Mobile Connectivity and Transit: A Case Study of Bl Ride, RidePingo, and What it Means for Residents, Planners, and other Stakeholders

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CEP 460
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The Task at Hand

- Kitsap Transit is promoting BI Ride, supported by the RidePingo app.
    - Why? **GHG reductions, and the “ride-hailing ease of an Uber app and affordability and accessibility of public transportation”**
- Challenges of transitioning to RidePingo:
    - **Primary: Network latency and disparities in connectivity between carriers.**
    - Secondary: Community pushback and regulation surrounding WCFs.

Logistics

- Data collection was undertaken four separate times, on **different days** of the week and **times of day**.
- The data points we were most concerned with were latency, upload, and download speeds, but jitter was also collected.
- Three **different carriers** were used, as well as two **unique operating systems** (Apple and Android).
- To get from location to location, BI Ride buses were utilized to simultaneously evaluate user and rider experience.

Data Representation:

Maps

FCC Wireless Speed Standards

- Minimums for a fixed service to have “advanced telecommunications capabilities.”

- Download Speed
  - **25** Mbps
- Upload Speed
  - **3** Mbps
- Latency
  - **64** ms

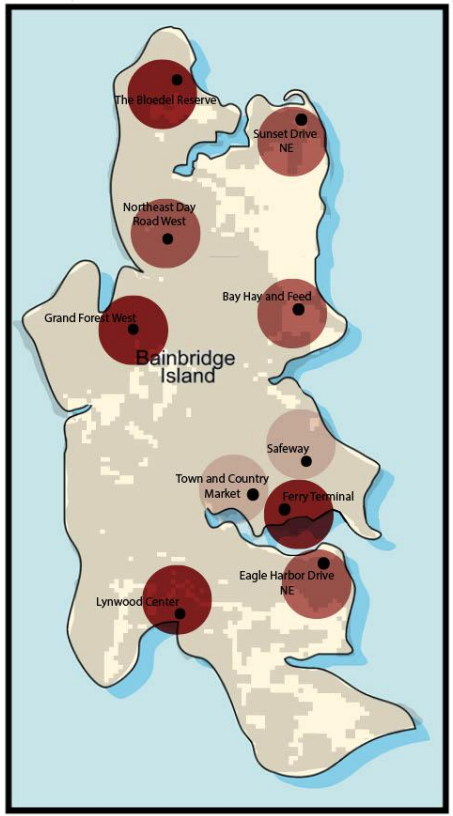
AT&T Download Speed Morning (8-12 A.M)

Phone Used:

IPhone 11 Pro Max

IPhone 11

Samsung Galaxy Z Flip



Download Speed (Mbps)

0-5
6-20
21-40
41-60
61 <

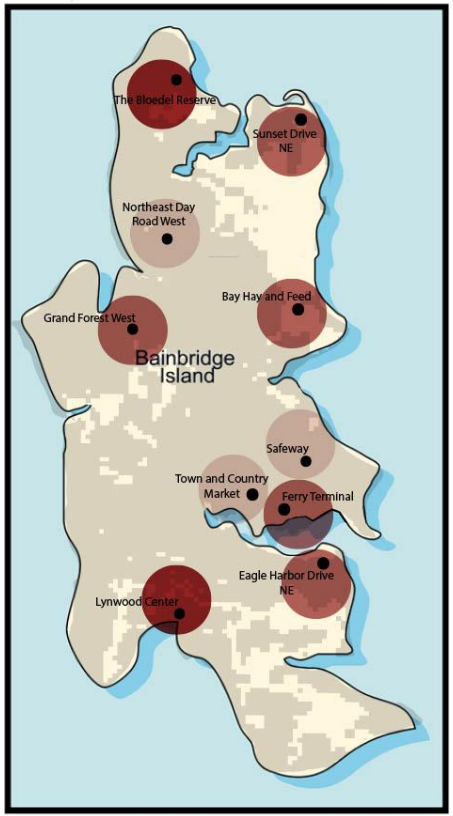
AT&T Download Speed Mid Day (12-3 P.M)

Phone Used:

IPhone 11 Pro Max

IPhone 11

Samsung Galaxy Z Flip



Download Speed (Mbps)

0-5
6-20
21-40
41-60
61 <

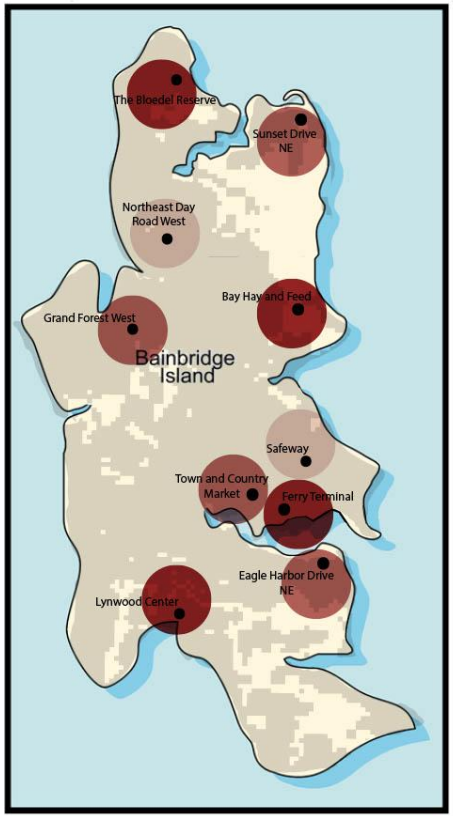
AT&T Download Speed Late Afternoon (3-5 P.M)

Phone Used:

IPhone 11 Pro Max

IPhone 11

Samsung Galaxy Z Flip



Download Speed (Mbps)

0-5
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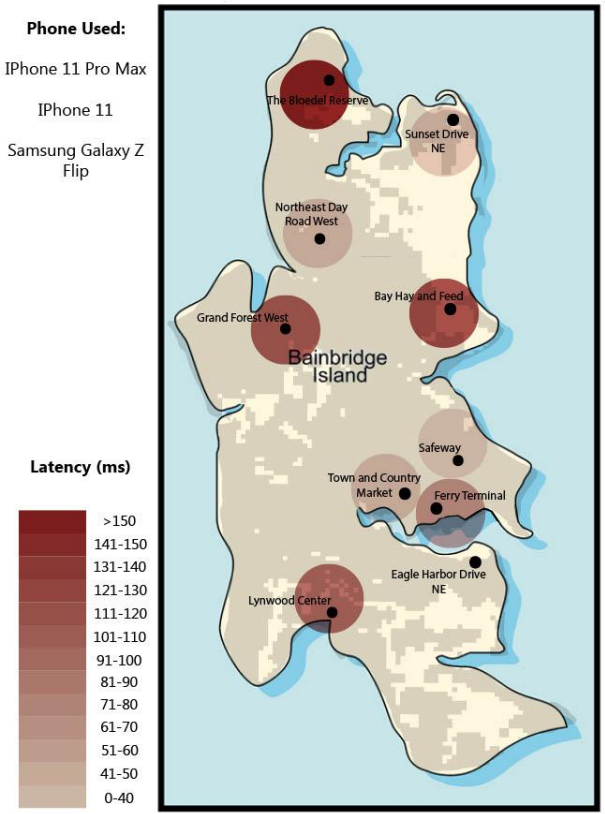
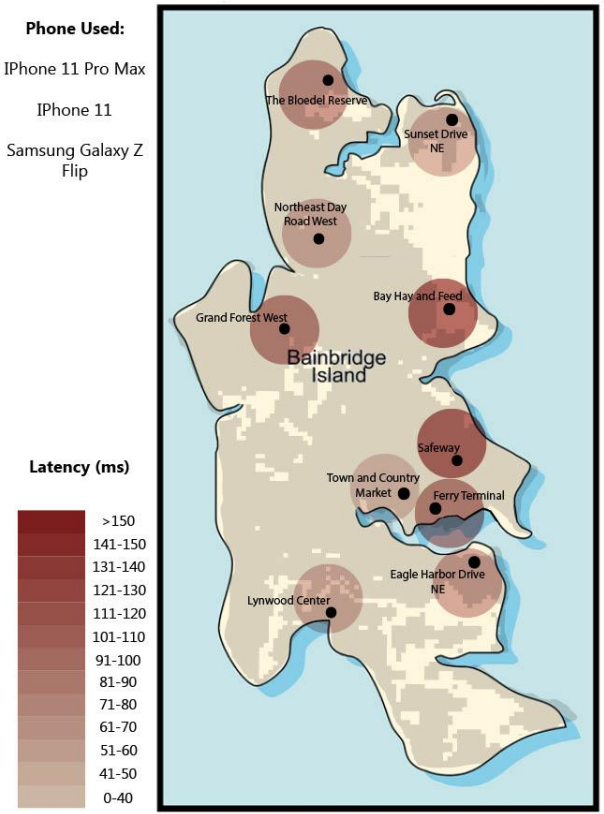
21-40
41-60
61 <

