DELIVERY CONGESTION REDUCTION

CMAP FREIGHT COMMITTEE MEETING – SEPTEMBER 16, 2019

CITY TECH OVERVIEW

City Tech Collaborative

City Tech Collaborative reinvents cities by…

1. Transforming cities into testbeds for new ideas
2. Working with partners + people to remake essential services and infrastructure, from skills to skyscrapers
3. Designing solutions from pilot to scale, thus increasing the world's odds of solving big urban problems
4. Reimagining cities as places where technology fuels opportunity, inclusion, engagement, and innovation for all

PROGRAMS & OFFERINGS

City Tech Drives Collaboration, Innovation, Product / Market / Business Development, and Deep Civic Engagement

	Description	Recent Examples
1. City Solutions	• **End-to-end opportunity identification, solution development / testing, and go-to-market support** to address pressing urban challenges	Night Game Alerts; Healthy Chicago (Chicago Department of Public Health); Connect Chicago (No matter where you are.); Chicago Data Collaborative – Criminal Justice Pilot Project; Array of Things
2. Civic Design & User Testing	• **Direct resident design input** and feedback on public-facing technology, including City Tech projects, local government initiatives, websites, apps, and other products and services	CityBase; Partners for Places
3. Convening, Facilitation & Education	• **Conferences, workshops, training, and ideation** with public, private, and civic leaders to drive innovative, inclusive, and impactful technology solutions	Uraia; Urban Waterways Forum; FMDV (Supporting local authorities to access funding); C40 Cities (Climate Leadership Group)

CORPORATE MEMBERS, PARTNERS, & COLLABORATORS

The City Tech Ecosystem Combines Broad Capabilities and Deep Expertise To Implement Groundbreaking Urban Solutions

City Tech Consortium Members & Key Grant Partners

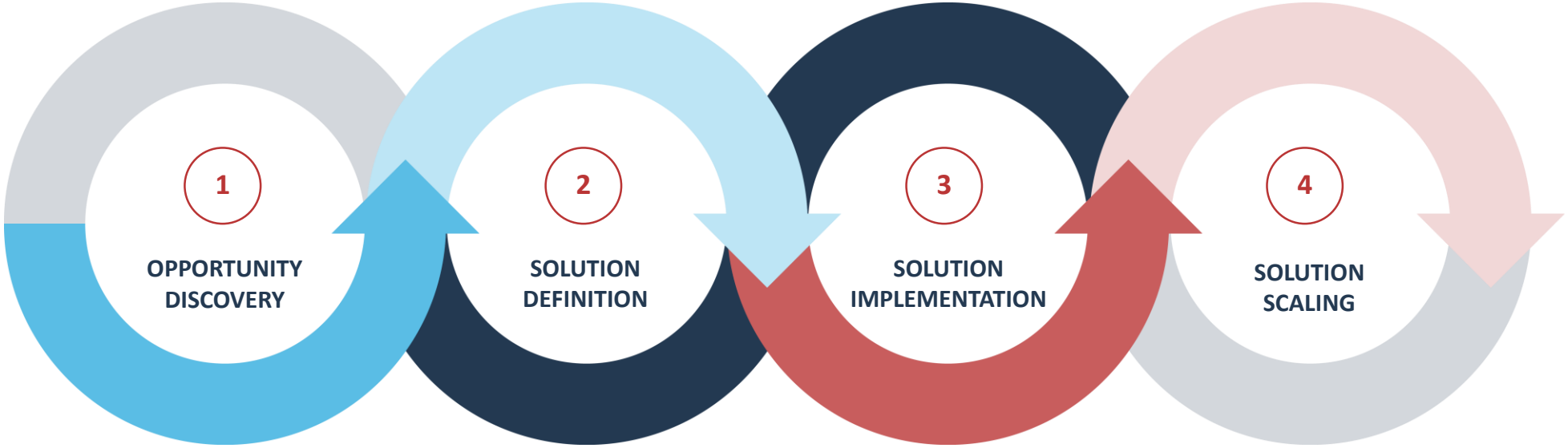
Microsoft
here
ComEd An Exelon Company
BOSCH
hbk ENGINEERING
mastercard
accenture
DOVER
AECOM
CROWN CASTLE
MacArthur Foundation
THE SPRAGUE INSTITUTE
THE CHICAGO COMMUNITY TRUST AND AFFILIATES
Bloomberg Philanthropies
EDA U.S. ECONOMIC DEVELOPMENT ADMINISTRATION

Select Solution Participants & Collaborators

SIEMENS
esri
Johnson Controls
WM WASTE MANAGEMENT
ups
CIVIS ANALYTICS
NASA
Sprint
NOAA
ELEVATE ENERGY Smarter energy use for all
cityzenith
PARQEX
CUBIC
3rd EYE
SENFORMATICS Sensing • Informatics • Innovation
Opti active intelligence | clean water
westMONROE PARTNERS
delta institute
CLARITY PARTNERS
ideas 42
Syniverse
WattTime
AMCS
kessler consulting inc. innovative waste solutions

A PROVEN APPROACH TO RESULTS-FOCUSED, HIGH-IMPACT COLLABORATION

Our Solutions Methodology Delivers Innovative, Market-Focused Results



- TRANSPORTATION
- WATER & SANITATION
- PHYSICAL INFRASTRUCTURE
- ENERGY MANAGEMENT
- CIVIC PILOTS
- AND MORE

MARKET READY RESULTS

ADVANCED MOBILITY INITIATIVE: NEW SOLUTIONS FOR SEAMLESS TRANSPORTATION

THREE YEAR IMPACT

Over three years, the initiative roadmap will work to create a more **seamless and frictionless transportation** system with **increased accessibility and reach** for residents, thereby **increasing utilization.** Through the roadmap work, there will be a greater ability to understand and manage **what is happening with both personal and freight mobility** on the street.

PRIORITIZATION

- Immediate work will focus on the most foundational problems, providing a stable base for the upcoming years of work.
- The work across themes can be integrated and the capabilities can build on each other for increased value and impact
- Additional opportunistic endeavors will also be reviewed and pursued

PRIORITY ACTIVITIES BY IMPACT THEME

Multimodal connectivity	» Immediate thought leadership and UX work will set up a framework for a pilot in year 2
Public transit access	» Piloting opportunities within year 1 » UX research better understand and solve for pain points
Freight	» Initial pursuit of grants will enable the development of infrastructure » Findings from work in other areas, like data standards, will support future Freight opportunities
Smart infrastructure management	» Immediate piloting opportunities » Design studio opportunities for developing street typologies
Electric Mobility	» Initial pursuit of grants will enable the development of infrastructure
AV/drone adoption	» Immediate piloting opportunities around drone safety » Grant opportunities will allow additional future work

DELIVERY CONGESTION REDUCTION PILOT

MITIGATING CONGESTION:
DELIVERY CONGESTION REDUCTION

PILOT TEAM

here | accenture | ups | Microsoft | City Tech

PROBLEM STATEMENT

The explosion of e-commerce has led to increasing delivery services and frequency, even in constrained geographies. These changes have resulted in:

- Increased congestion in cities
- Disruptions to supply chains
- Increased costs for delivery providers

SOLUTION

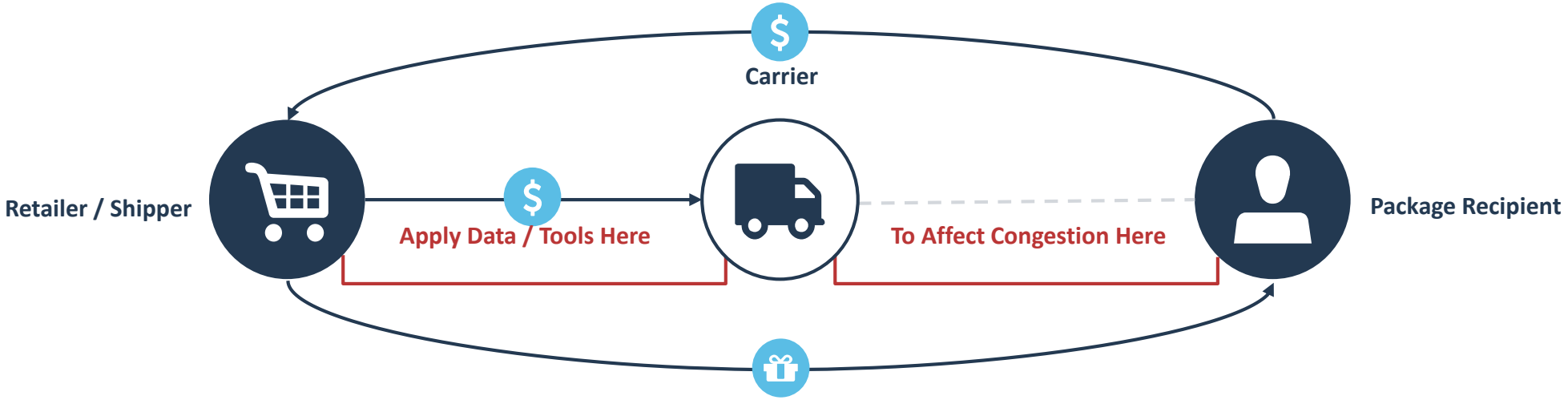
New data tools to create flexibility for last-mile package deliveries, based on predictive information about delivery difficulty and consumer validated delivery alternatives.

