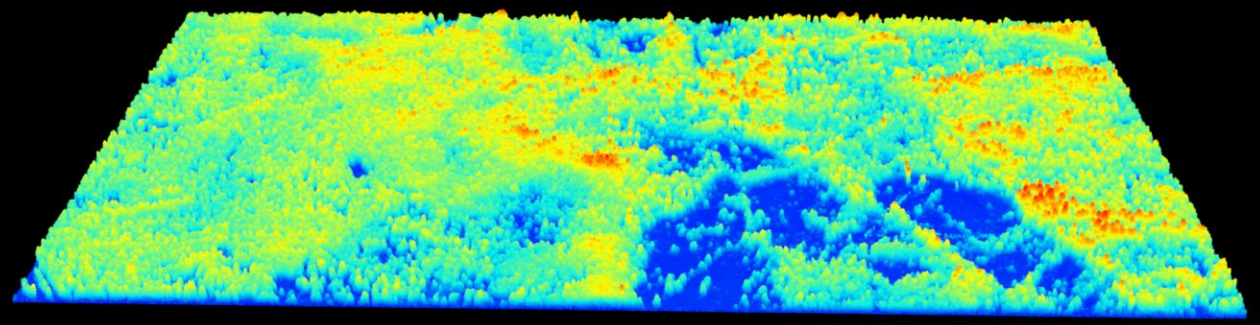
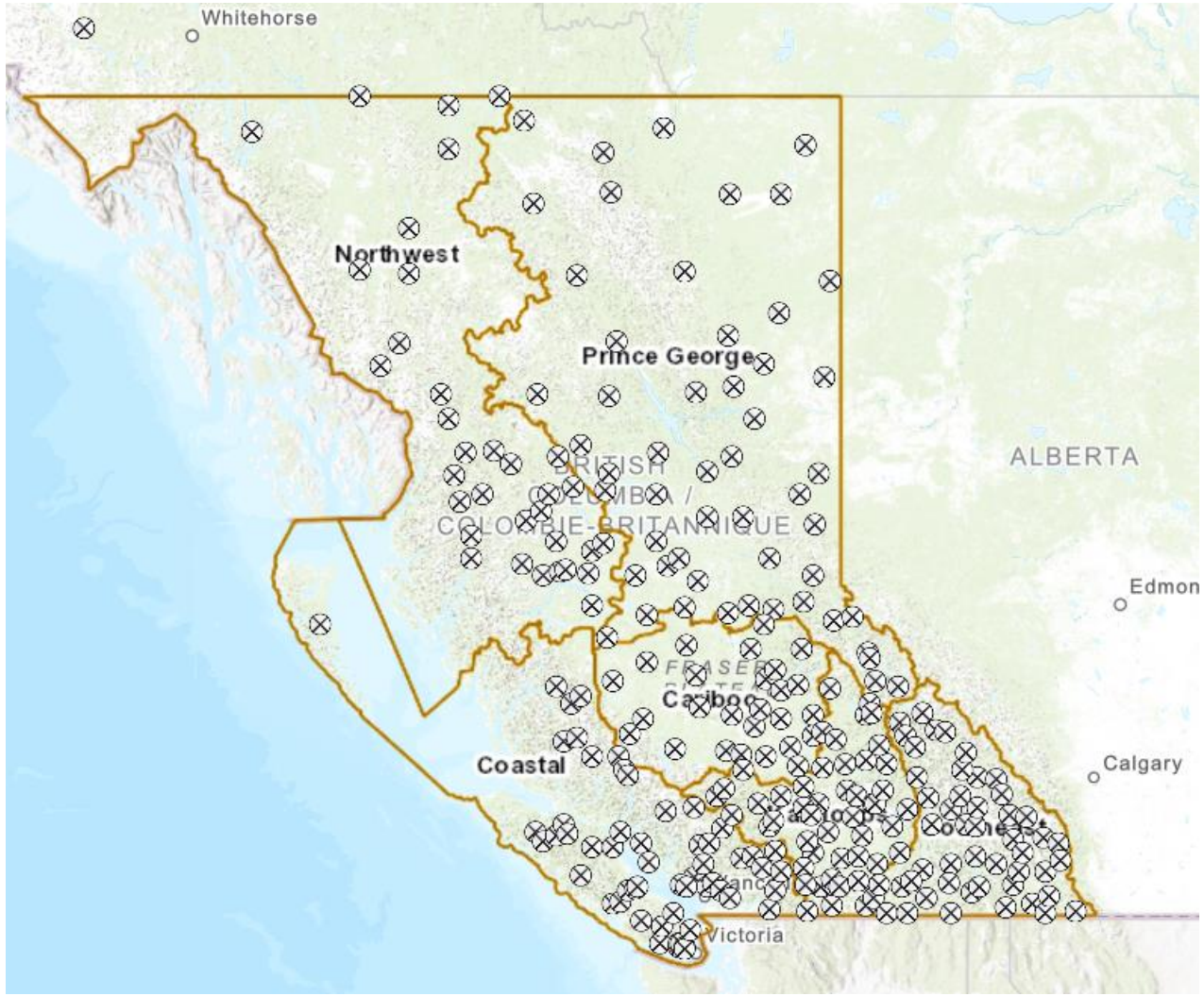


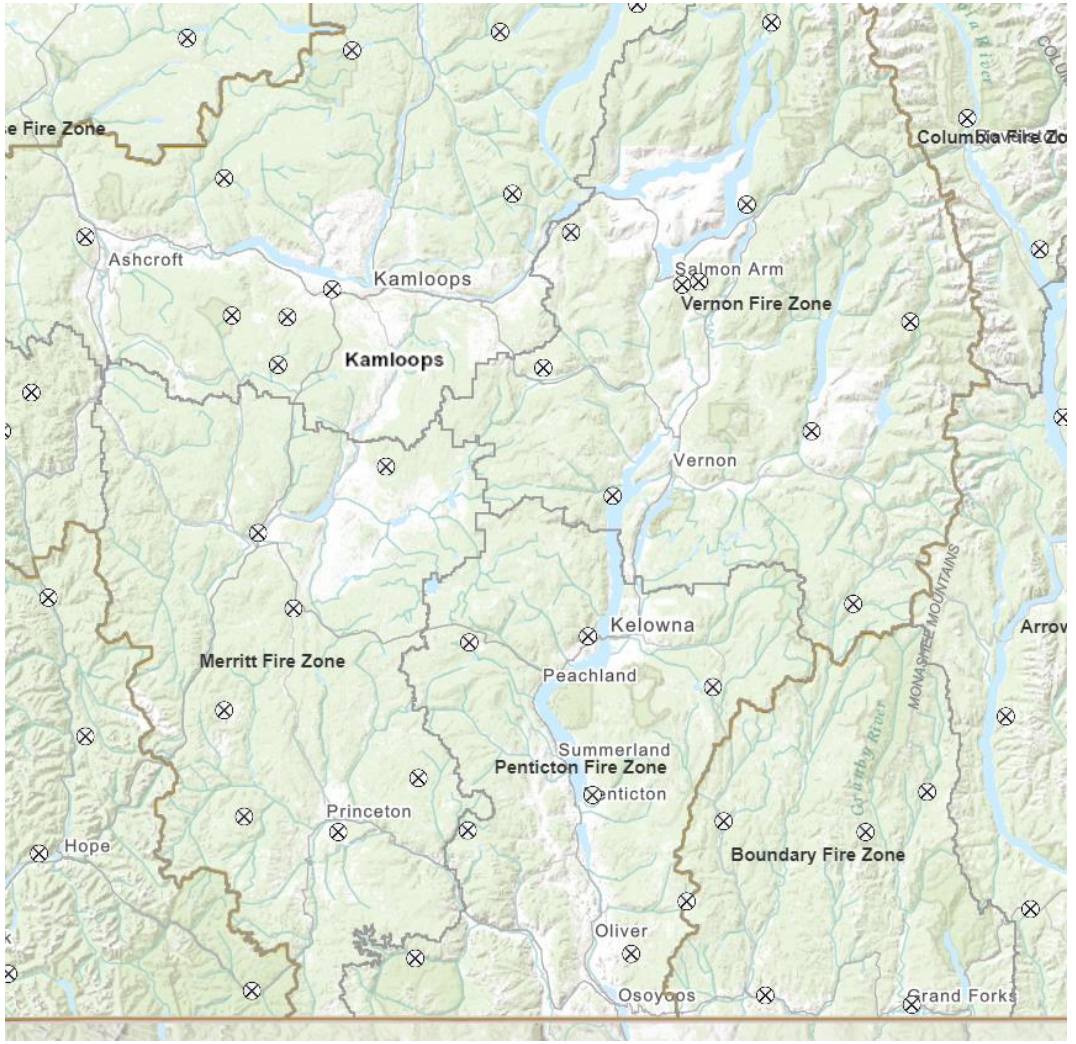
Image: ITRES

# Background

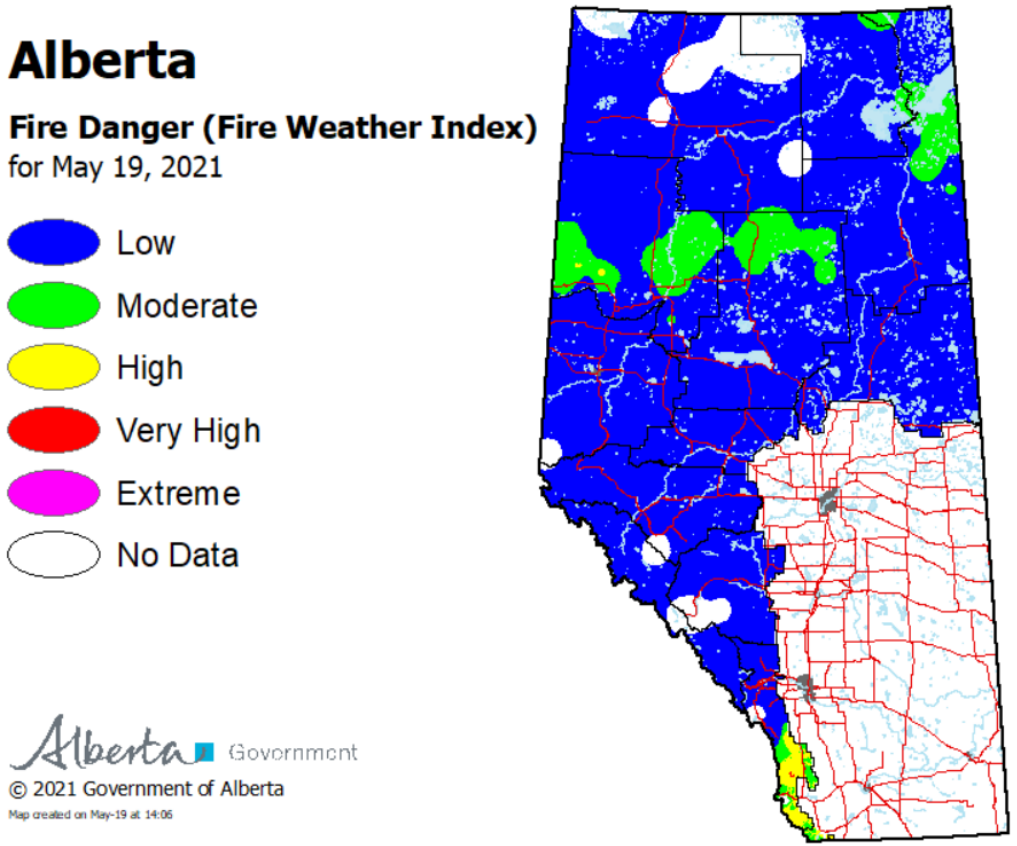
Image: Bernie Hudyma

# Background


Whitehorse
Northwest
Prince George
ALBERTA
Edmon
Caribo
Coastal
Calgary
Victoria


Ashcroft
Kamloops
Salmon Arm
Vernon Fire Zone
Kamloops
Vernon
Kelowna
Merritt Fire Zone
Peachland
Summerland
Penticton Fire Zone
Princeton
Hope
Boundary Fire Zone
Oliver
Osoyoos
Grand Forks

