TriMet
OTP SUM: OTP Integration of Transit with Shared-Use Mobility, Real-Time, and Data Enhancements

Mobility on Demand Sandbox Program
Workshop Kickoff Report
January 18-19, 2017

PROJECT SUMMARY

Overview

TriMet's project includes the development and expansion of two core data frameworks that current and future collaborative OpenTripPlanner (OTP) initiatives can be built upon, producing replicable software and results for communities across the country. These two core project elements are to:

- Extend the OTP code base to integrate shared-use mobility modes into transit trip planning, such as bike share and Transportation Network Companies (TNCs), and updated real-time transit information.
- Implement a fully-functional and comprehensive open source geocoder built off the existing open source Mapzen Pelias geocoder. Geocoding, or address locating, is a primary requirement for trip planning. A non-proprietary and non-restrictive option for address locating would substantially lower the barrier to entry for many transit systems to offer a trip planning tool and can achieve significant cost savings for transit agencies, government agencies, and the public.

In addition to developing and expanding core elements on the foundation frameworks, the project will also include:

- Development of a new, comprehensive web-based user interface that will allow users to make intermodal trip plans including shared-use modes. The new interface will also display real-time information and report impacted itineraries to users.

- Improvements to basemap data, enabling the trip planner to support enhanced pedestrian/wheelchair accessibility information.
- Improvements to regional address data that will make location search and geocoding more effective and user-friendly.
- Design and implementation of compatibility for future booking and payment options in moovel's RideTap product, allowing customers to plan and pay for their trips in one app.

The resulting systems, all utilizing open source software and open data, will support the rapid deployment of the intermodal transit trip planner throughout the transit industry. The open source trip planner is sustainable beyond the Mobility on Demand (MOD) demonstration, and will be able to leverage new enhancements as it gets rolled out to the OTP development community and transit industry. Future enhancements could include full integration with a mobile ticketing platform, meeting a common request of transit customers. Collaboration in the transit and open source software development community is growing in strength; it is important to leverage these resources as new software is constantly under development. This collaborative approach will continue to empower public transit agencies to provide low cost, sustainable, scalable solutions to customers at a national level.

Project Goals and Objectives

Goal: Improve the open source, non-proprietary OTP system and make it easier to deploy for other transit agencies.

Specific objectives:

- Allow users to get information about and compare Shared Use Mobility (SUM) options in addition to transit, bike, and walking options in OTP
- Provide users with a more accurate matching of addresses when using OTP
- Improve the usability and design of the web-based OTP interface
- Provide users with real-time information regarding their trip plans, and any impacts thereon

Project Key Partners

Organization	Organization Type	Role	Contact
IBI	For-profit entity	Project Management	Ritesh Warade
Conveyal	For-profit entity	Application Development	David Emory
Mapzen	For-profit entity	Geocoder Development	Diana Shkolnikov

Oregon Metro Data Resource Center	MPO	Regional address data maintainer/provider	Robert Kirkman
moovel	For-profit entity	Integrated payment plan	Regina Clewlow

WORKSHOP GOALS AND OBJECTIVES

On January 18th and 19th, 2017, TriMet held a two-day workshop to kickoff the OTP SUM project. With attendees representing not only the OTP SUM project team, but also other OTP stakeholders, the workshop had the following goals and objectives.

Goals:

- Establish a vision for OpenTripPlanner incorporating the various OTP initiatives underway
- Kickoff and coordinate technical development for the TriMet OTP SUM project

Objectives/Expected Outcomes:
Everyone leaves workshop with common understanding of:

- What their development objectives are
- What they need to do to meet TriMet technical requirements
- How their tasks interface with the other components of the project and broader OTP ecosystem

WORKSHOP ATTENDEES

Participating Agencies and Companies	Out-of-Town	Local	Remote	Total

AC Transit Piush Dahal Manjit Sooch			2	2
Cambridge Systematics Paul Sorenson David Benoff Simon Jacobs	3			3
City of Portland & PBOT Steve Hoyt-McBeth Anne Hill		1	1	2
Conveyal David Emory Kate Chanba Landon Reed	3			3
CUTR Sean Barbeau			1	1
IBI Ritesh Warade Jon Campbell	2			2
LA Metro Doug Anderson Mike Gibbs	2			2
Lyft Debs Schrimmer		1		1
Participating Agencies and Companies	**Out-of-Town**	**Local**	**Remote**	**Total**
Metro Robert Kirkman Tom Rippetoe Caleb Winter		3		3
moovel Regina Clewlow Courtney Longfellow Ali Waters Michal Nakashimada Scott Wilson Erin Collins	1	5		6
ODOT Mathew Barnes	1			1
Ride Connection		1		1