PILOT

Using a known congested area in Chicago, model the proposed value and impact of reduced freight congestion, and determine best fit delivery flexibility options (time / location) through data analysis and consumer engagement.

PILOT OBJECTIVES

- Traffic & Congestion Analysis
  - Can the application of data tools between retailers and deliverers reduce traffic congestion and lower delivery costs?
  - Can traffic and delivery data be efficiently linked to produce meaningful insights?
  - Do the results identify specific areas to target with incentives that would improve flexibility and enable cost savings?
- Consumer Preferences & Modeling
  - Are consumers willing to accept the incentives offered?
  - Does the amount of incentives accepted by consumers produce enough savings for shippers to operationalize at scale?

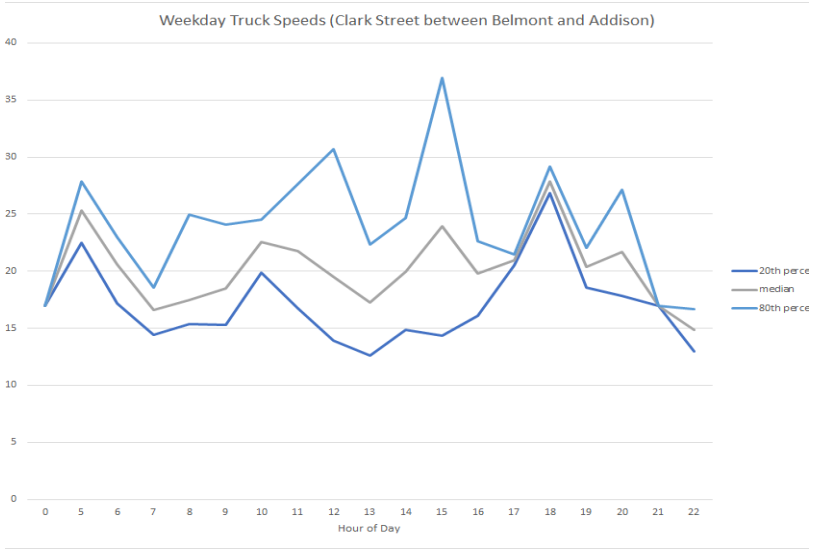


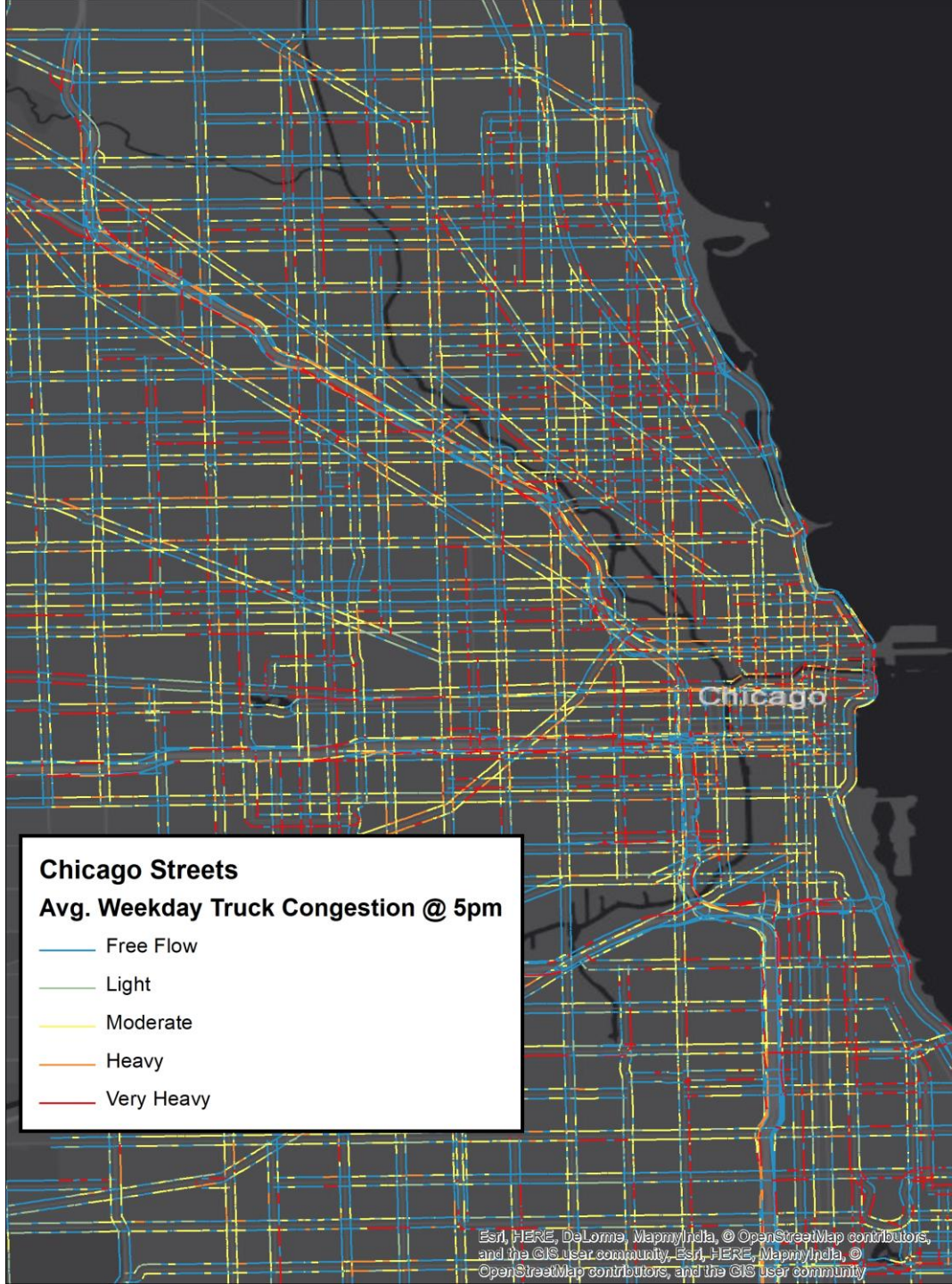
DATA ANALYSIS

Initial Data Summary – HERE Historical Traffic Data

HERE provided and analyzed traffic congestion data at road segment level, in highly granular or more aggregate time slices

- Extracted data for the test bed / timeframe
- Associated the spatial and temporal data with the available UPS data
- Analyzed the correlation and identify potential areas where flexibility in time or location of deliveries could reduce costs and ease congestion