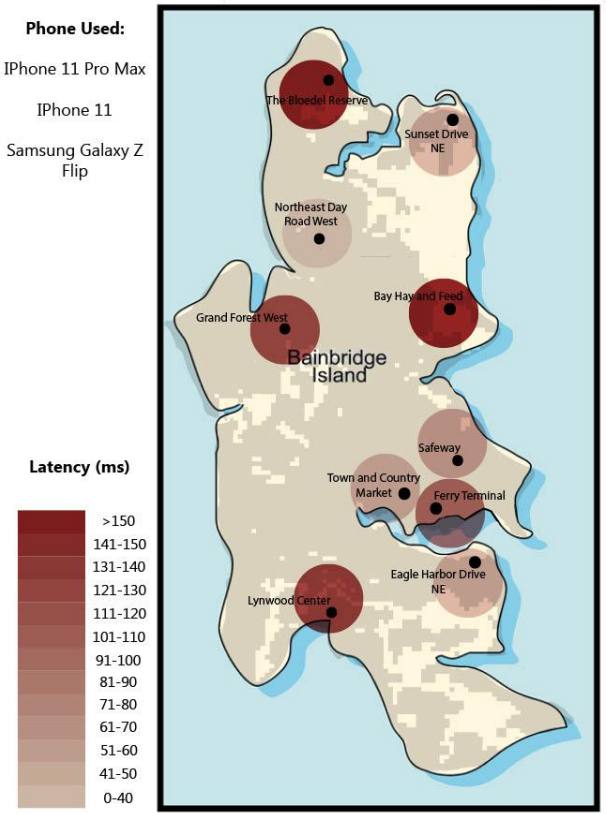
AT&T Latency Speed Morning (8-12 A.M)



AT&T Latency Mid Day (12-3 P.M)



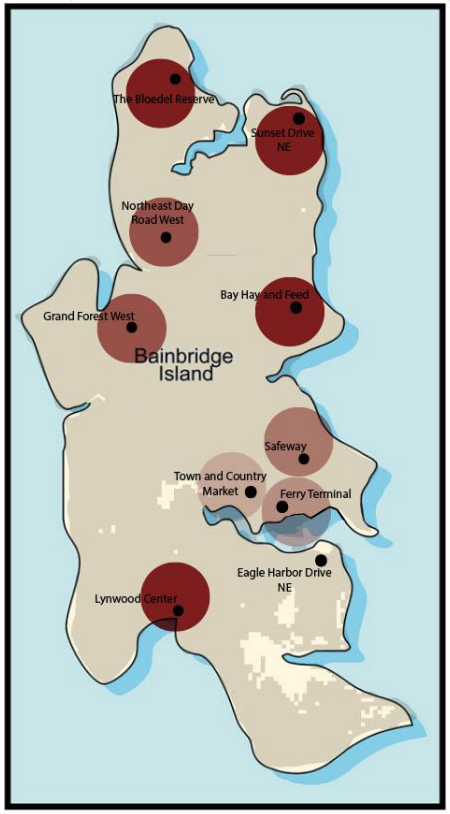
AT&T Latency Speed Late Afternoon (3-5 P.M)



Verizon Download Speed Morning (8-12 A.M)

Phone Used:

IPhone 7



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- 41-60
- 61 <

Verizon Download Speed Mid Day (12-3 P.M)

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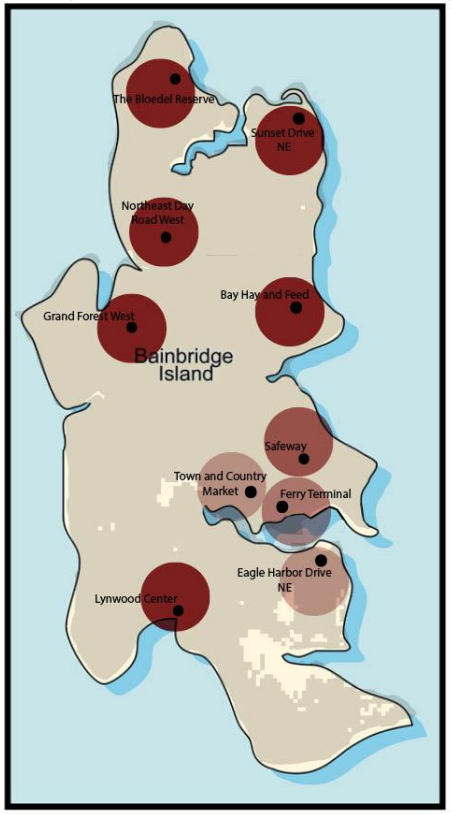

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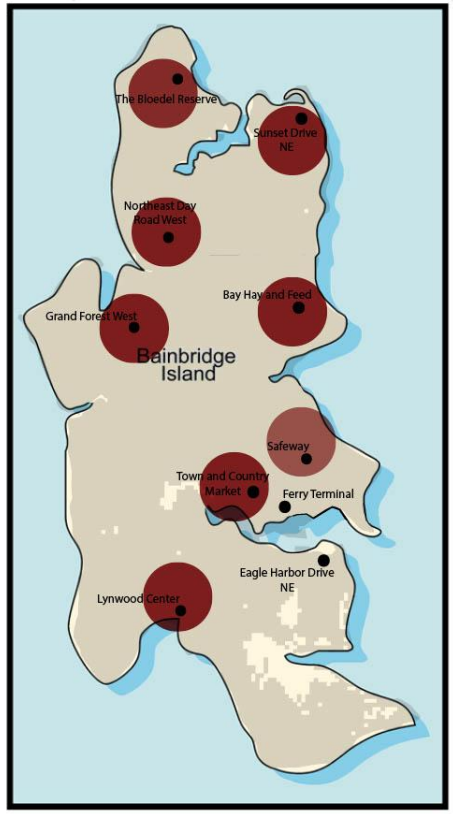

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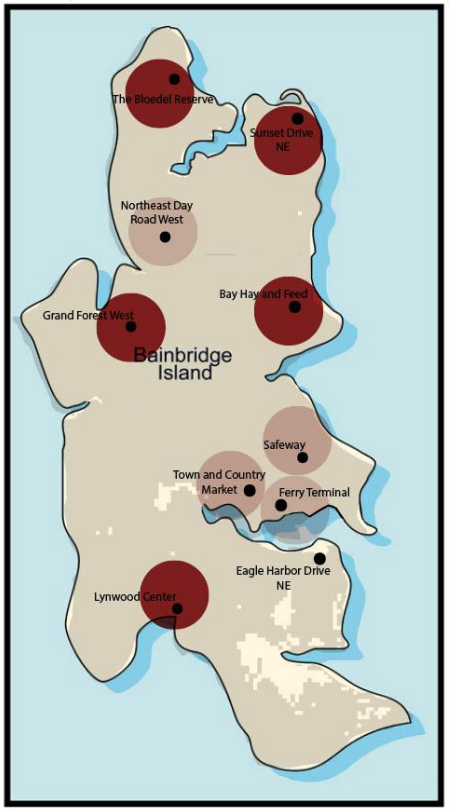