# Background

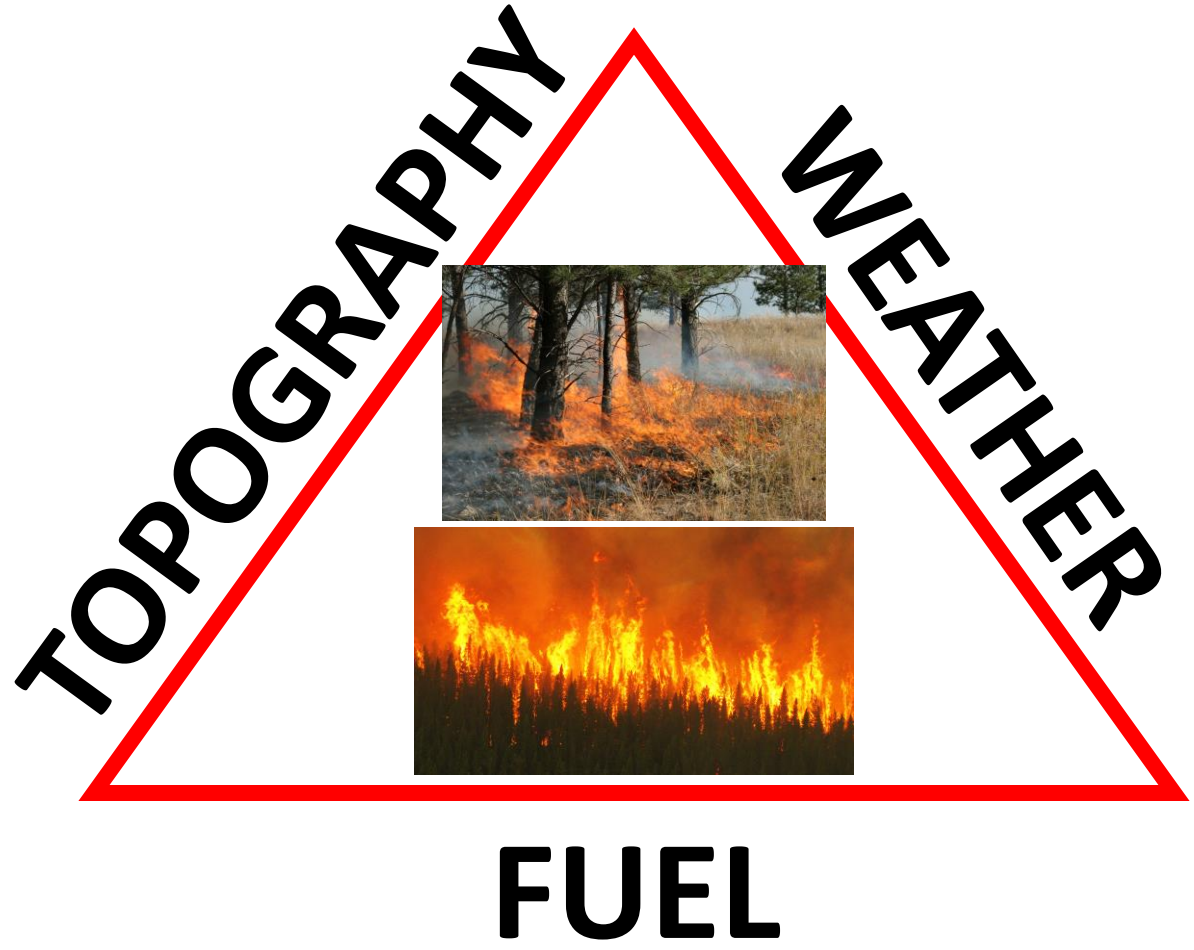

Alberta
Fire Danger (Fire Weather Index)
for May 19, 2021
Low
Moderate
High
Very High
Extreme
No Data
Alberta Government
© 2021 Government of Alberta
Map created on May-19 at 14:06

# Background

# Internet of Things (IoT)

- Network of physical objects ('things') embedded with sensors and software allowing them to connect and exchange data with other devices over the internet = Internet of Things
  - Low-cost and low-power sensors
  - Cellular connectivity
  - Cloud computing
  - Machine learning and AI

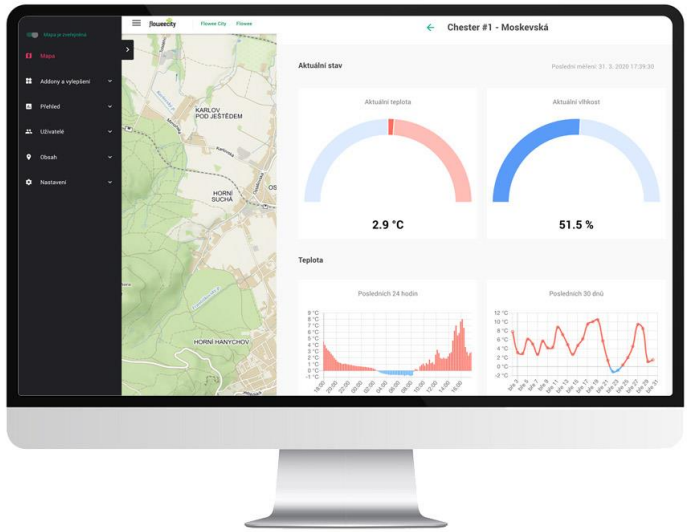

- Fitbits and wearable health sensors, cars (Tesla), your toaster and fridge…




Develop, deploy and test a low-cost IoT system using the Rogers network for monitoring weather and fuel conditions for assessing wildfire danger and risk and to support fire behaviour modelling

# Hardware

HARDWARIO
INDUSTRIAL IOT KITS




LTE-M NB-IoT LoRaWAN sigfox kinéis

# Hardware

- Chester gateway:
  - Sensor data
  - Position data from GNSS module
  - LTE network data (or NB-IoT or LoRa)
  - Battery & system data
- Communicates on LTE-M with internal or external antenna
- Runs custom firmware application on processor chip

# Hardware

Attached to Chester:

- Temperature
- Humidity

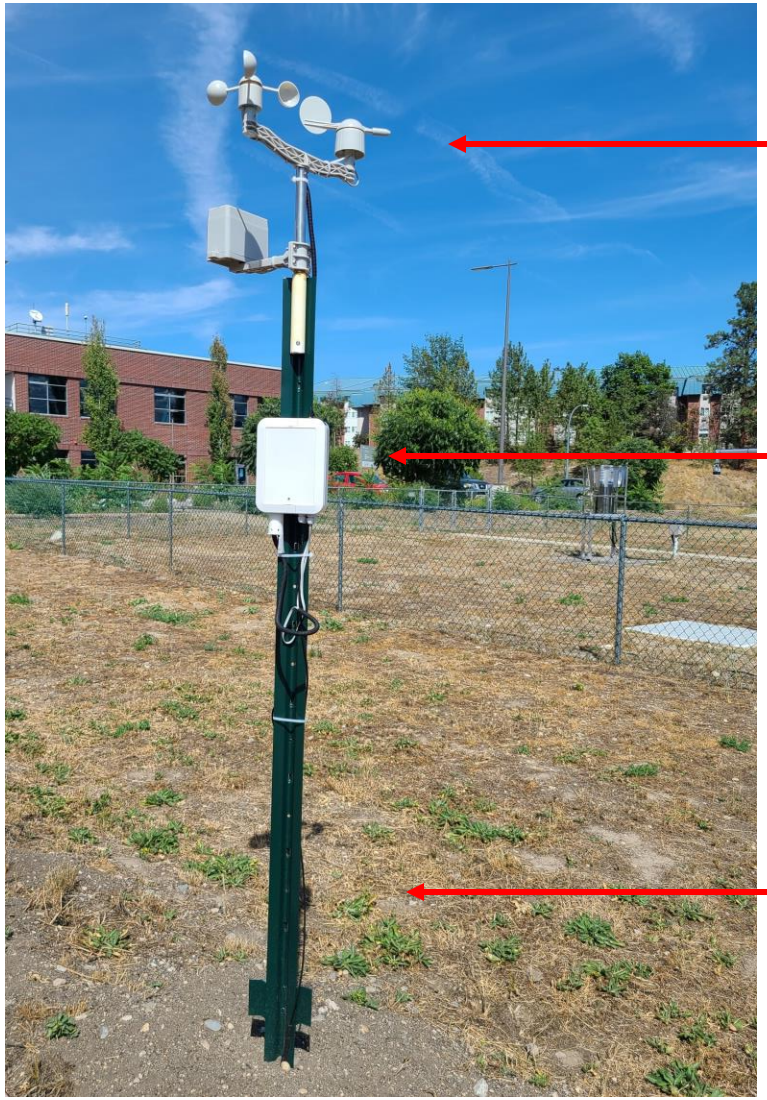
Weather station:

- Wind speed
- Wind direction
- Precipitation

Soil sensor:

- Soil moisture
- Soil temperature

# In-field assembly

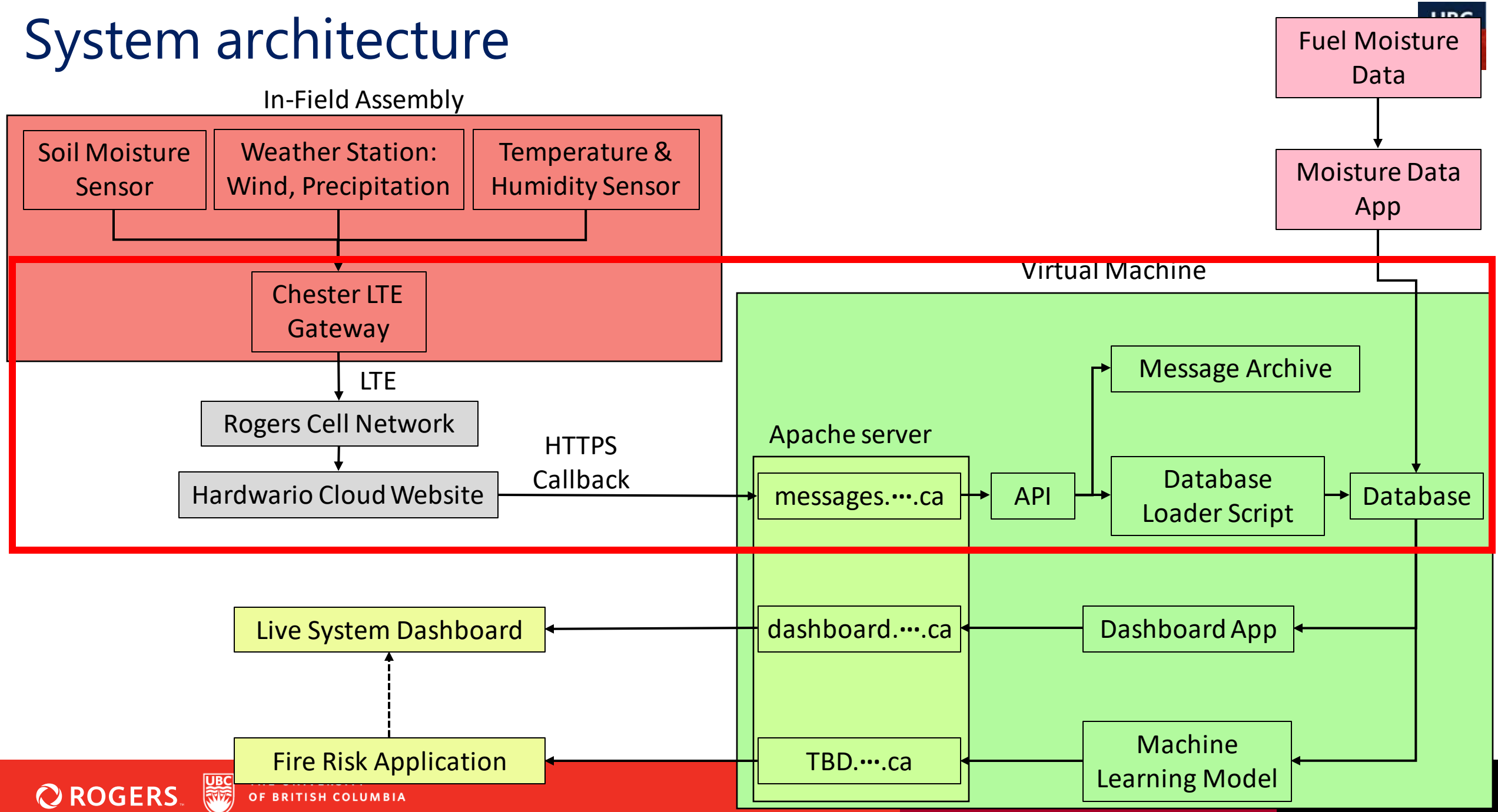


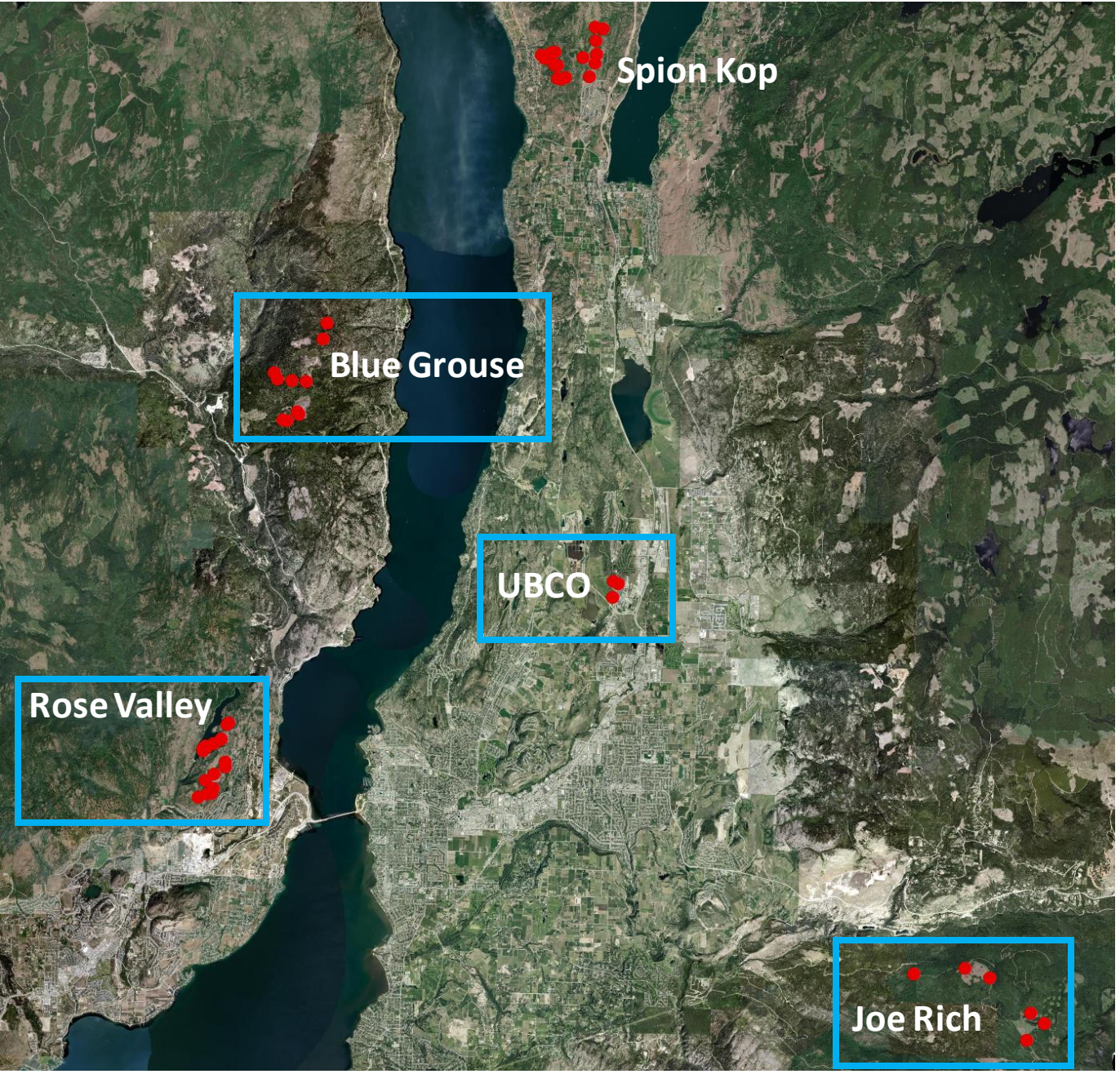
Weather Station

Chester LTE Gateway

Soil Moisture Sensor

# System architecture



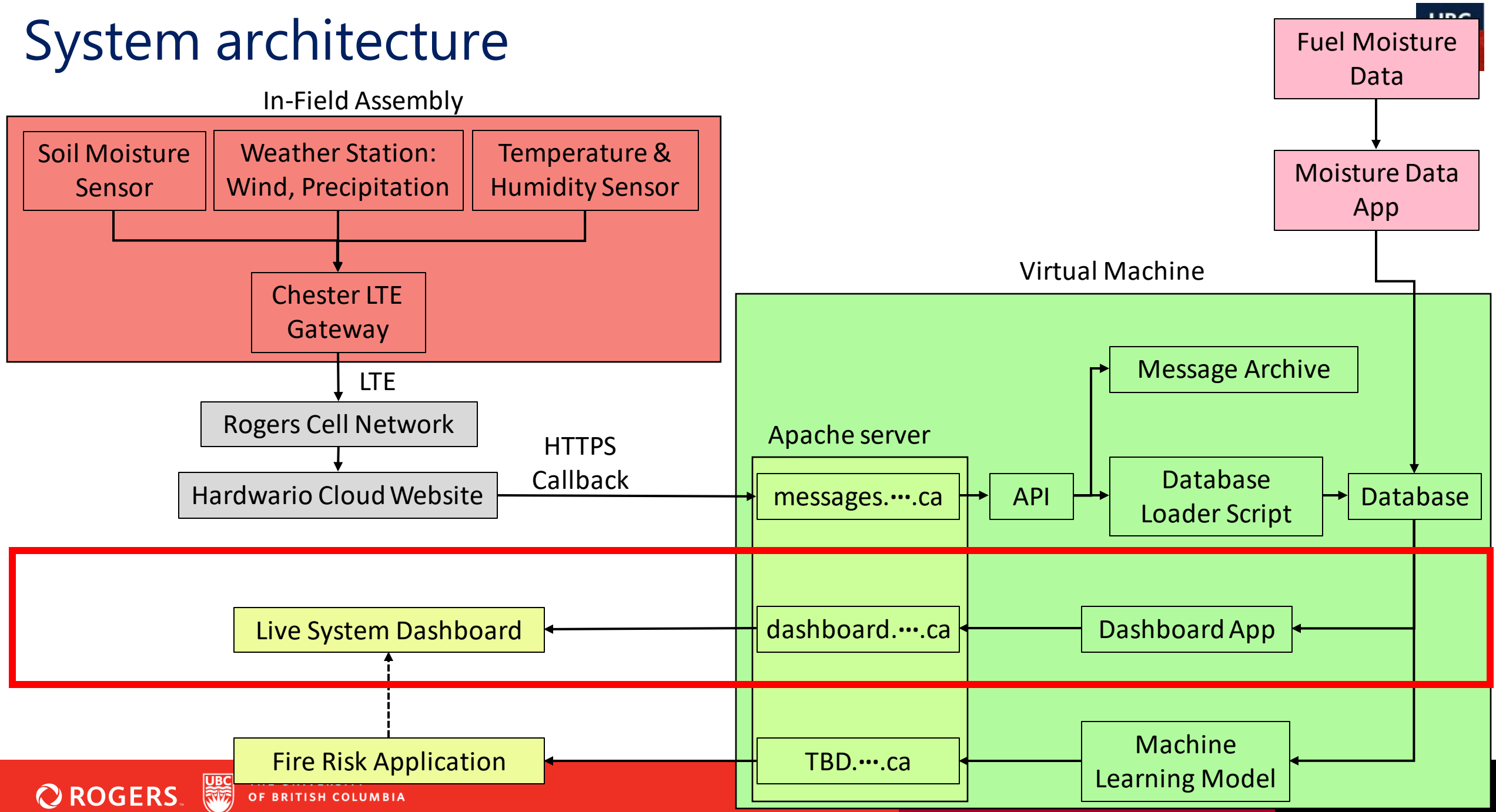

Spion Kop
Blue Grouse
UBCO
Rose Valley
Joe Rich







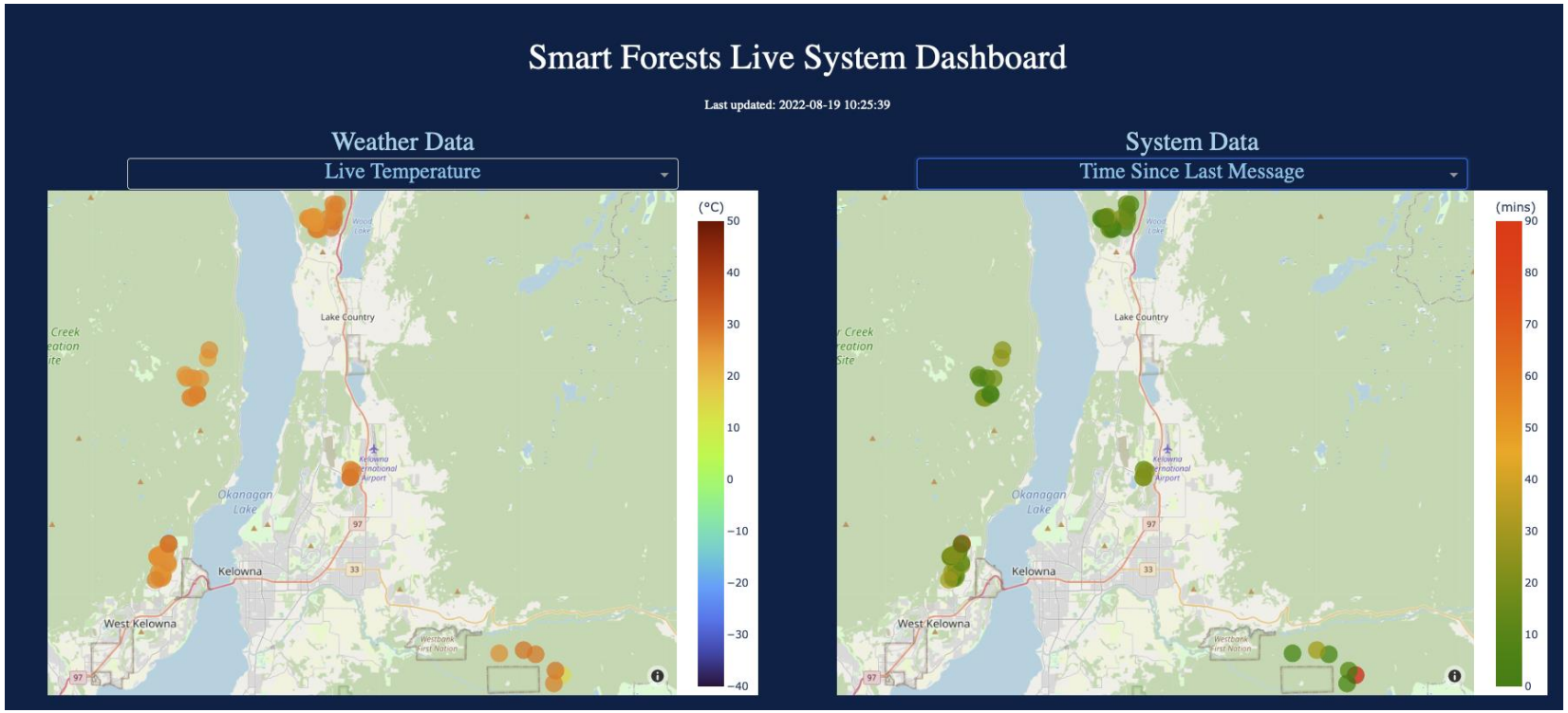