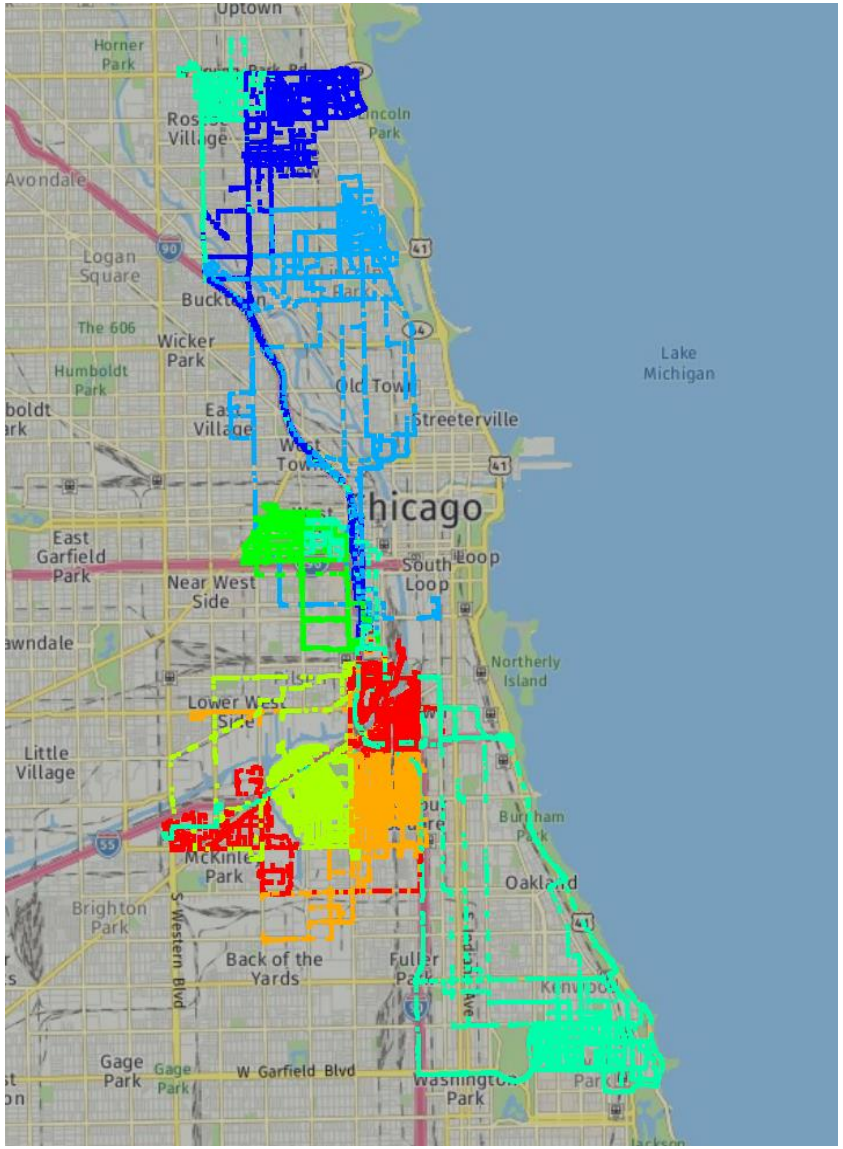




TRAFFIC AND DELIVERY DATA CONGESTION ANALYSIS

- UPS provided vehicle trajectory and stops data to HERE for analysis:
  - 10/09/2018-11/07/2018
  - 7 routes
  - 23 vehicles
  - 288K GPS points
  - 152 trajectories
  - Totally 12612 stops

Date Time	Latitude	Longitude	Speed	Ignition	Aux1_Backing	Aux2_Braking	Aux3_Bulk Head	Aux4_Seat Belt
12:52:39.063	41.95435	-87.66321	0.00					
12:53:03.063	41.95433	-87.66323	1.24					
12:53:07.127	41.95425	-87.66328	9.32					
12:53:08.127	41.9542	-87.66328	9.32					
12:53:15.127	41.9539	-87.66328	9.32					
12:53:30.063	41.95407	-87.66349	0.00					
12:53:34.063	41.95407	-87.66349	0.00					Off
12:53:37.063	41.95407	-87.66349	0.00	Off				Off
12:53:39.063	41.95407	-87.66349	0.00	Off			Open	Off
12:58:32.063	41.95407	-87.66349	0.00	Off				Off
13:34:11.063	41.95407	-87.66349	0.00	Off				Off
13:36:41.063	41.95407	-87.66349	0.00	Off			Open	Off
13:37:07.127	41.95407	-87.66349	0.00	Off			Open	Off
13:37:35.063	41.95407	-87.66349	0.00	Off				Off
13:37:44.063	41.95407	-87.66349	0.00					Off
13:37:45.063	41.9541	-87.66349	0.00					Off
13:37:47.127	41.9541	-87.66349	0.00					
13:37:52.063	41.95412	-87.66349	1.24					
13:37:56.127	41.9542	-87.66354	9.32					
13:38:01.063	41.9543	-87.66351	0.00					
13:38:06.063	41.9543	-87.66351	2.49					
13:38:08.127	41.95435	-87.66349	9.32					
13:38:09.127	41.95435	-87.66344	12.43					



FINDINGS FROM SPEED ANALYSIS

- No statistical difference was seen between speeds before, during or after UPS stops

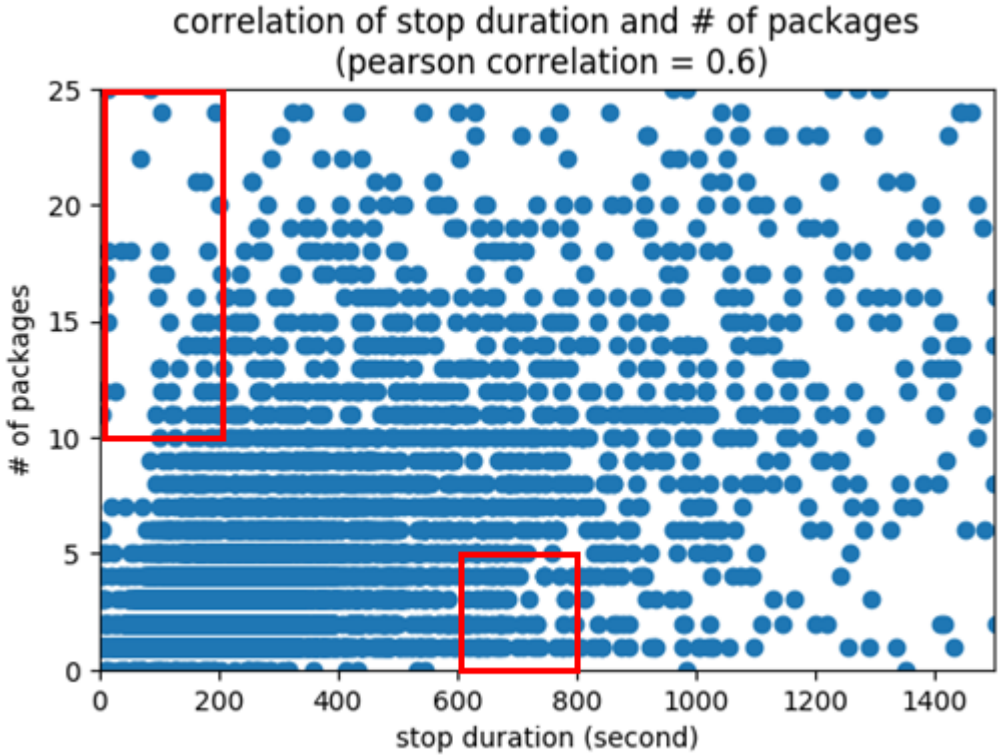
- Assumptions:
  - Variances on roads with high speeds can be attributed to small sample size.
  - There are probably a small number of UPS stops (double parking or otherwise) that may impact traffic, but the amount of data that can be analyzed is too small.
  - Delivery vehicles surely impact traffic, but there’s much more going on the ground beyond UPS vehicles that cannot be analyzed here.

FINDINGS FROM STOP DURATION ANALYSIS

- UPS overall does a good job of balancing load per route
  - Median time per package is roughly equal per route
  - Routes with more commercial activity / mixed use roads present the most difficulty (Park West, West Loop, Wrigleyville)
  - Specific roads pose the most challenge (e.g. Clark, Madison, Washington, etc.)
- Inverse correlation between length / number of stops, trend shows peak stop time occurs typically at 10-11am
- Peak delivery cost (time per delivery) occurs at 2pm
- Separately, we looked at variance between Orion schedule vs. actual driver activity:
  - Drivers tend to deliver more in the AM than scheduled, reduce deliveries in PM
  - Drivers tend to beat overall Orion scheduled time

CORRELATION OF STOP DURATION AND NUMBER OF PACKAGES

- Opportunity to look more closely at deliveries that take a longer time with fewer packages delivered
  - » Low rate (bottom center)
- Similarly deliveries with many packages delivered with shorter duration
  - » High rate (upper left)



ANALYSIS LESSONS LEARNED

- Data size:
  - A larger data sample is necessary to determine statistical significance of any applicable impacts
- New opportunities:
  - Possibilities exist to merge traffic data and delivery activities into more efficient road-sharing techniques to optimize traffic conditions and decrease delivery costs
- Cost optimization:
  - Identification of peak delivery cost times and locations can help inform the creation of delivery routes and optimization of delivery windows to minimize delay as a result of congestion
- Scheduling efficiency:
  - Differences between driver preferences and behavior and routing software recommendations show potential for more optimal routing to be implemented to improve efficiencies and reduce costs for carriers and consumers

PILOT FINDINGS AND RECOMMENDATIONS

- Pilot Outcomes:
  - ✓ Demonstrated capabilities to validate routing and scheduling models
  - ✓ Identified specific locations to target with interventions
  - ✓ Identified characteristics of last-mile delivery high congestion/cost areas
  - ✗ Validated incentives that modify consumer behavior to enable delivery flexibility
- Key Recommendations:
  - » Cities, retailers, and shippers focus on locations where interventions can be most impactful at lowering congestion and costs
  - » Shippers and retailers offer incentives at scale at target locations to increase delivery flexibility
  - » Future engagements could produce alternative delivery models across multiple providers
  - » Cities make data on traffic congestion and mitigation efforts easily accessible by third parties