Latency (ms)

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131-140
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111-120
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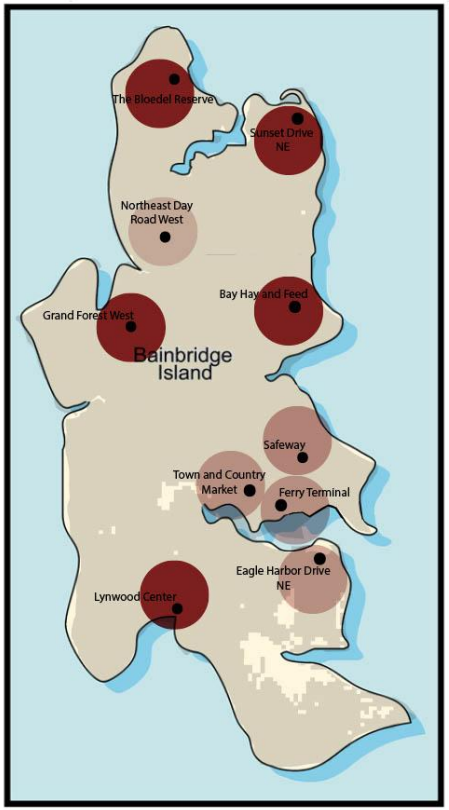
Verizon Latency Mid Day (12-3 P.M)

Phone Used: IPhone 7



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Verizon Latency Late Afternoon (3-5 P.M)

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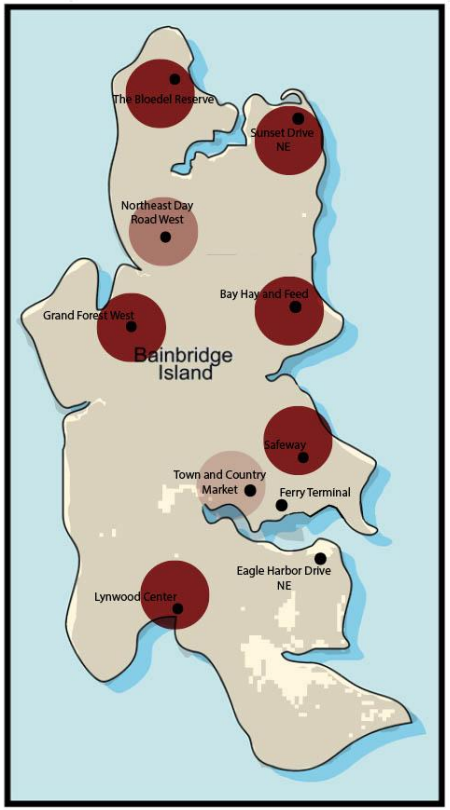

Latency (ms)

>150
141-150
131-140
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111-120
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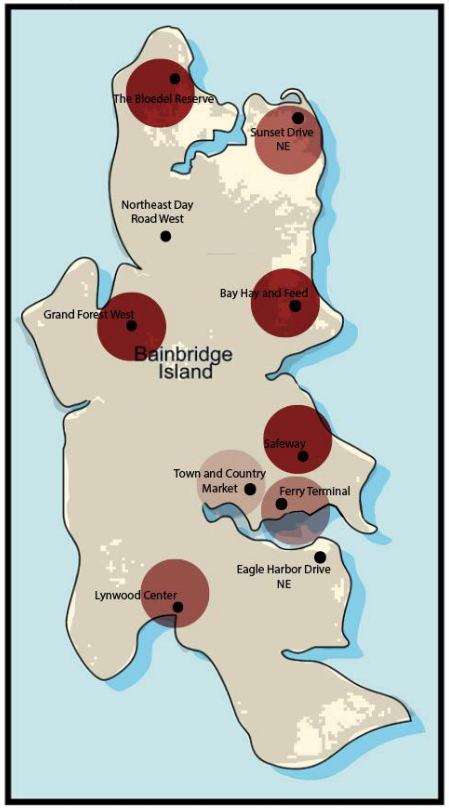
71-80
61-70
51-60
41-50
0-40

T-Mobile Download Speed Morning (8-12 A.M)

Phone Used:

Oukitel WP5

Samsung Galaxy S10



Download Speed (Mbps)

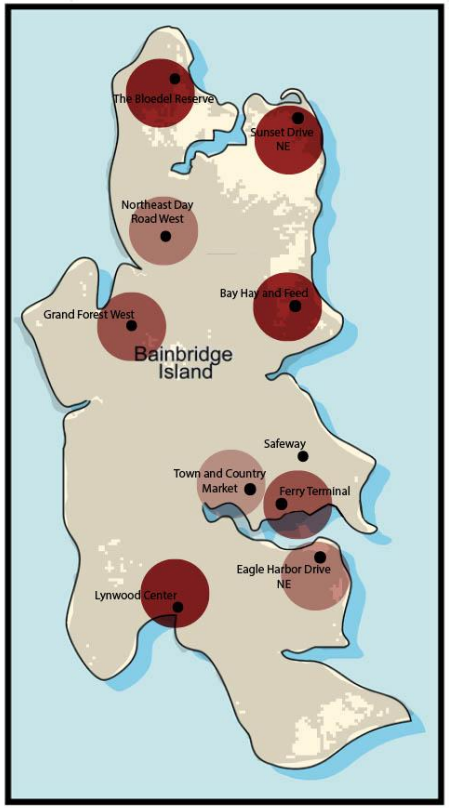
0-5
6-20
21-40
41-60
61 <

T-Mobile Download Speed Mid Day (12-3 P.M)

Phone Used:

Oukitel WP5

Samsung Galaxy S10



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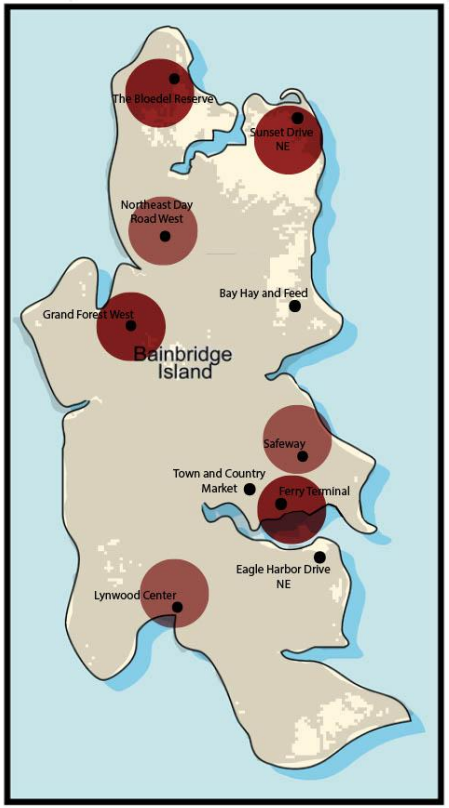
21-40
41-60
61 <

T-Mobile Download Speed Late Afternoon (3-5 P.M)

Phone Used:

Oukitel WP5

Samsung Galaxy S10



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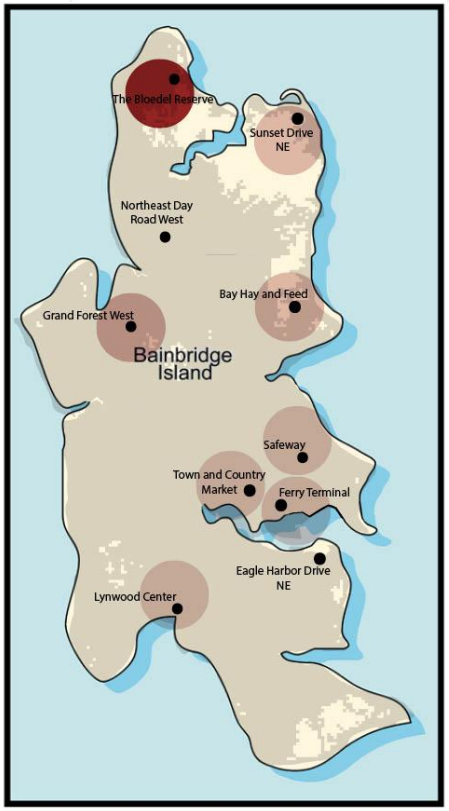