# System architecture



# Web-based dashboard app

## Weather Data

- Temperature
- Relative humidity
- Precipitation
- Wind speed
- Wind direction
- Soil temperature
- Soil moisture

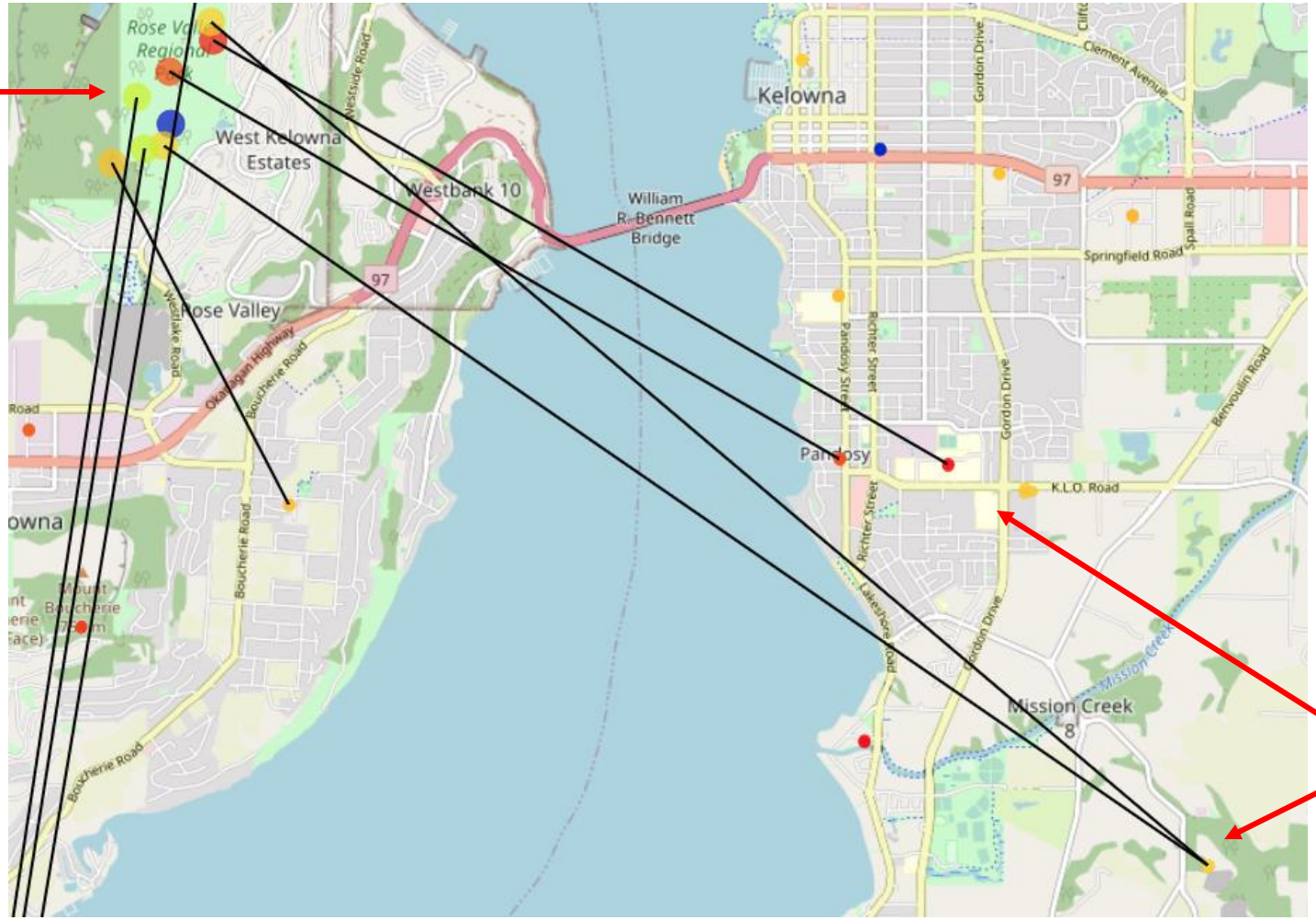



## System Data

- Time since last message
- GNSS position
- Battery level
- Cell tower receiving
- Signal strength