CityTech Collaborative

THANK YOU

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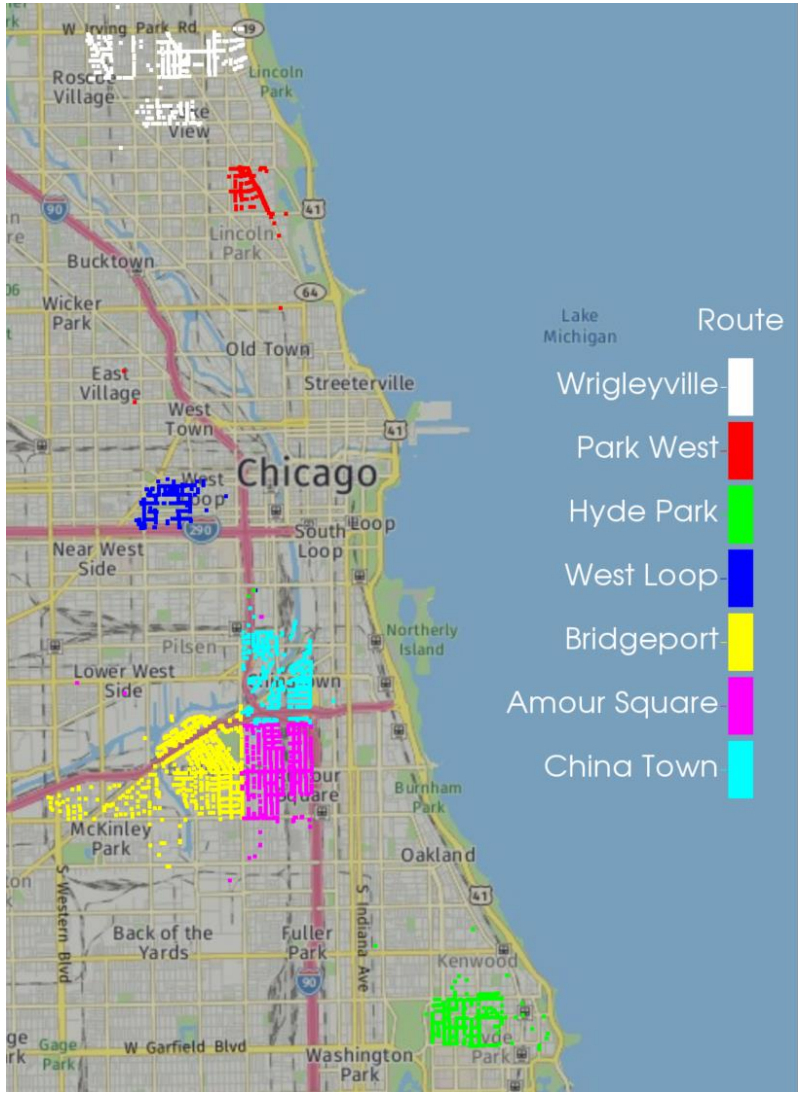
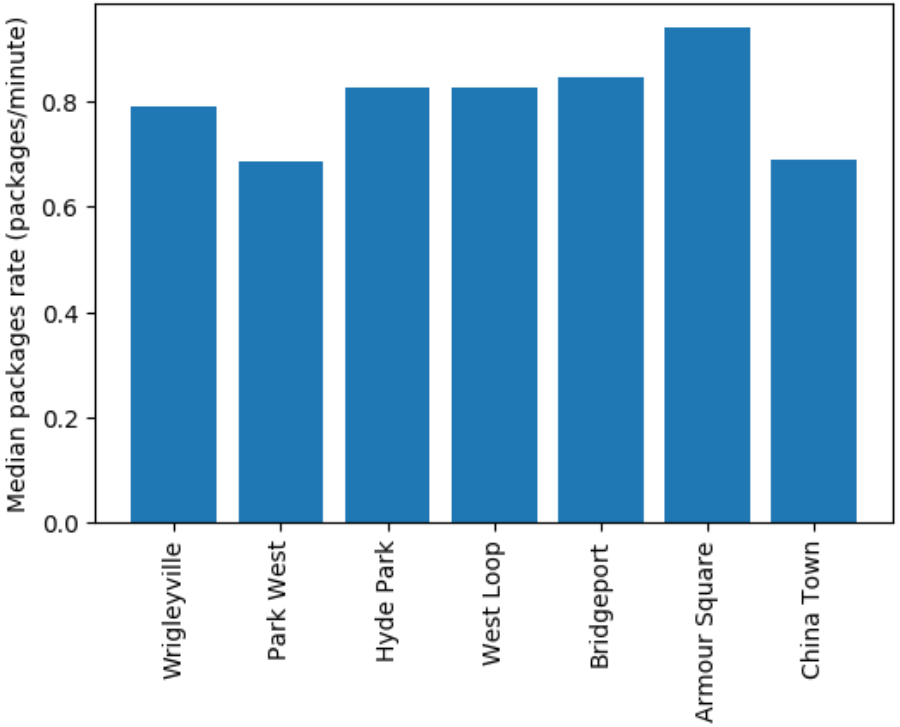
APPENDIX

BALANCED LOAD

- UPS routes balance the number of packages delivered on a route to the level of difficulty (amount of time required) quite well

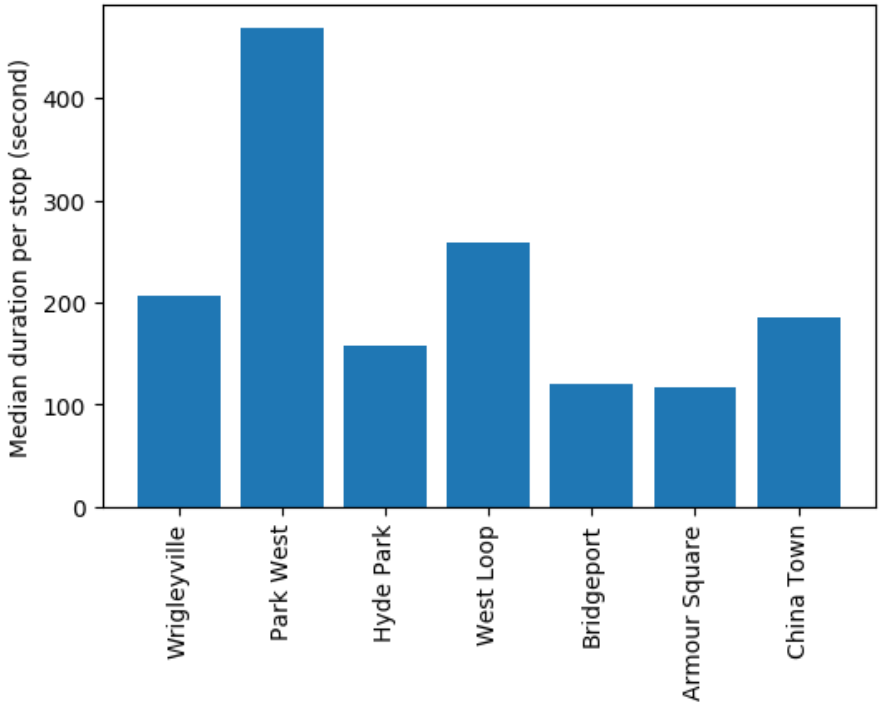
- The median rate per package delivery across all seven analyzed routes is very similar