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T-Mobile Latency Mid Day (12-3 P.M)

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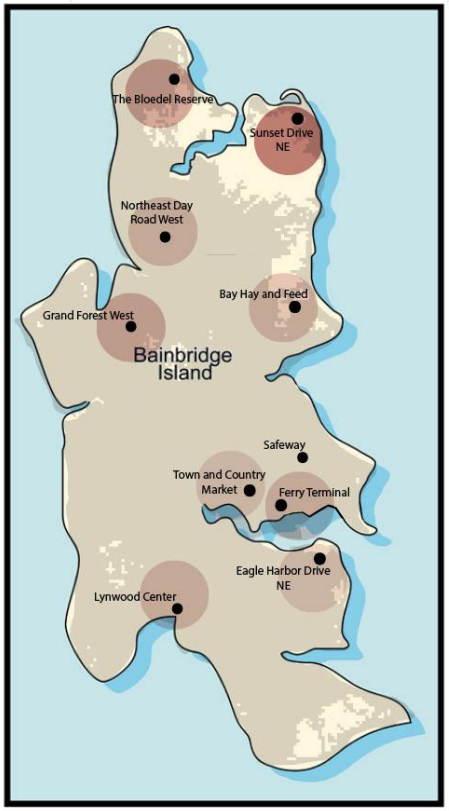

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T-Mobile Latency Speed Late Afternoon (3-5 P.M)

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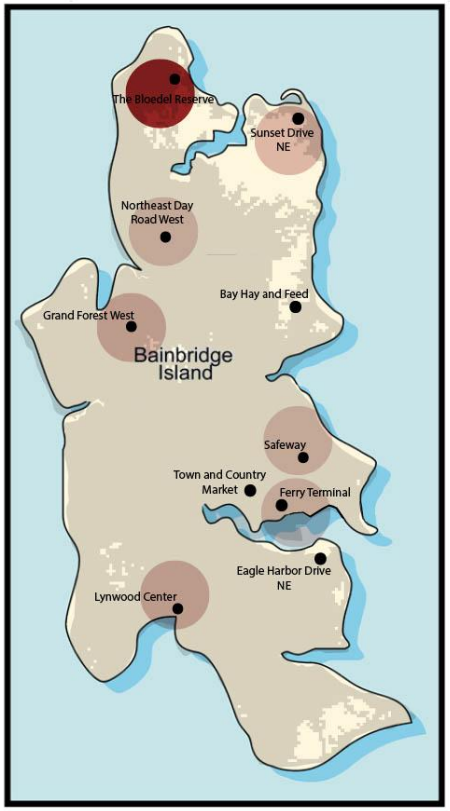

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81-90
71-80
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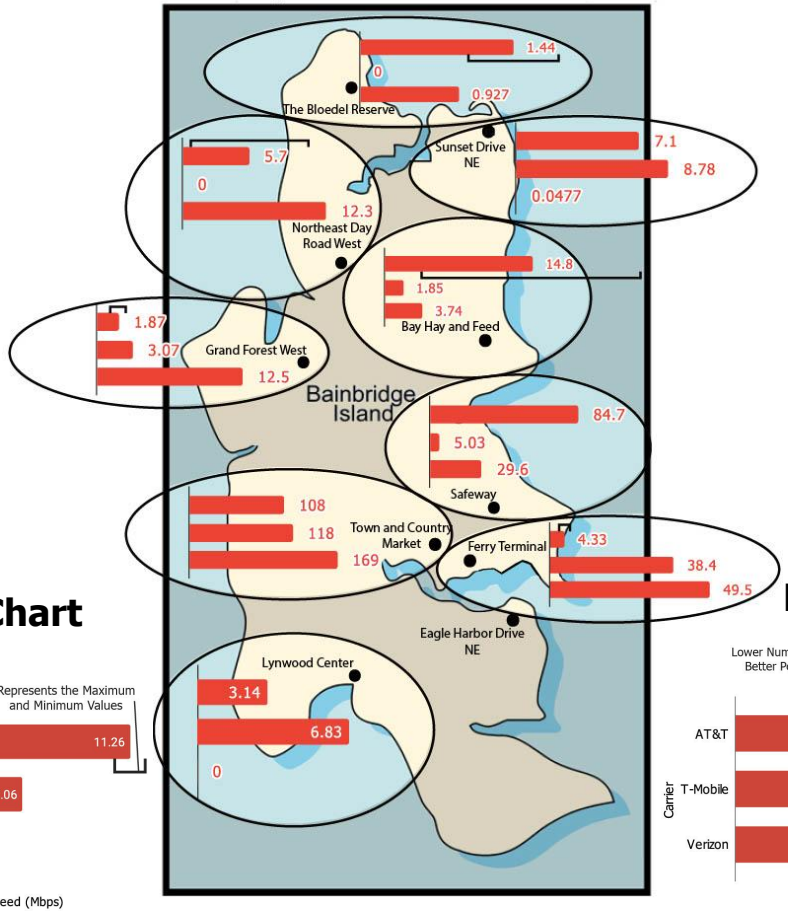
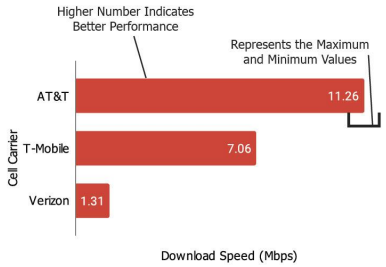
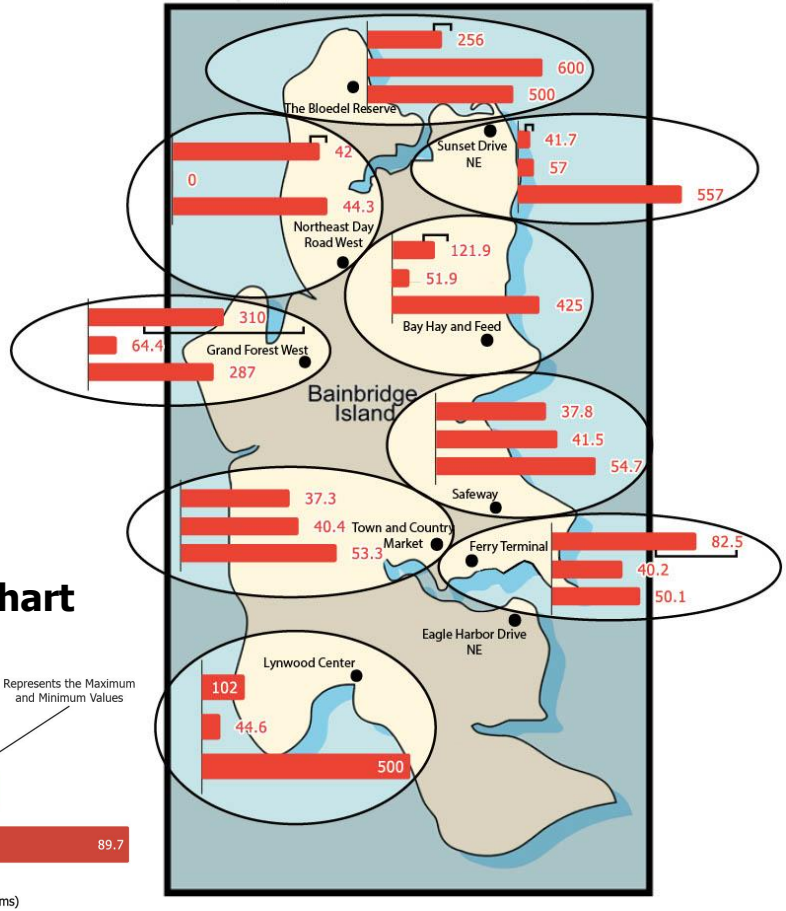
Download Speed Morning Comparison (8-12 A.M)