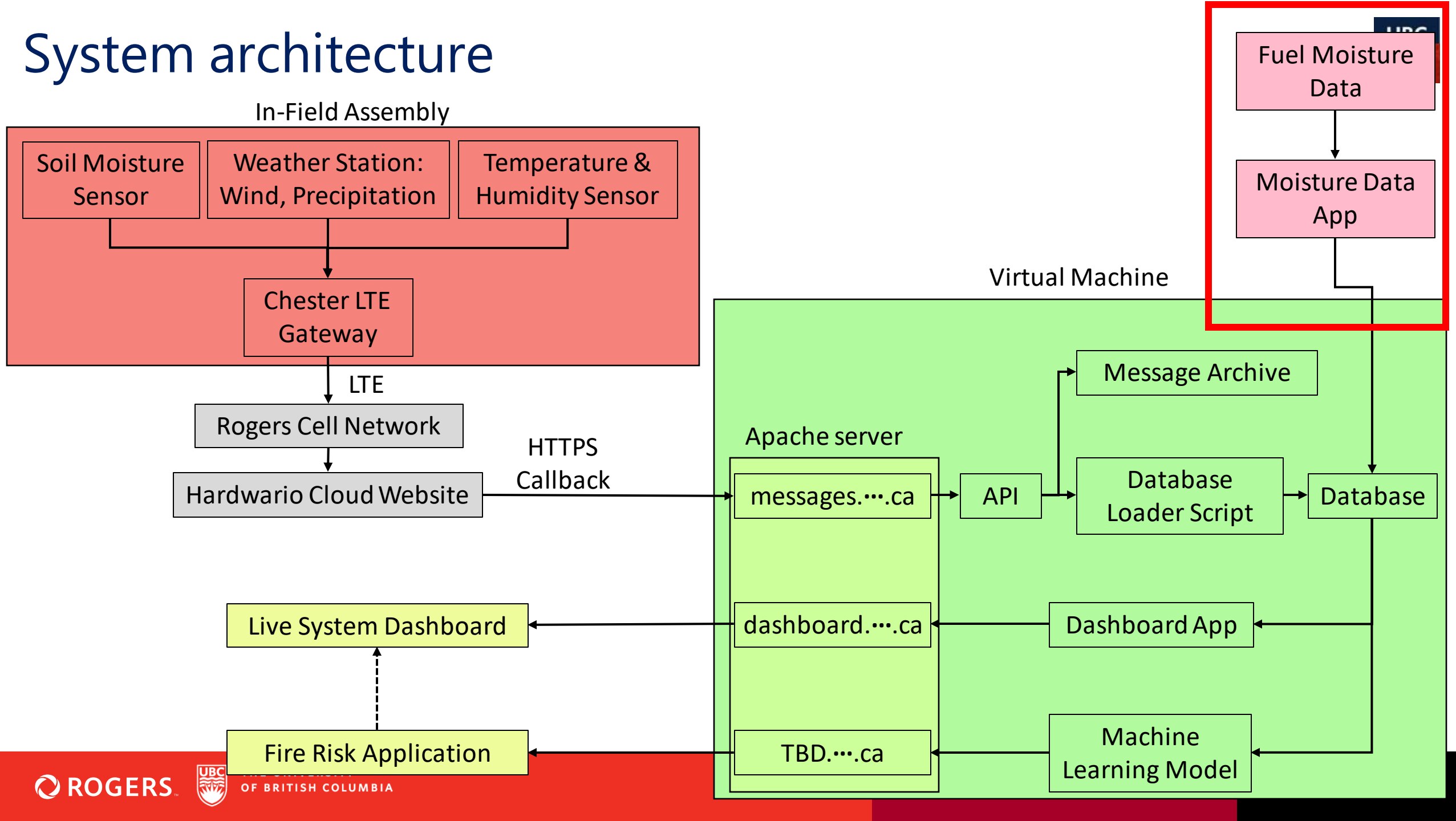
# LTE-M Connection

Weather Stations

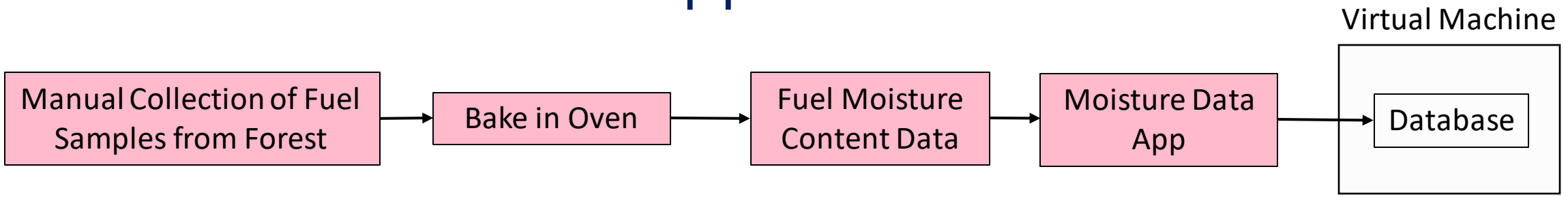



Rogers Cell Towers

# System architecture



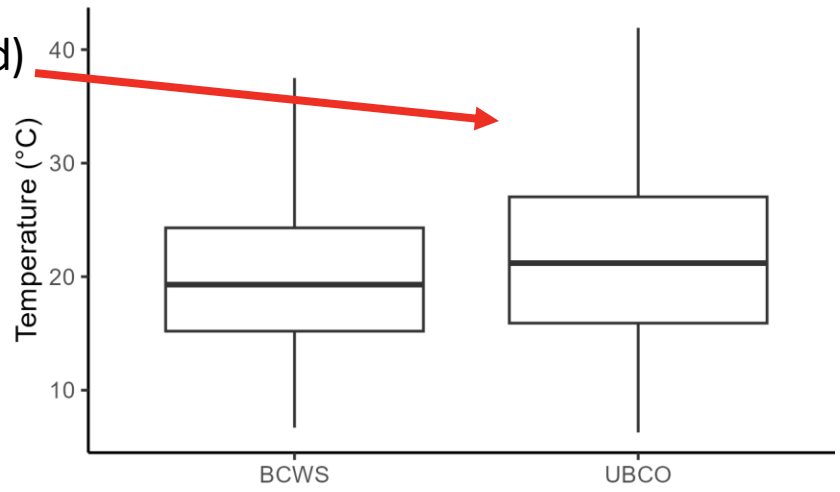
# Web-based dashboard app

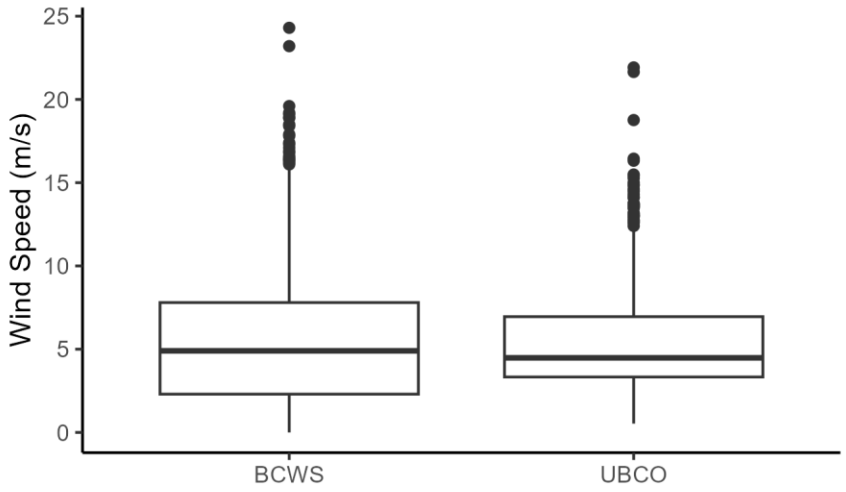


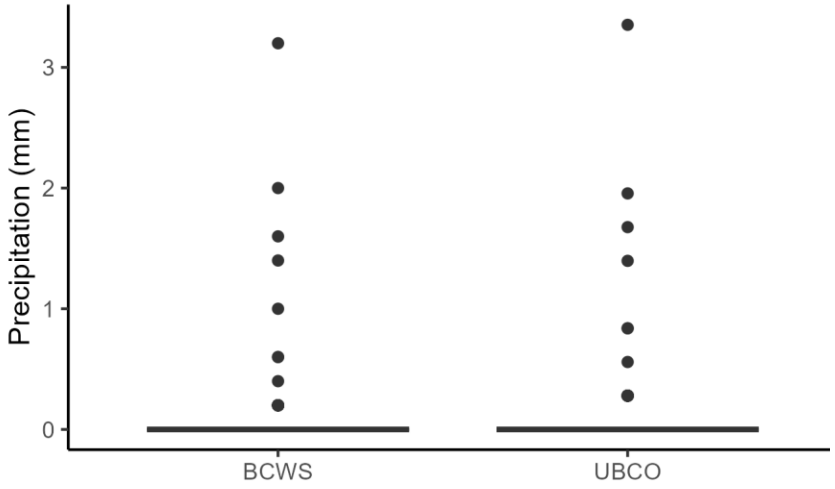

- Fuel moisture data:
  - Dead and live (by species/type) fuel moisture
  - Custom app loads data into same database as weather data
- Additional stand-level data:
  - Crown closure
  - Stem density
  - Forest height
  - Standing biomass
  - Ground fuel load and biomass

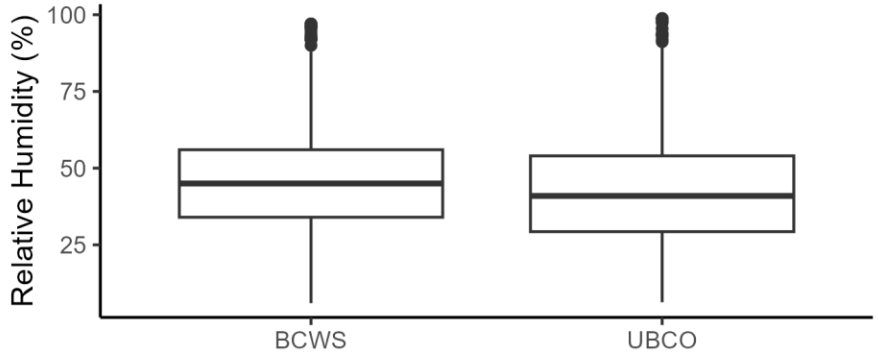
# Results

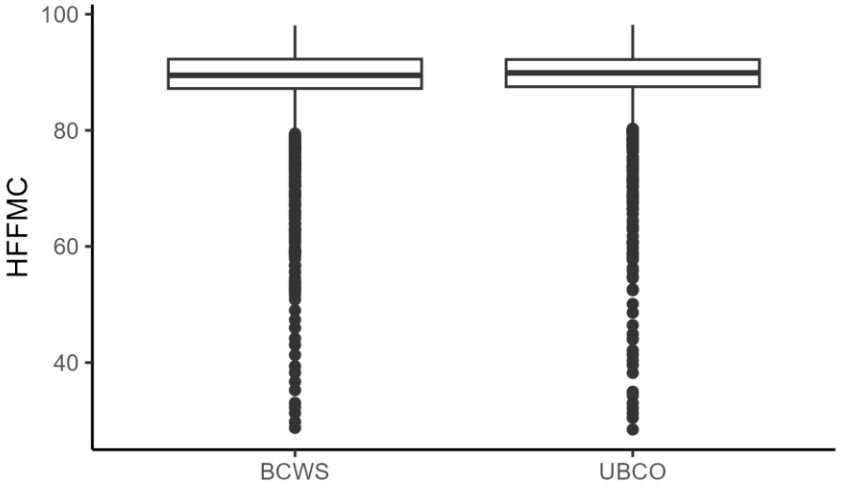
Temperature is running a bit hot at mid-day (solar radiation shield)