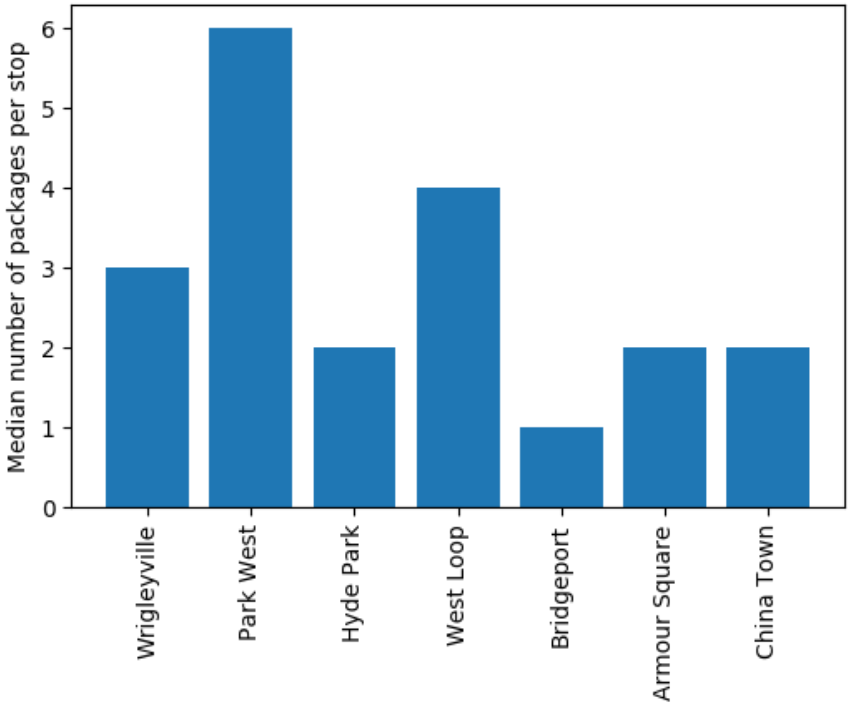




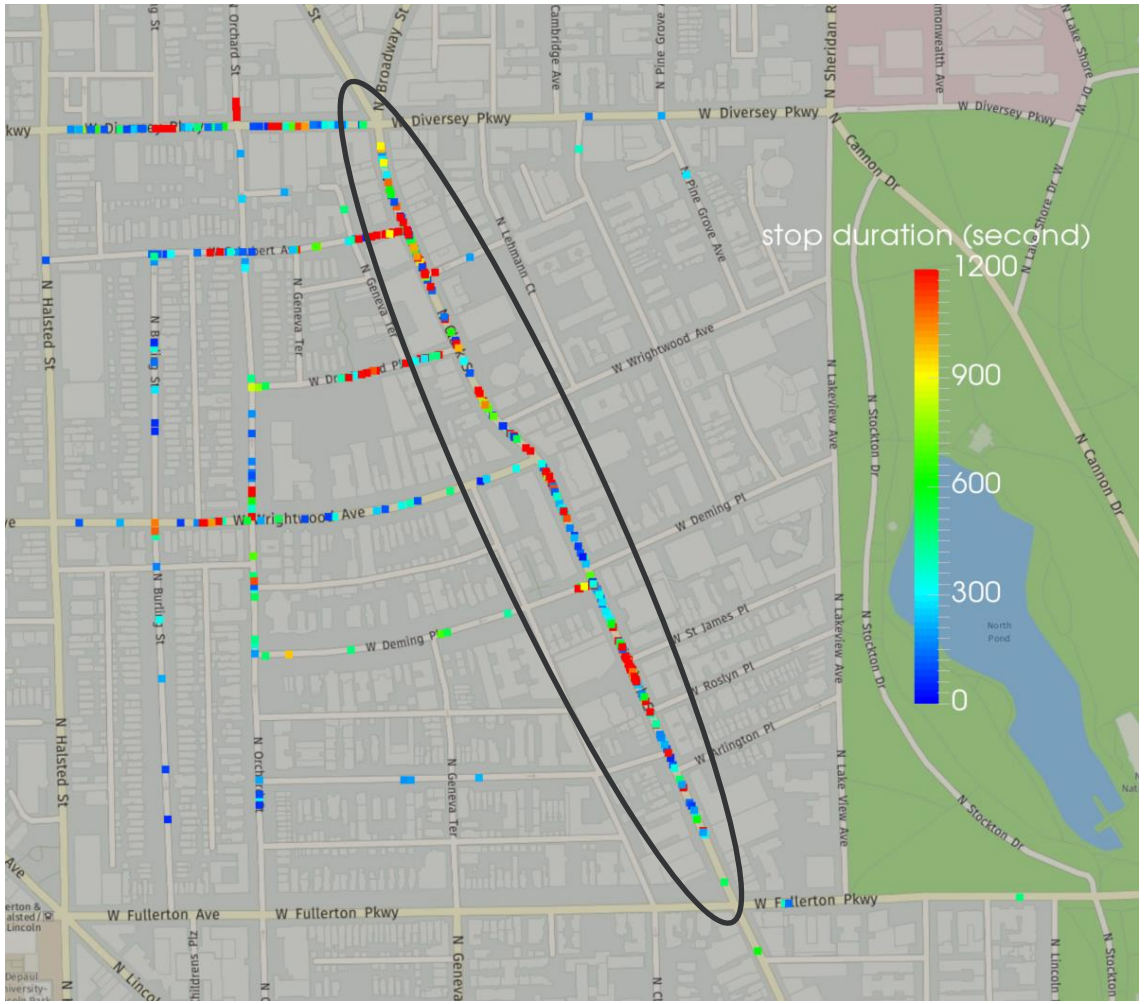
VARIANCE OF DELIVERY TIME PER PACKAGE

- Though the overall per package rate is relatively consistent across routes, variances in time per stop and time per package do exist.
- These high package count / stop time tend to be more prevalent on routes with more commercial streets.
- Park West tends to have longer stops and more packages delivered per stop than other routes. West Loop is the second.