Key Chart



Latency Speed Morning Comparison (8-12 A.M)



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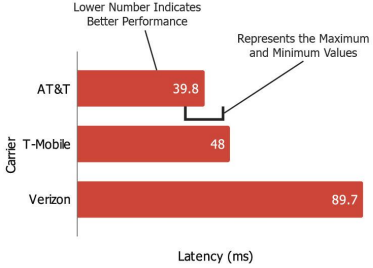
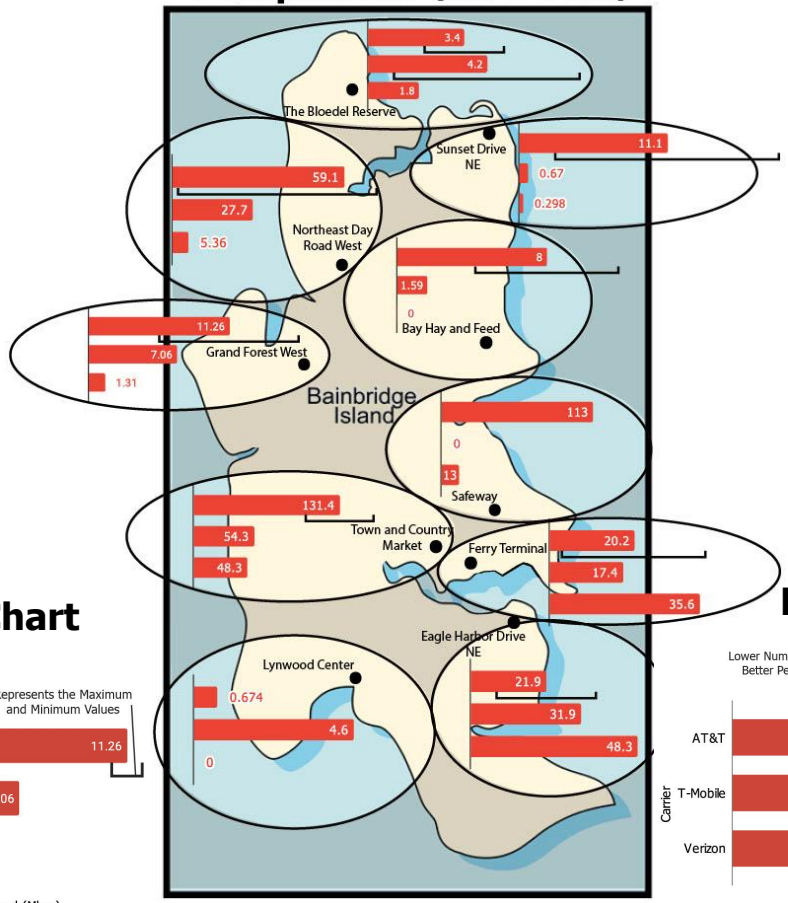
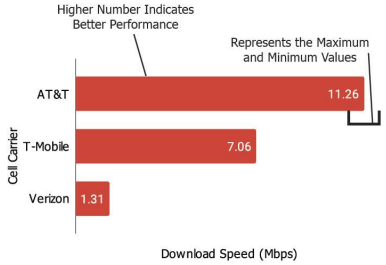


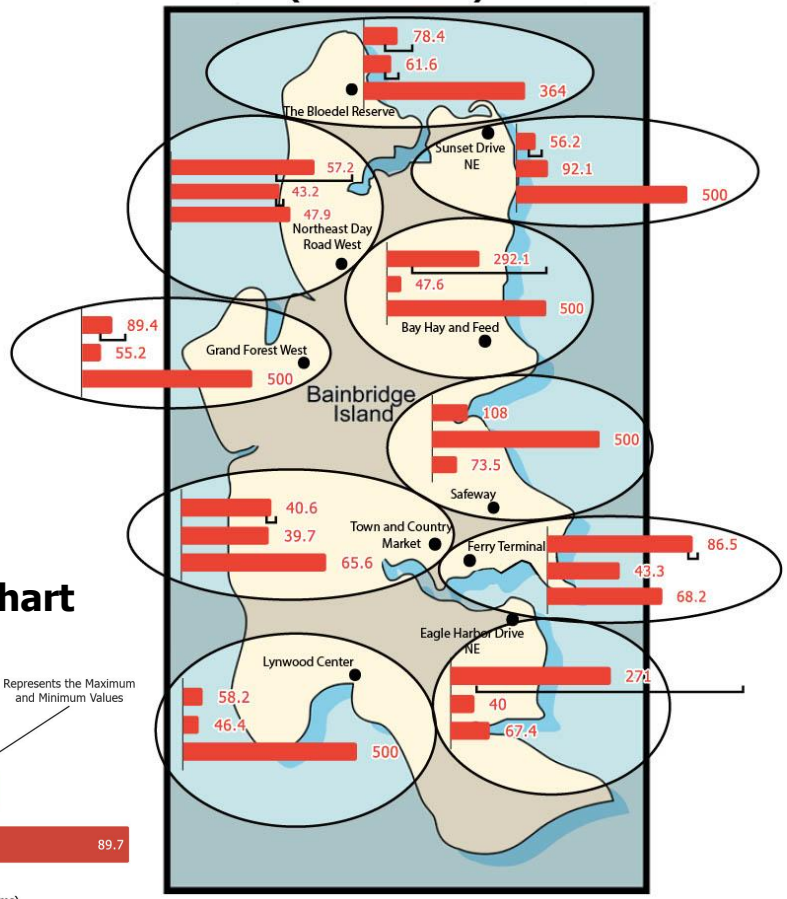
Download Speed Mid Day Comparison (12-3 P.M)



Key Chart



Latency Mid Day Comparison (12-3 P.M)



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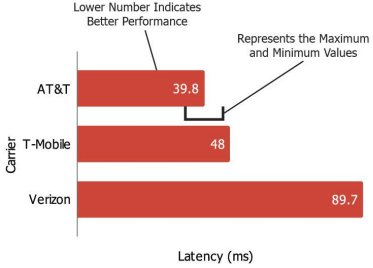
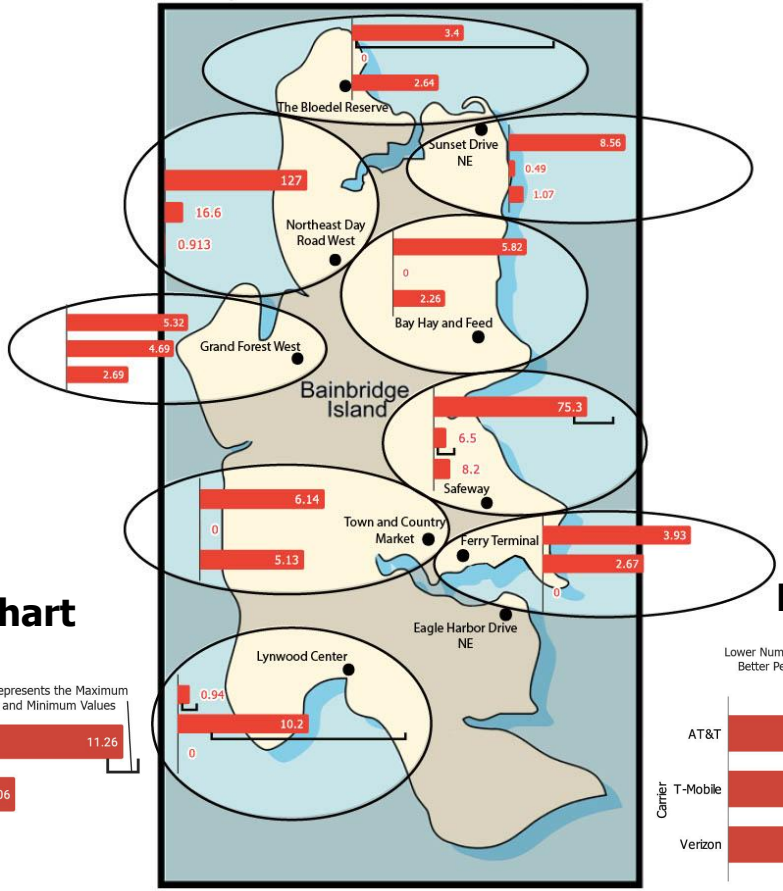
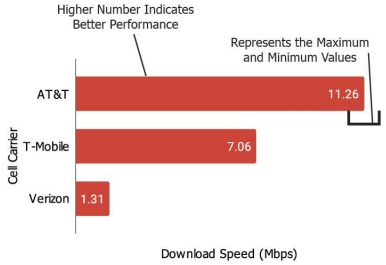