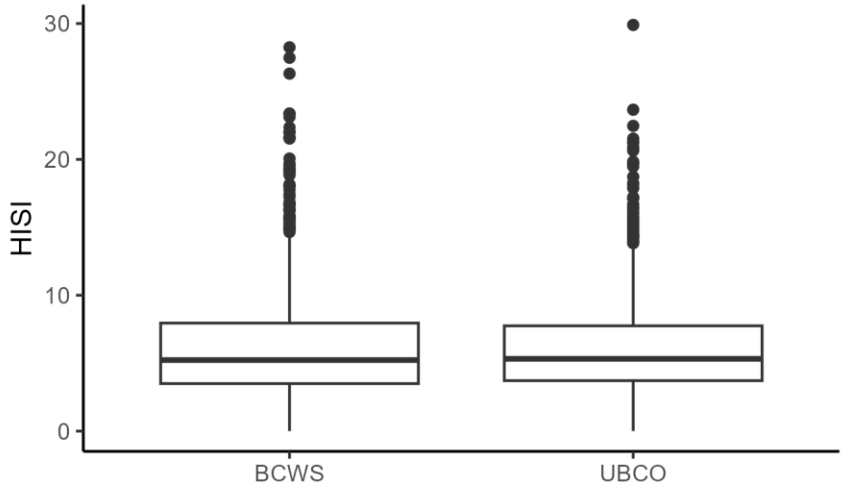


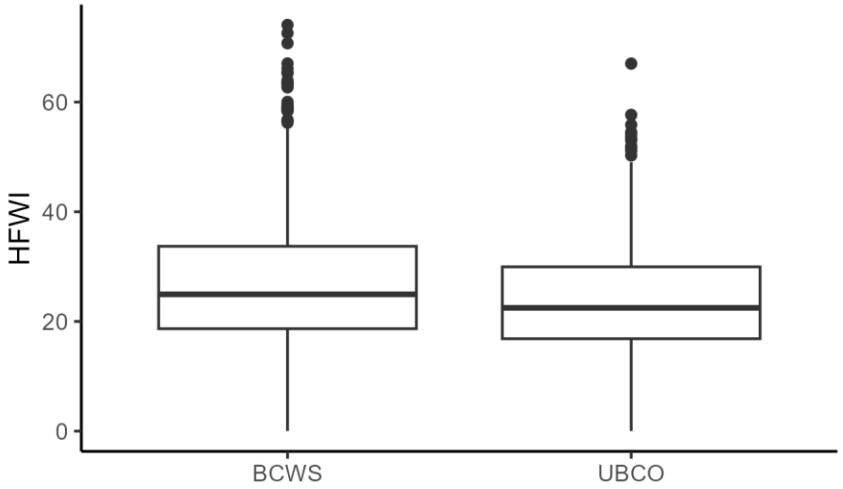



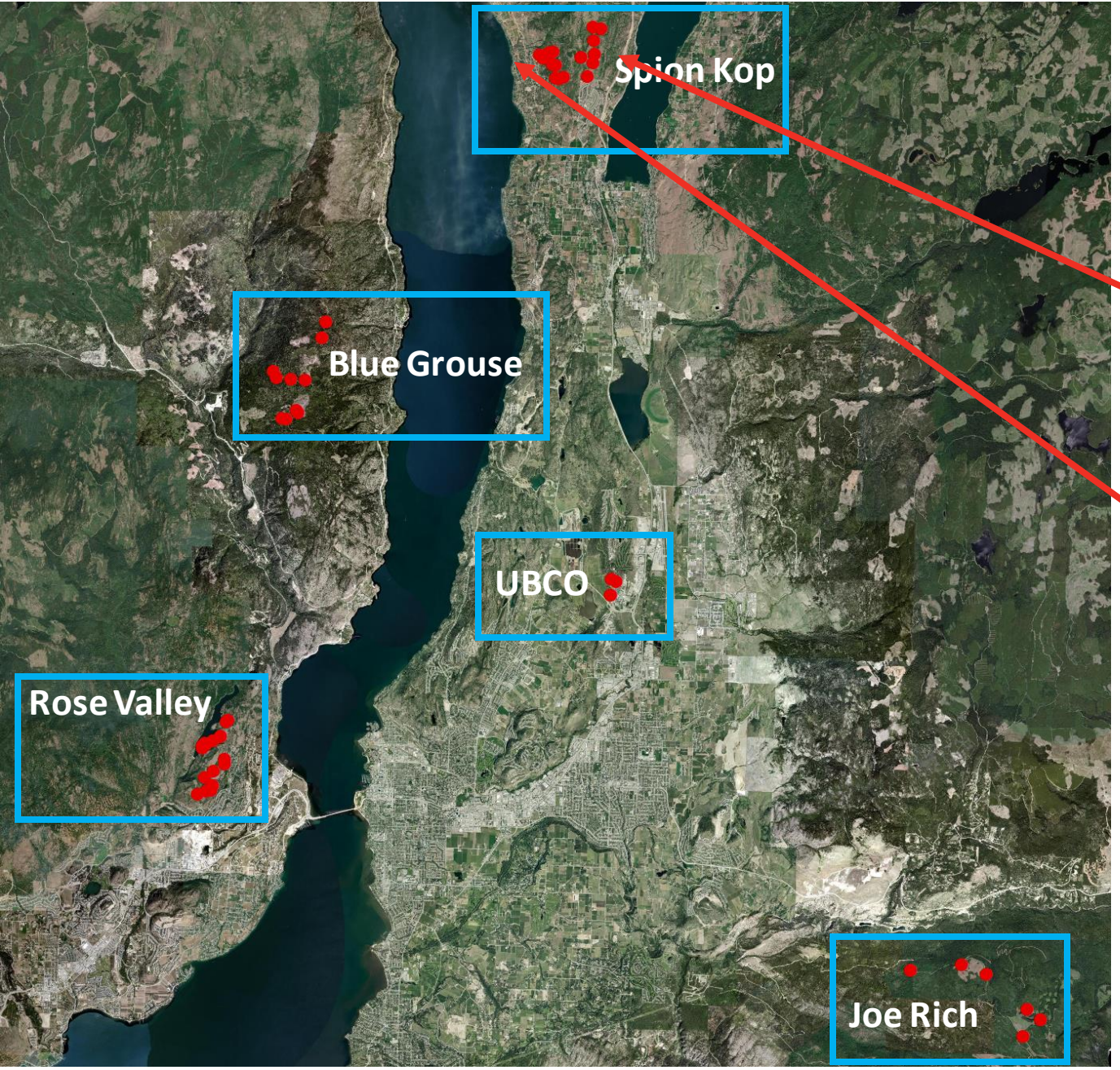



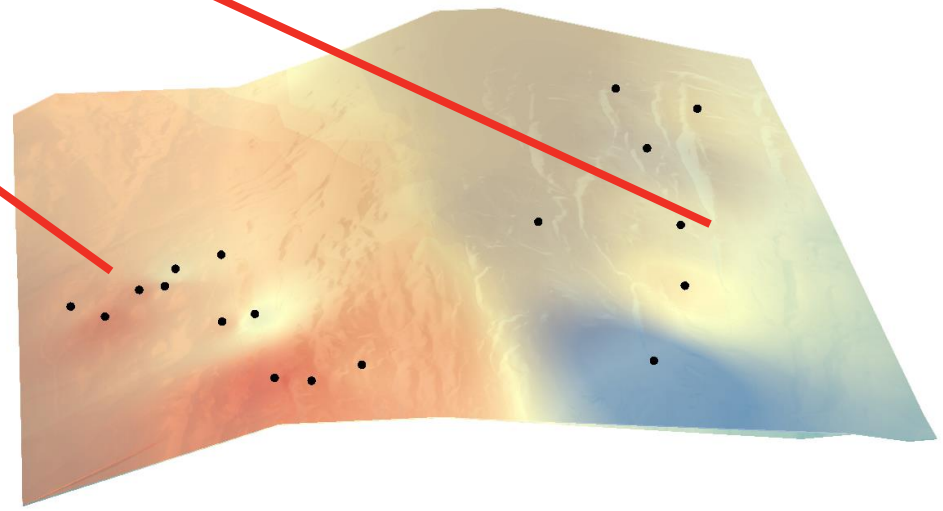

HFFMC
100
80
60
40
BCWS
UBCO


HISI
30
20
10
0
BCWS
UBCO

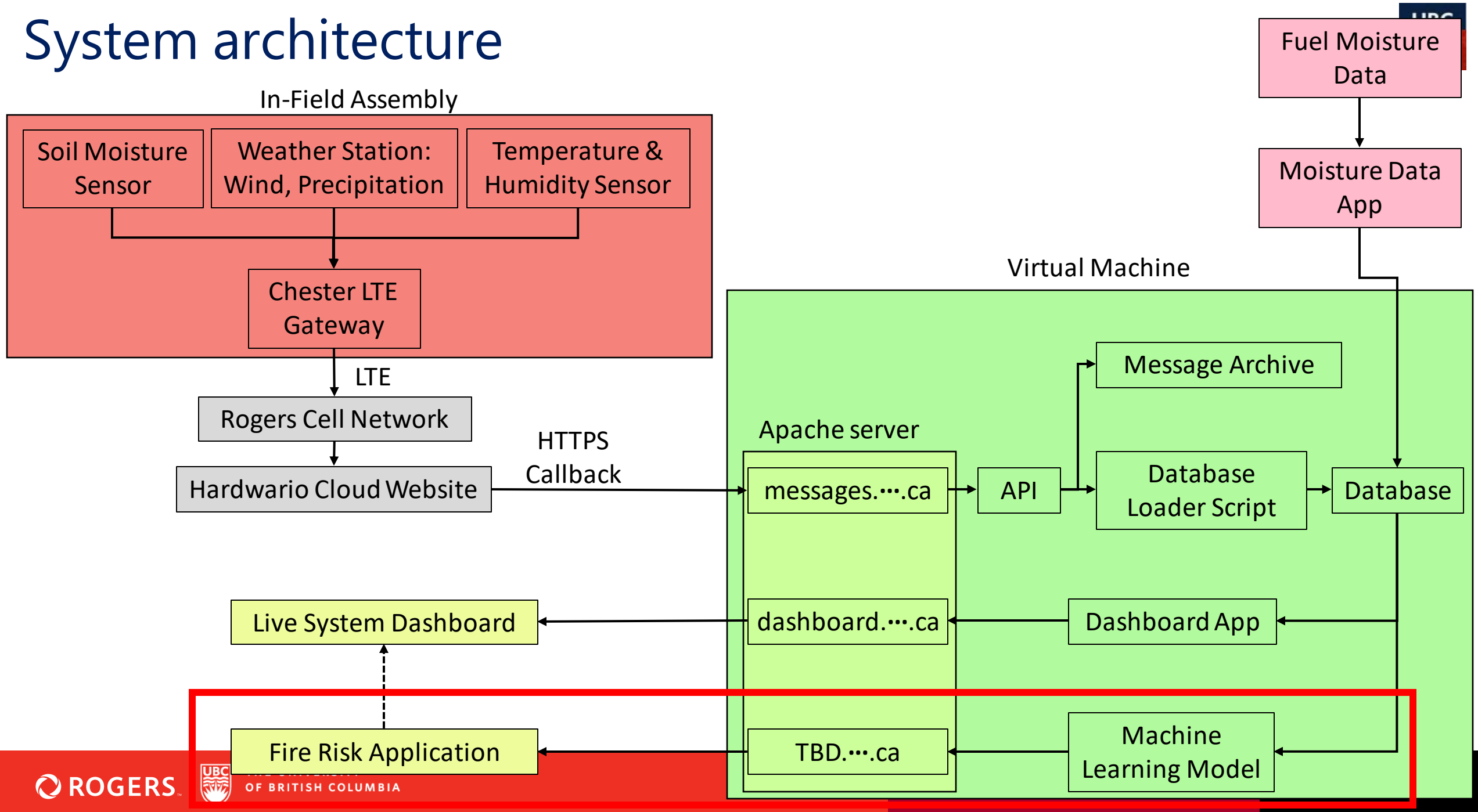