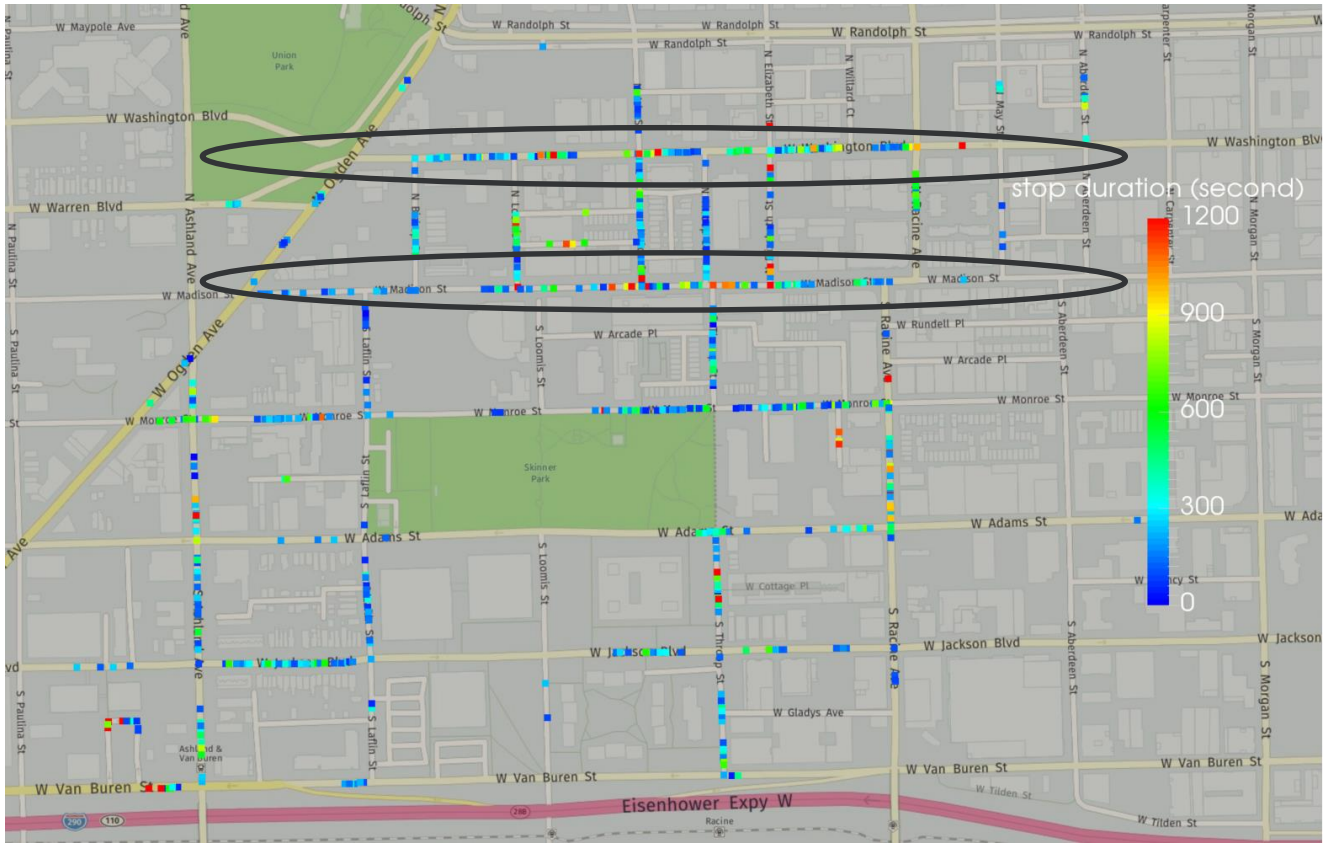


HIGH DENSITY / LONG STOP ROUTES AT A GLANCE



Park West

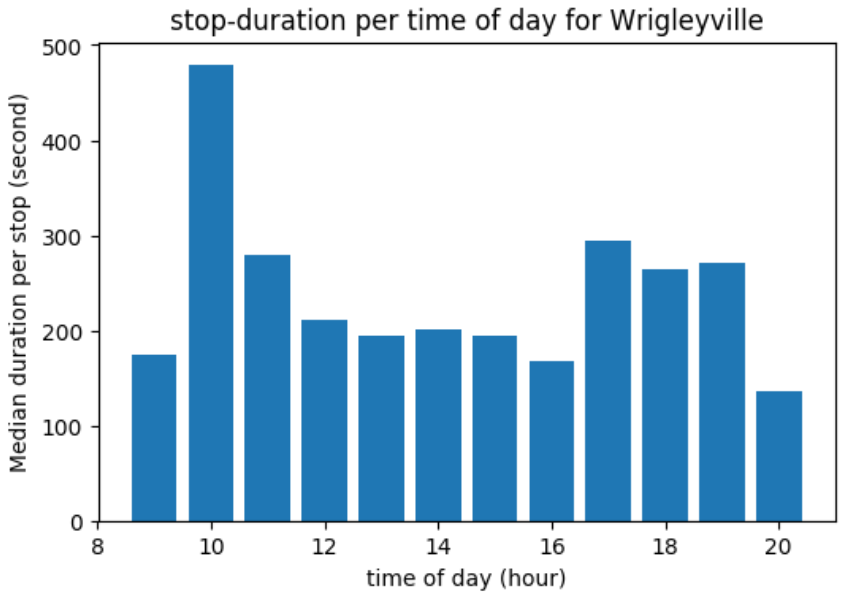
- High density, mixed use streets have the longest stop duration

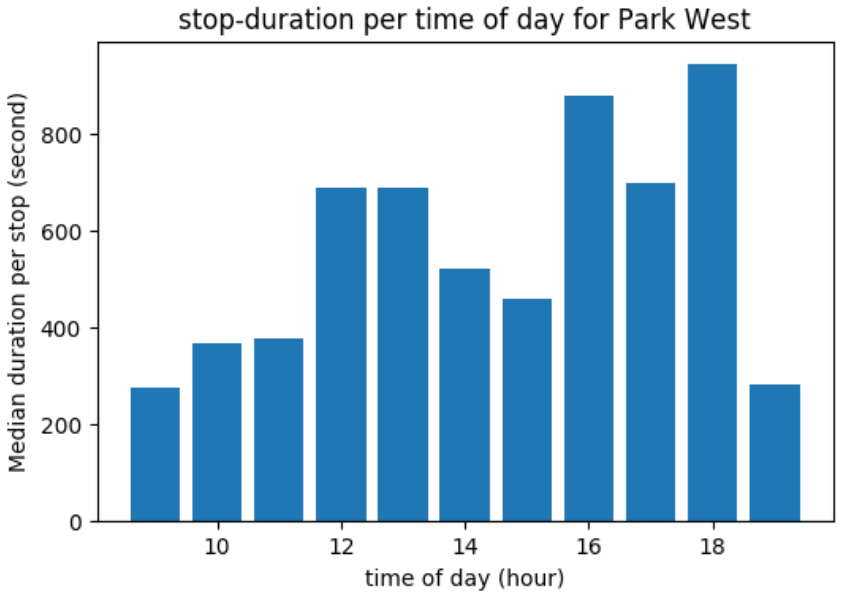


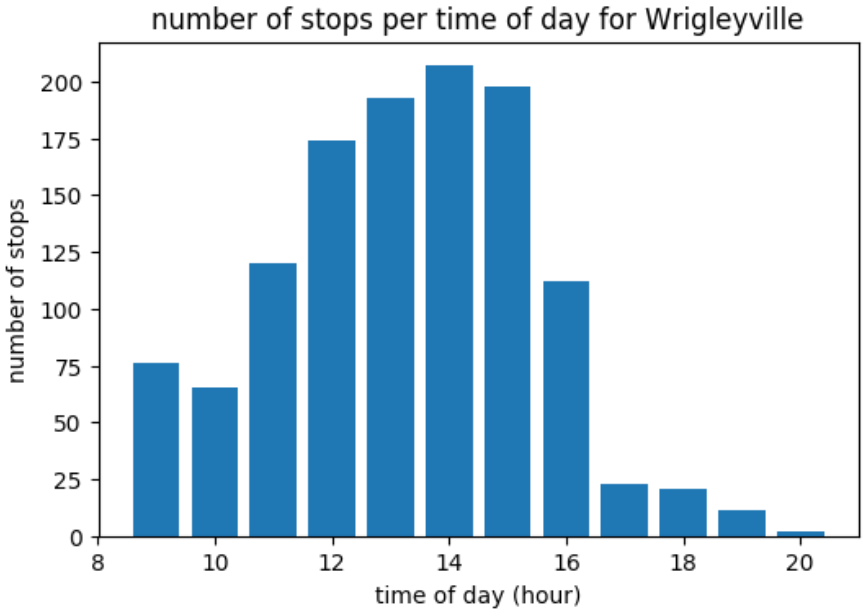
West Loop

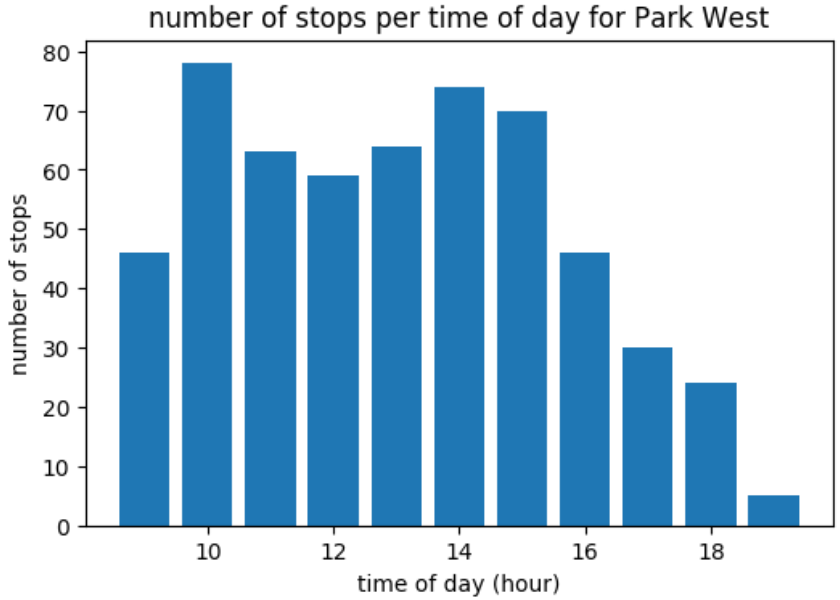
CORRELATION OF STOP DURATION AND NUMBER OF PACKAGES

- Inverse correlation between number of stops and stop duration
- For most routes, the longest stops occur at 10 and 11am (Wrigleyville is representative)
- Park West is the outlier, where the longest stops occur at 4pm