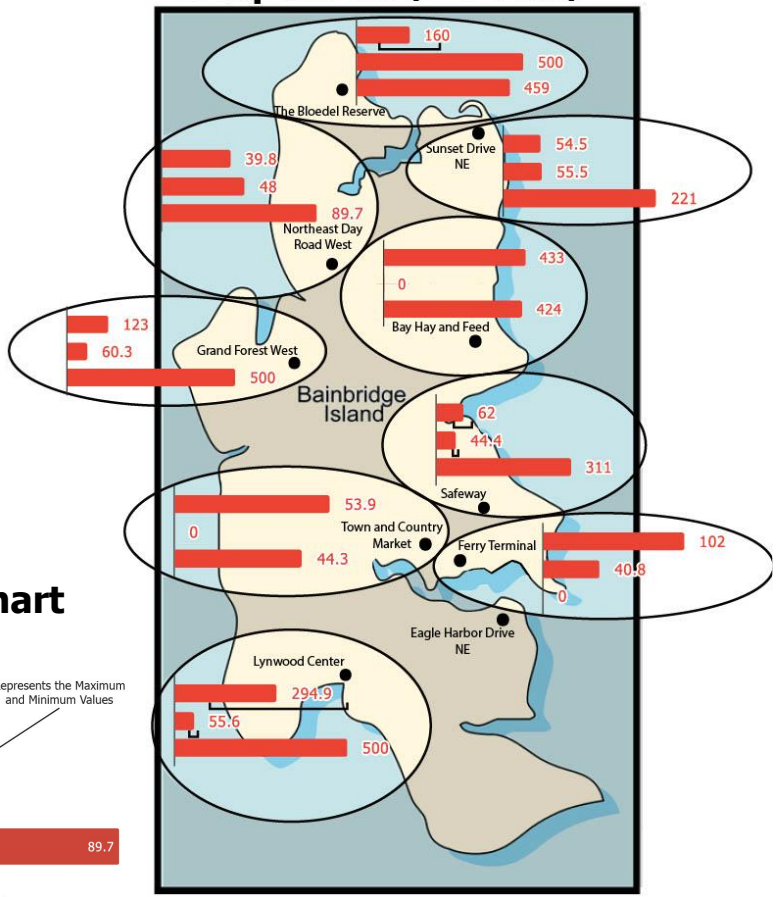
Download Speed Late Afternoon Comparison (3-5 P.M)



Key Chart



Latency Speed Late Afternoon Comparison (3-5 P.M)



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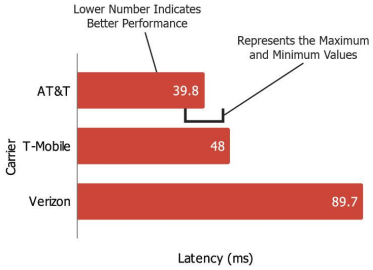


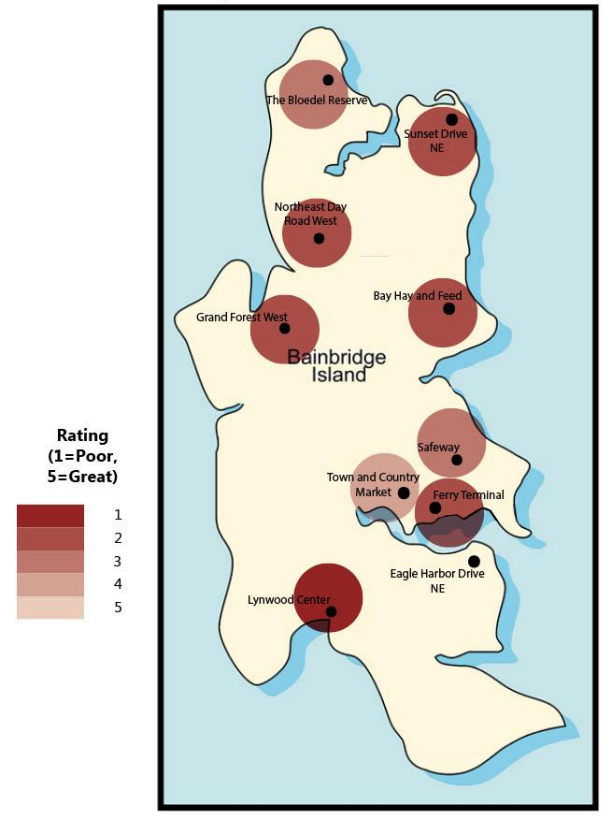
Ride Pingo Usability Evaluation

- Data was collected by the research team rating their own experience and ease of use with the Ride Pingo app.

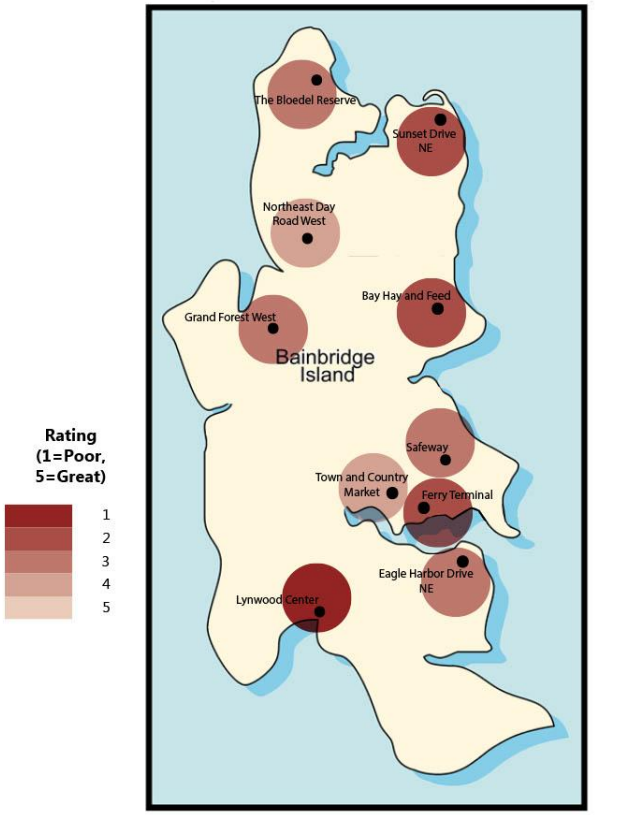
Rating System:

- 5 - Loaded right away with no issues
- 4 - Loaded quickly with little wait time
- 3 - Took a while to load and may have needed to retry once or twice
- 2 - Loaded very slowly and took more than one attempt
- 1 - Could not load the app and order a bus without several attempts or at all