HFWI
60
40
20
0
BCWS
UBCO


Spion Kop
Blue Grouse
UBCO
Rose Valley
Joe Rich

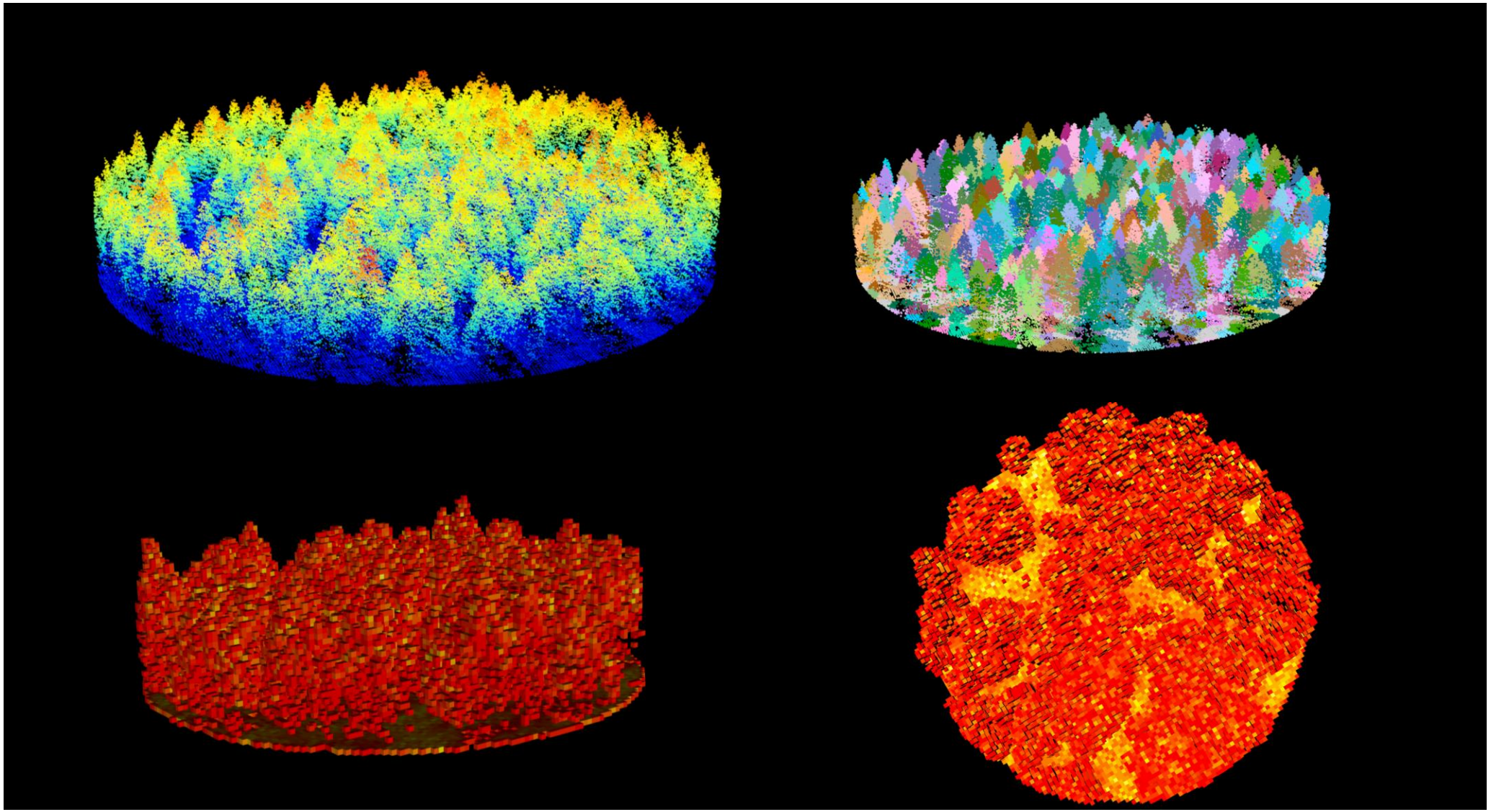




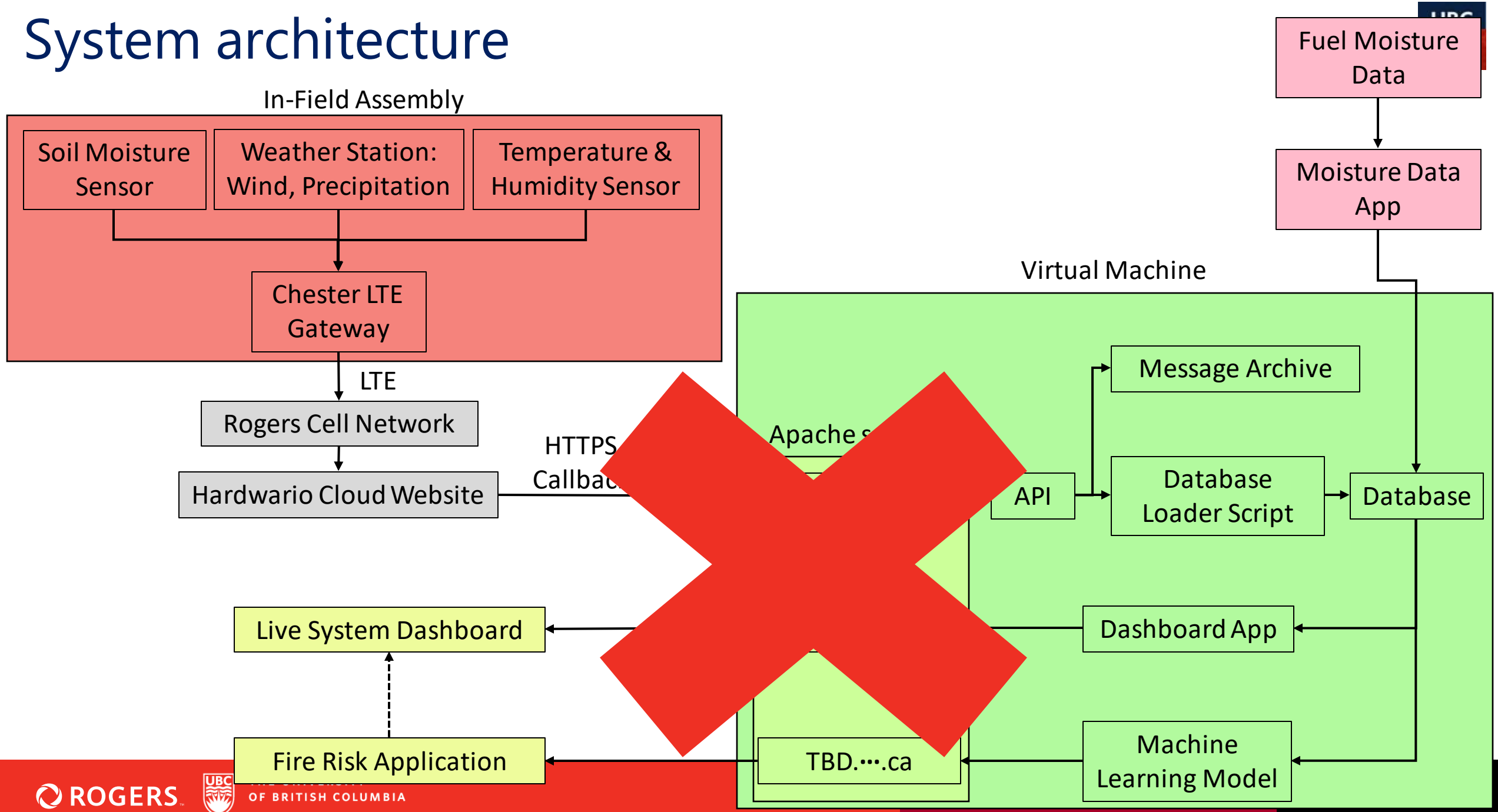
# System architecture



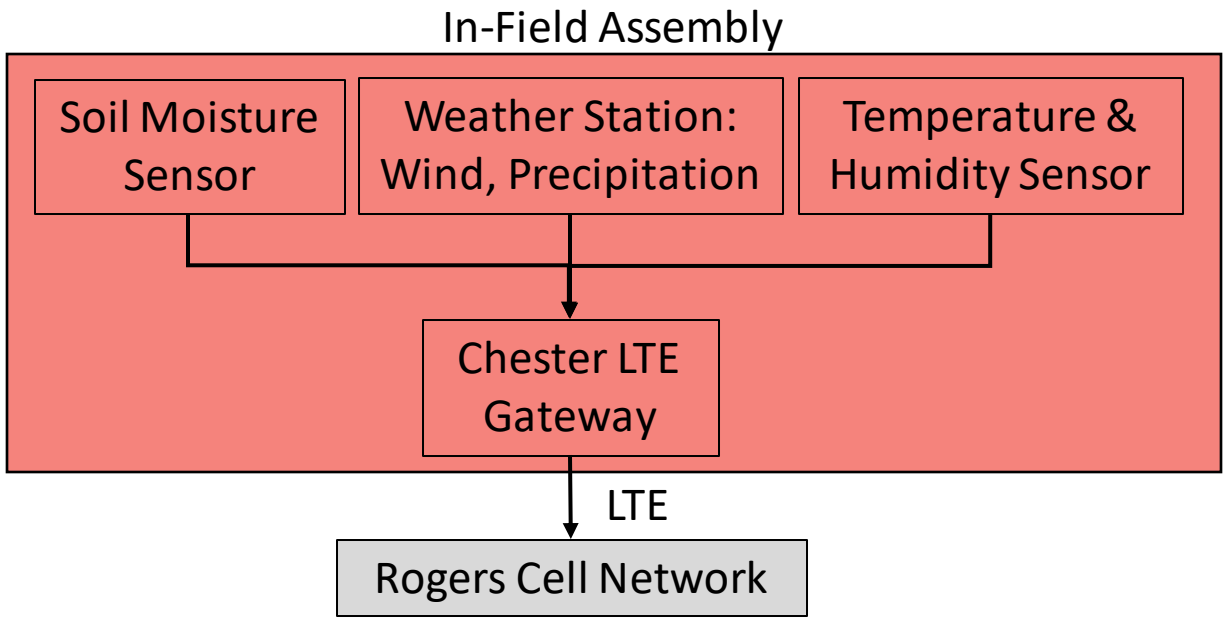
# What's next?