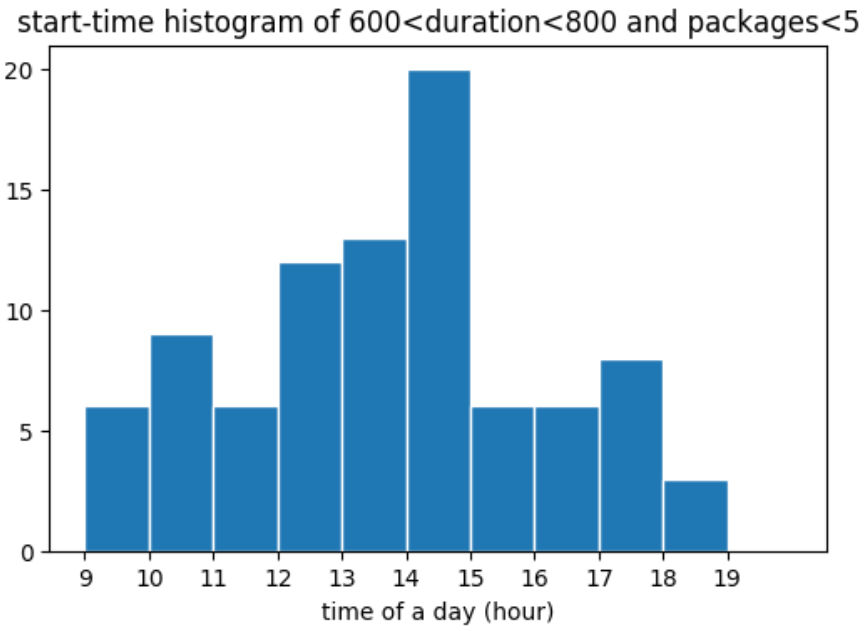


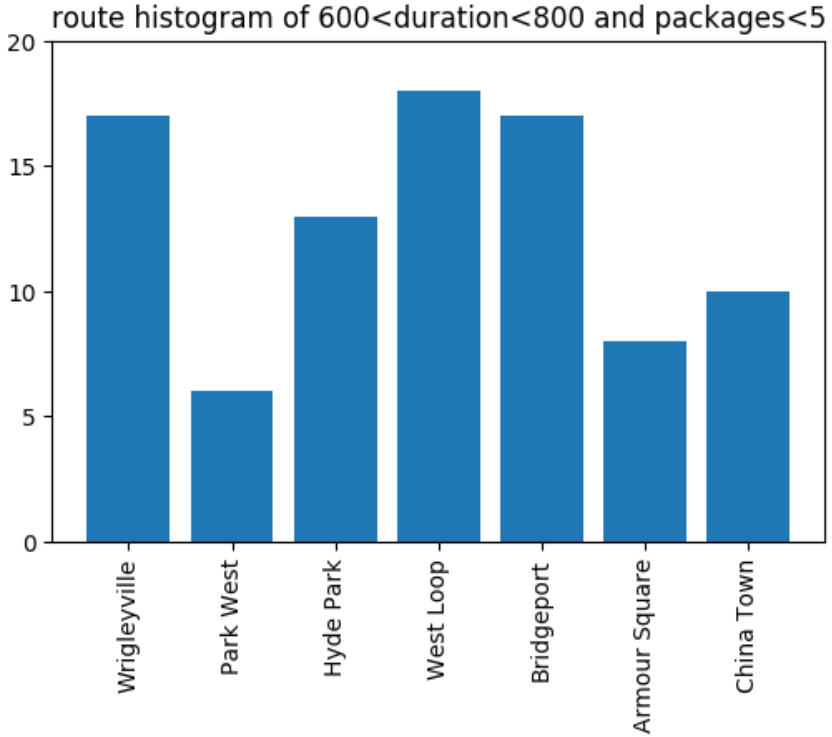




ANALYSIS OF LOW RATE DELIVERIES

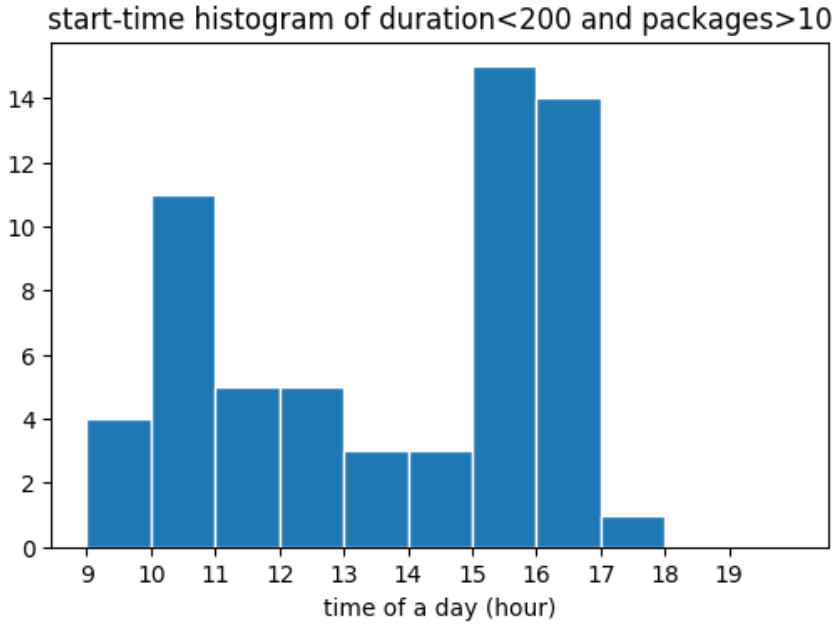
- Peak time for low rate deliveries (few packages, long duration) is 2pm
  - » Assumption is that larger, more difficult deliveries are deliberately scheduled for midday
- Low rate deliveries are most concentrated in Wrigleyville and West Loop
- Bridgeport and Armour Square have higher overall number of packages than other routes (more residential deliveries?)

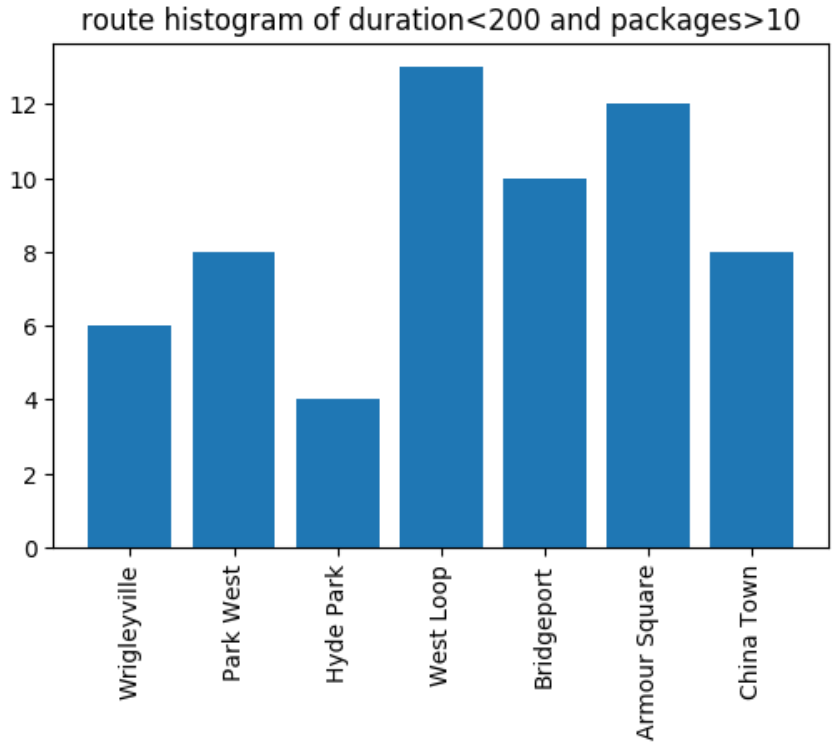




ANALYSIS OF HIGH RATE DELIVERIES

- Peak time for high rate deliveries (many packages, short duration) is right after and right before rush hours (10pm, 3-4pm)
- West Loop seems unique for having both the most number of high rate and low rate deliveries (most diverse route?)
- Bridgeport and Armour Square have both higher overall number of packages and higher rate of delivery (more residential deliveries?)