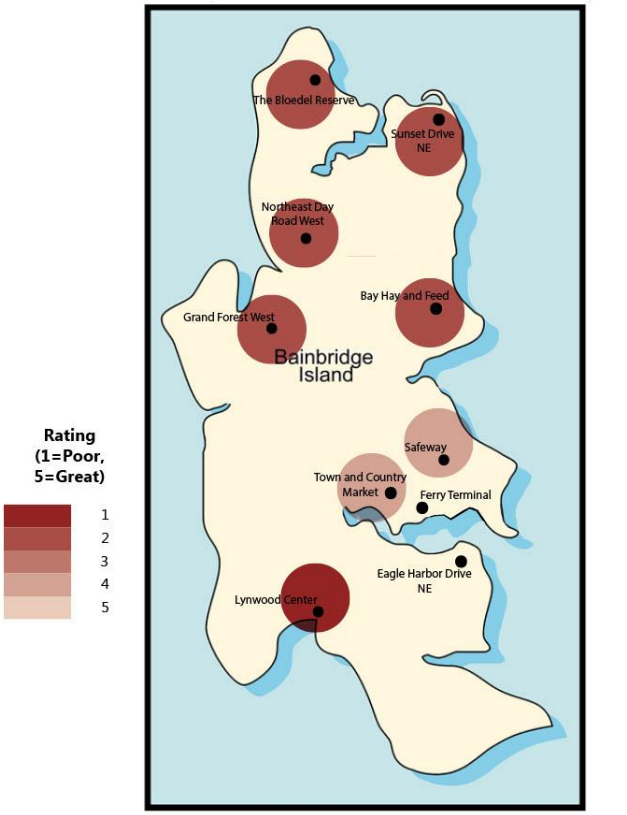
Ride Pingo Overall Usability Evaluation Morning (8-12 A.M)



Ride Pingo Overall Usability Evaluation Mid Day (12-3 P.M



Ride Pingo Overall Usability Evalua Late Afternoon (3-5 P.M)



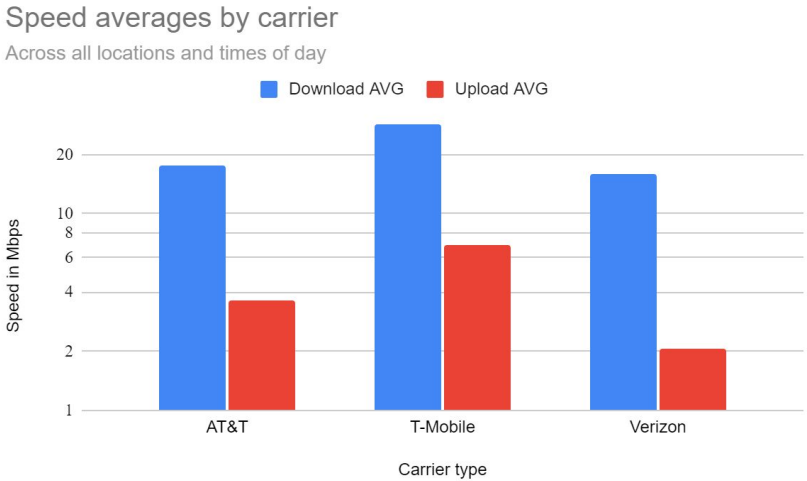
Data Analysis

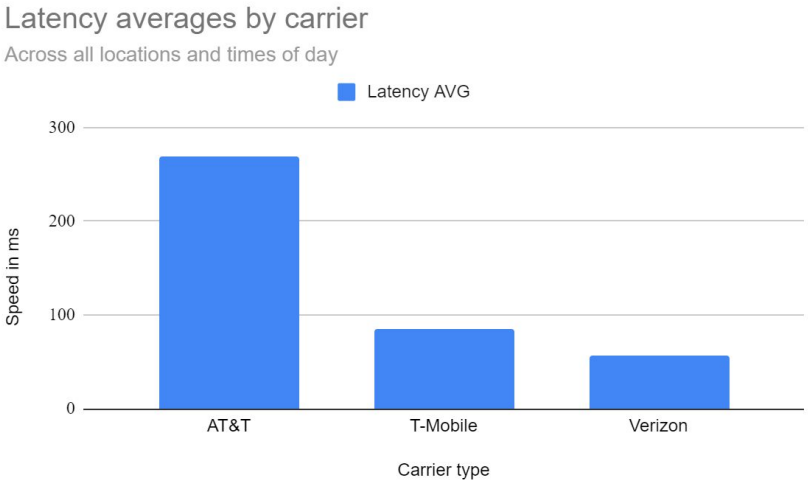
- Most issues with latency and download speed was found outside the Winslow area locations.
- Locations with the most issues
  - Lynwood Center
  - Bloedel Reserve
  - Grand Forest West
  - Bay Hay and Feed
- Locations with the least issues
  - Town and Country Market
  - Safeway
  - Northeast Day Road

Data Analysis (Cont)

- Locations with major differences between carriers
  - Ferry Terminal
    - AT&T and T-Mobile performed worse than other locations in Winslow, while Verizon performed better than both.
  - Sunset Drive NE
    - AT&T performed substantially better than T-Mobile or Verizon.
  - Lynwood Center
    - While no carrier performed well here, T-Mobile did perform consistently better than the other two.

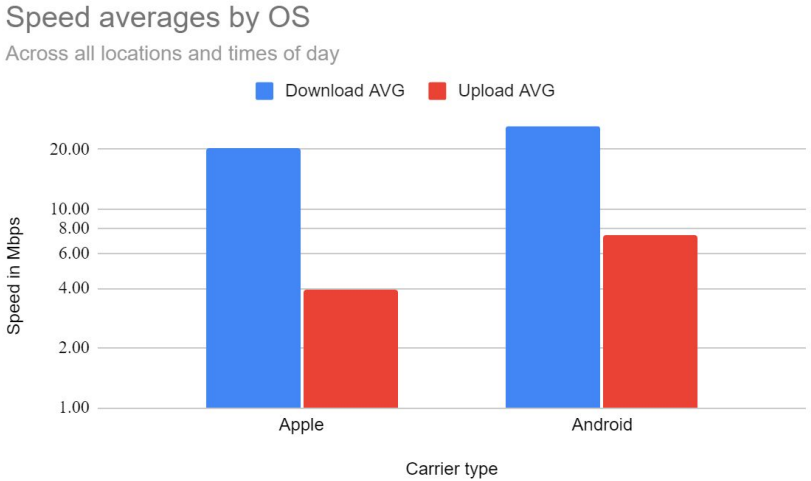
Carrier type is a foundation

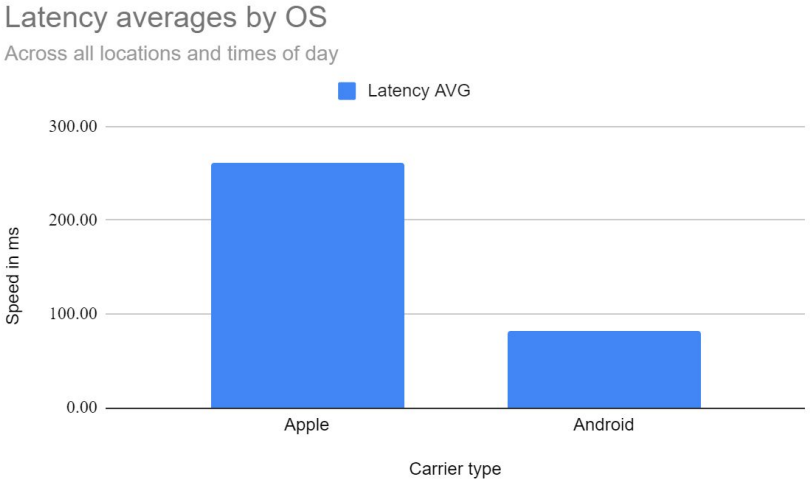




- Speed averages were by carrier were barely met or underperforming; often spotty connections