# System architecture

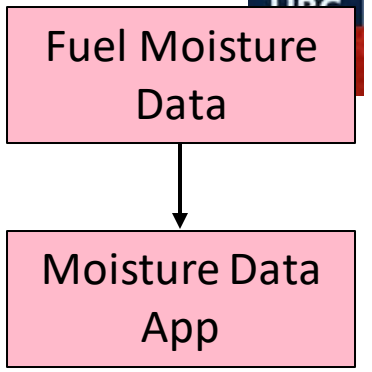


# System architecture

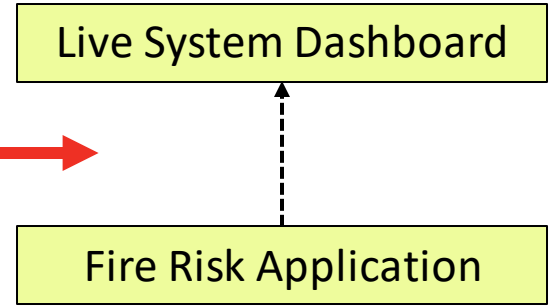



Additional hardware:

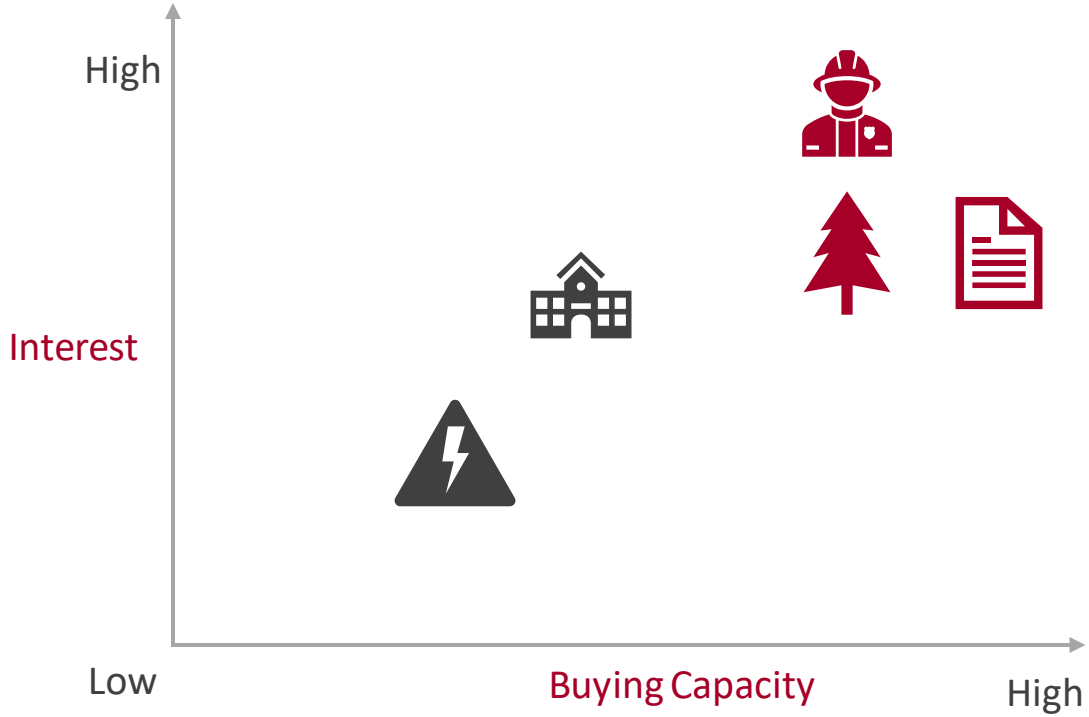
- Solar panel
- RGB and thermal camera
- Pyranometer
- 10h fuel moisture sensor







# Both Public and Private Players are the primary customers in need of the Fire Risk-Mapping Capability


Wildfire Agencies

Insurance/ Risk Rating

Forestry

Municipal Govt.

Utility Companies

# What's next?

NTITYIX RESOURCES LP

Agriculture and Agri-Food Canada

PENTICTON INDIAN BAND

Image: BCWS

# What's next?

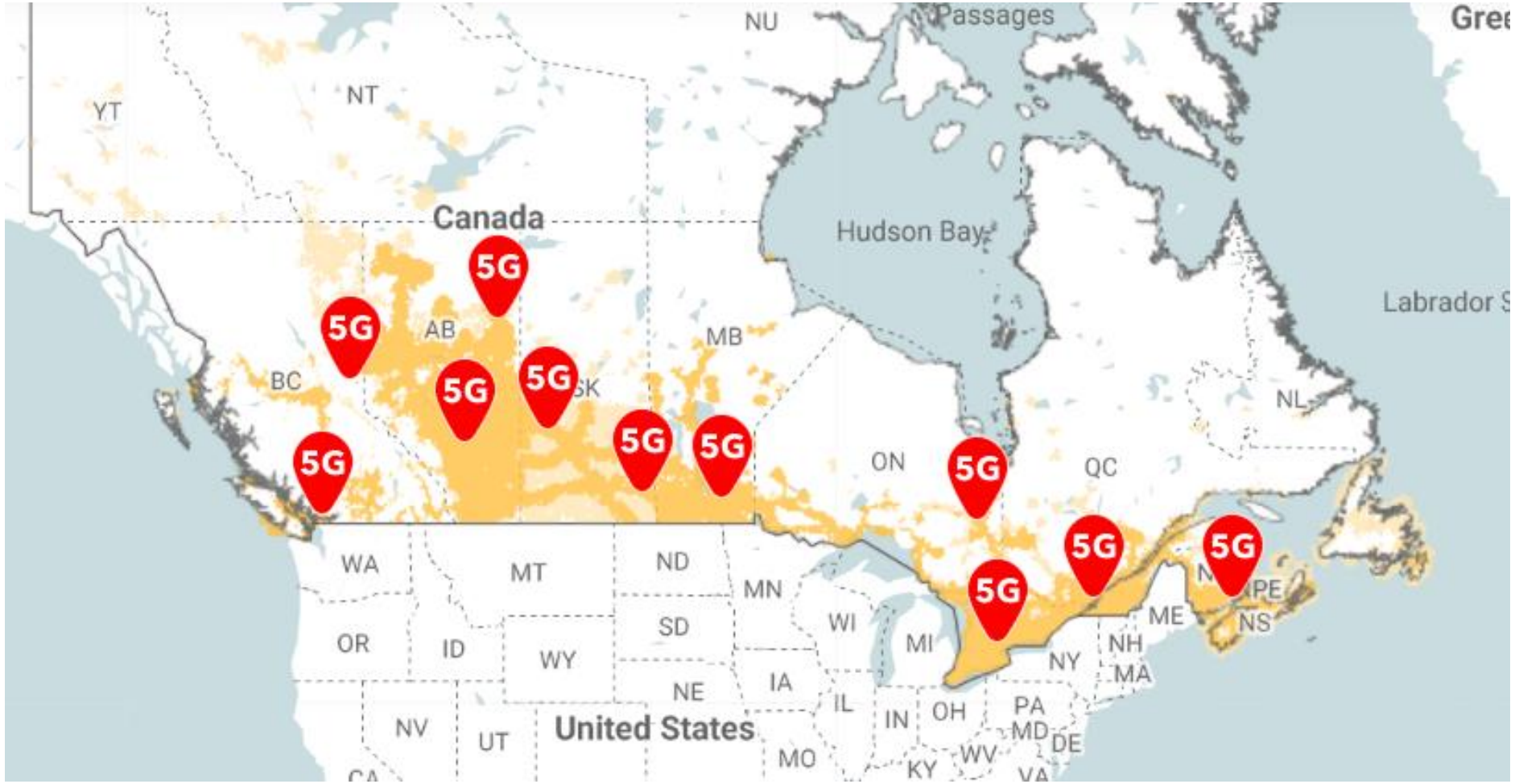
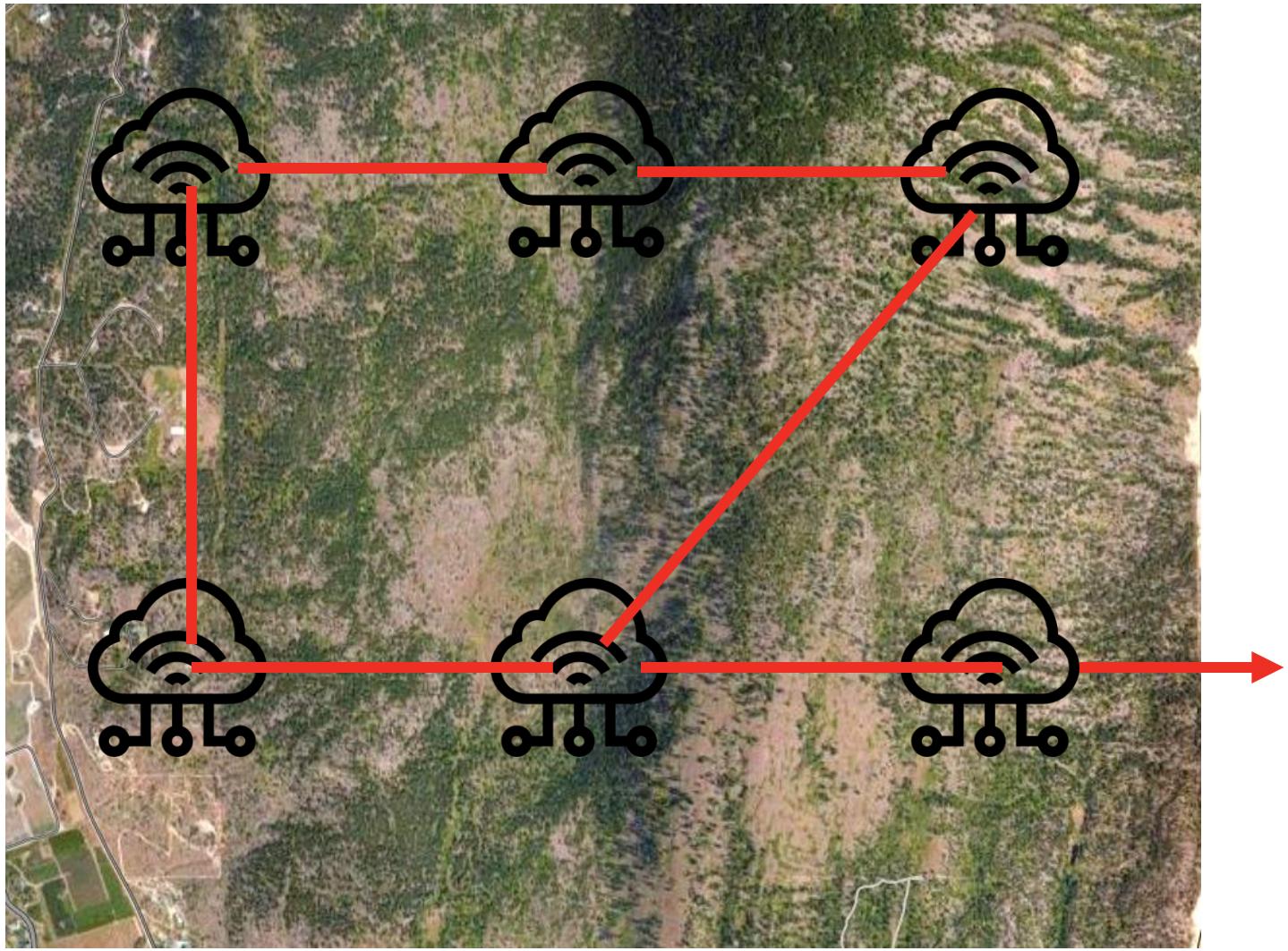



Image: Rogers Communications

# What's next?



- **Amitabh Chhabra**, Technology Lead
- Jade Salazaar, Partnership lead
- Pratham Mehta, Solutions designer

- **Mathieu Bourbonnais,** PI
- Lael Parrott, Co-I
- Ian Parfitt (PhD student)
- Vivien Nagy (BSc student, Math)
- Toni-Rae Dube (BSc student, Enviro Chem)
- Lewis Arnold (BSc student, Engineering)
- Arianna Johnstone (BSc student, Enviro Sci)

Question or comments:

mathieu.bourbonnais@ubc.ca

ROGERS

THE UNIVERSITY OF BRITISH COLUMBIA