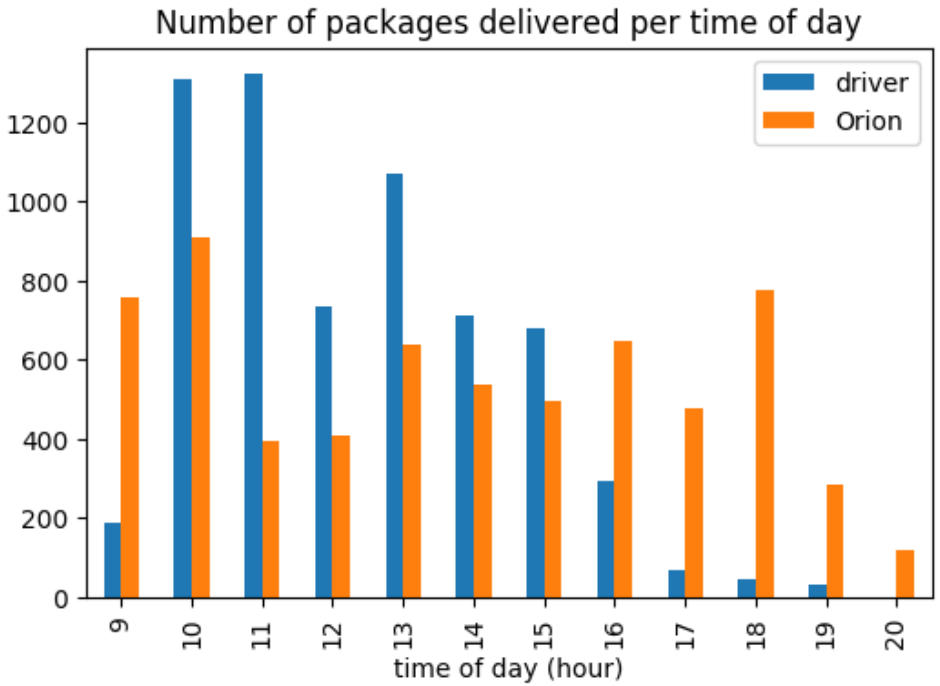


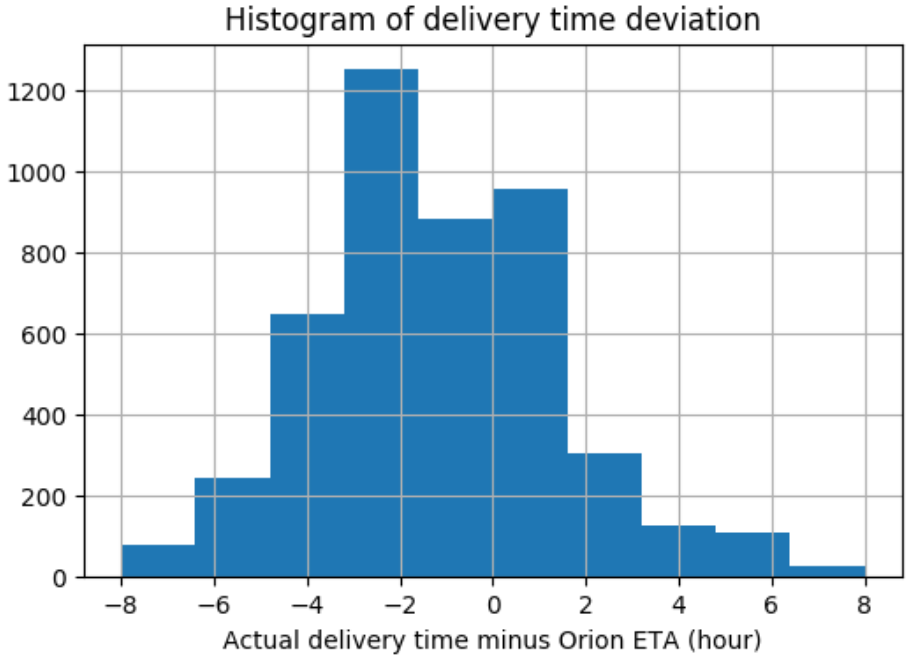


ANALYSIS OF ORION MANIFEST ETA VS. ACTUAL

This data was provided only for Wrigleyville route

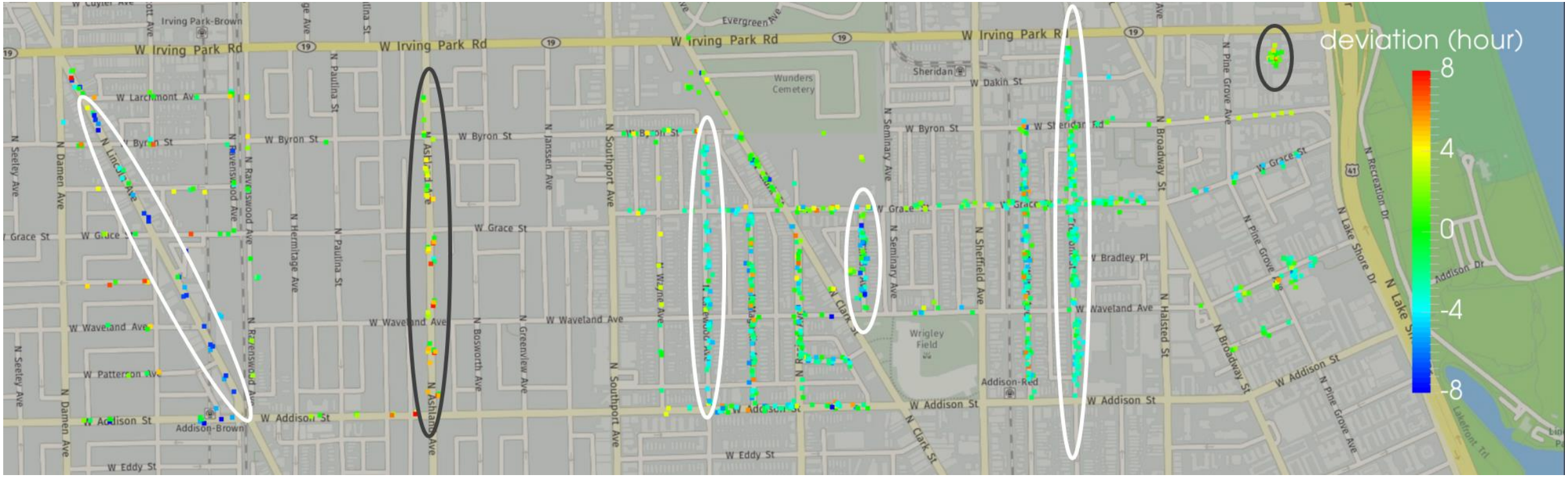
- Comparing the number of packages as a function of time of a day between driver delivery and Orion scheduled delivery.
- It can be seen that the driver heavily pushes delivery to a time period from 10am and 3pm, perhaps to avoid the rush hour traffic.
- The Orion schedule, on the other hand, puts a lot of deliveries at 9 am, and at 4pm and 6pm.
- On average the actual delivery is 1.3 hours earlier than Orion ETA
  - » Some deliveries are as much as 8 hours earlier or later than scheduled.





SPATIAL DISTRIBUTION OF ORION ETA VS. ACTUAL

- The figure below shows the spatial distribution of deviations. White ellipses highlight the road sections where actual deliveries tend to be earlier than ORION ETAs. Black ellipses highlight the road sections where actual deliveries tend to be later than ORION ETAs.



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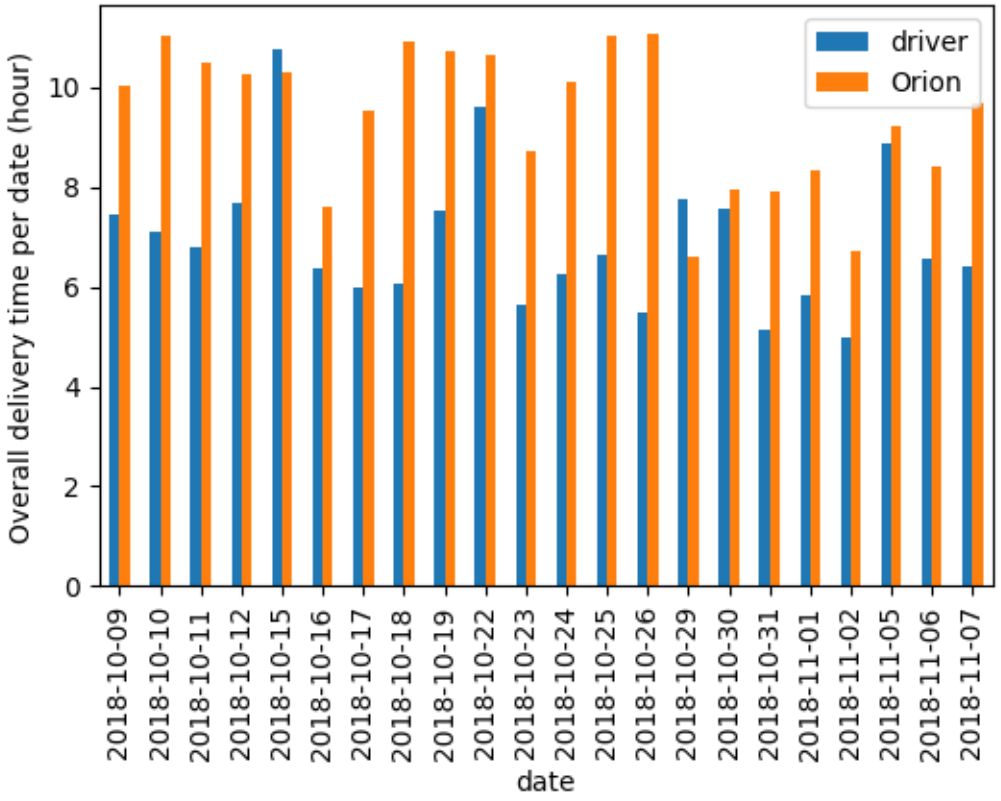
- Comparing actual route time and Orion in terms of the total amount of time spent for delivery per day.
- The overall delivery time is defined to be the length of the time period starting from the first delivery of a day until the last delivery of the same day.
- From the figure it can be seen that the driver tends to beat Orion schedule expectations on this route.
  - » UPS has stated that this is a metric that they expect from the drivers