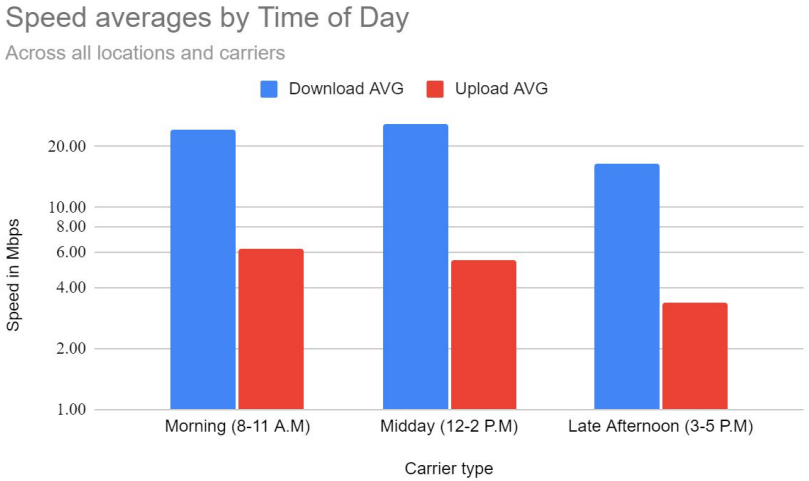
Operating system matters

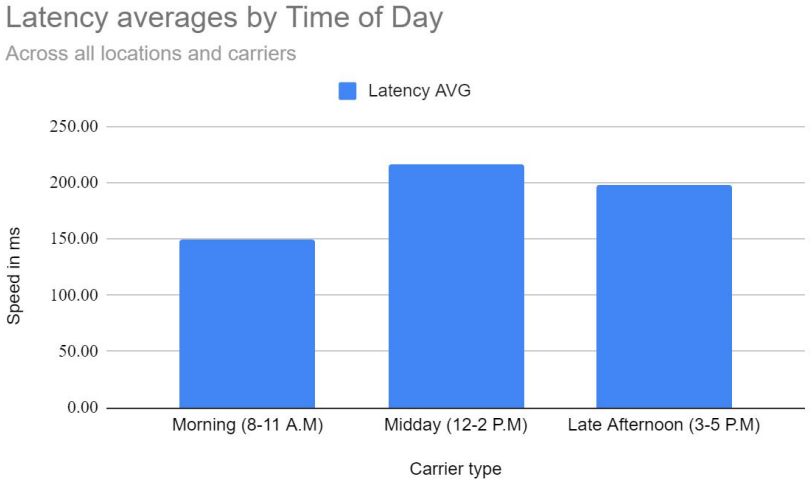




- OS dictates user experience!

Connectivity fluctuates over time



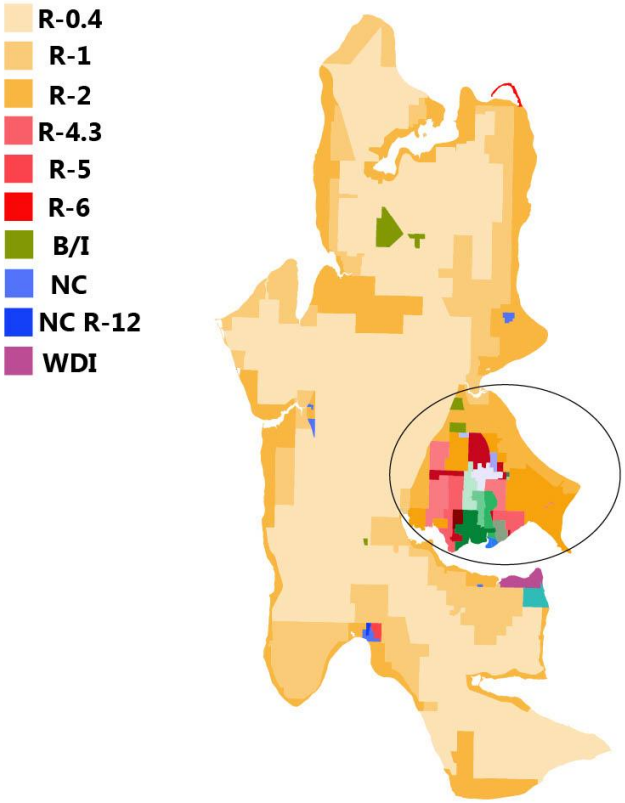


- Our experience became worse over time. Difficult to use in the later afternoon.

Limitations and Strengths of Data Collection

- We only had a limited number of phones and therefore a limited amount of data points.
- We made four separate trips to Bainbridge Island to collect data and that brings more variables into play such as varying levels of activity on the Island.
- Unequal distribution of carriers across the team
    - Verizon only had one representative, T-Mobile had two, and AT&T had three.
- Data was collected using the FCC Speed Test App which is a recognized method to collect standardized data and is how the FCC encourages the public to test their network performance.

Bainbridge Island Zoning/Land Use

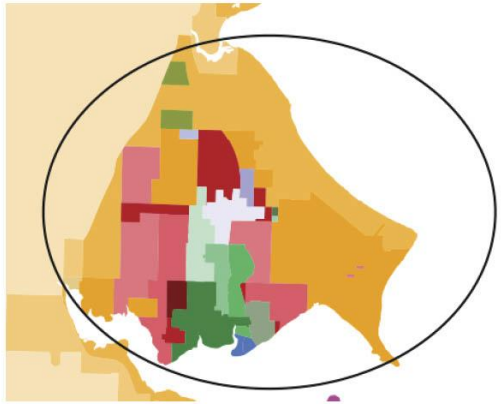


- Most of Island Zoned for low density residential.
- Noticeable by zoning designation

R (Residencial) - # (Housing Units per Acre)

So R-1 is one residence per acre

Bainbridge Island Zoning/Land Use (Cont.)



R-0.4
R-1
R-2
R-2.9
R-3.5
R-4.3
R-8
R-14
B/I
HS-1
HS-2
MAD
ERICK
GATE
CORE
FTD
CURR USE

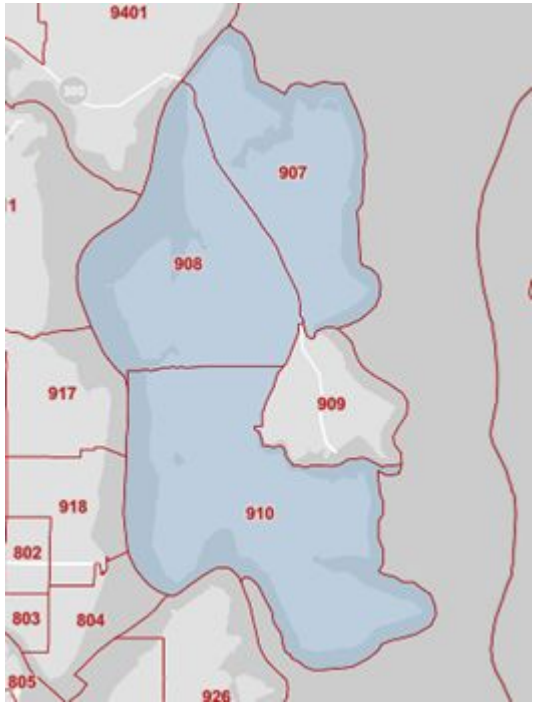
>Winslow has more dense and mix-use zones.

>Winslow has several designations for promoting specific aspects to be considered within those areas.

>Greater population supports better cell network connection

Winslow is where there were the least issues with latency and download speeds.

Bainbridge Island Demographics



- Poor cell signal primarily affects the areas outside Winslow
- Demographic Characteristics of Interest
  - Total Population: 16,858
  - 23.7% Under 18
  - 24.3% Over 65
  - 8.8% With Disability
  - 8.4% population below 200% Federal Poverty Line
  - 1.5 % households without a motor vehicle

Recommendations

- **Cell Signal booster installation** in more rural areas of the island where changes to zoning codes are not feasible. How they work:
    - “An **external antenna** detects and captures cellular signals from outside your home, vehicle, or building”, while the **booster amplifies the signal**.
- **Changes to zoning codes.**
- **Utilization of small-cell wireless communications facilities.**
- The creation of an **estimated wait-time and coverage map** that can be used as a reference for RidePingo users.

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