Kevin Chambers				
RTD Jonathan Wade Brett McDavid Judy Wang	3			3
Trillium Transit Aaron Antrim Thomas Craig		2		2
Uber Jon Isaacs Andrew Freeman		2		2
VTA Marshall Ballard			1	1
Totals: 20	**17**	**15**	**8**	**38**
TriMet		13	2	15

Note:
Out-of-Town = person(s) traveled from outside Portland Metro Area to attend in person
Local = person(s) from Portland Metro Area/vicinity and attended in person
Remote = person(s) attended remotely

WORKSHOP AGENDA

AGENDA **TriMet Mobility On Demand Sandbox Workshop** OpenTripPlanner (OTP) and Pelias Enhancements January 18-19, 2017	**LOCATION** TriMet Administrative Office Harrison Square Building Saltzman Conference Room (Located on P2, Parking Level) 1800 SW 1st Avenue Portland, OR 97201

DAY 1 WEDNESDAY JANUARY 18th		
8:30am	COFFEE/BAGELS	
9:00am	Nazy Sobhi, FTA	**Opening Remarks** MOD Sandbox Grant Award
9:05am	Gustave Cordahi, Booz Allen Hamilton	**Independent Evaluation of MOD Sandbox Projects**
9:10am	Participant Introductions	**Participant Introductions** Briefly state: name, organization, position, role/interest in project
9:30am	Ritesh Warade, IBI Group	**OpenTripPlanner (OTP) Initiatives Overview** - The OTP initiatives underway - How do these initiatives fit together? - What do we want to accomplish over the next two days?
9:45am	Bibiana McHugh, TriMet	**OTP Shared-Use Mobility (SUM) Project Overview** - Workshop Overview - OTP SUM Project Scope and Objectives
10:00am	Group Discussion	**Vision for OTP (SUM, FLEX, and other initiatives) in the MOD SANDBOX Context - Part 1**
11:00am	BREAK (breaks will be 20 minutes to allow people to check messages, etc.)	
11:20am	Group Discussion	**Vision for OTP (SUM, FLEX, and other initiatives) in the MOD SANDBOX Context - Part 2**
12:20pm	Neil McFarlane, TriMet General Manager Metro Councilor Bob Stacey	**Welcoming Remarks**
12:30pm	LUNCH (provided)	

DAY 1 WEDNESDAY JANUARY 18th		
12:45pm	Ritesh Warade, IBI Group	**Recap and Role of Next Sessions:** - Brief recap and additional observations on the prior sessions - Overview of afternoon sessions and their goals
1:00pm	David Emory and Kate Chanda, Conveyal	**Technical Presentation - Conveyal**
1:30pm	Thomas Craig, Trillium Solutions	**Technical Presentation - Trillium and Cambridge Systematics**
2:00pm	Diana Shkolnikov, Mapzen	**Technical Presentation - Mapzen**
2:30pm	Regina Clewlow, moovel Group	**Technical Presentation - moovel**
2:40pm	BREAK	
3:00pm	Bibiana McHugh, TriMet	**Technical Presentation and Discussion - TriMet**
4:00pm	Group Discussion	**Planning for Technical Breakout Sessions** (unconference sign-up style)
4:45pm	Bibiana McHugh	**Wrap-Up** - What's happening tomorrow? - Other next steps
6:00pm	**DINNER** Rock Bottom Brewery 206 SW Morrison St Portland, OR 97204	

Note: Afternoon technical presentations will include main project components and preliminary technical issues.

DAY 2 THURSDAY JANUARY19th		
8:30am	COFFEE/BAGELS	
9:00am	**Technical Breakout Sessions** • Routing Engine: Flex+SUM+RT+Accessibility • UI/UX: Journeys and Scenarios; Testing Process • Geocoding: Integration with OTP/Trimet Website	
10:30am	BREAK	
10:45am	**Technical Breakout Sessions** • OTP Infrastructure & Testing: Build Management Decisions and Test Procedures/Change Management/Component Integration • UI/UX: Flex+SUM+RT+Accessibility	
12:30pm	LUNCH (provided)	
1:00pm	**Technical Breakout Sessions** • OTP Web Services/Middle Tier • UI/UX: Integration with Trimet • Fares/Incentives in OTP	
2:30pm	Breakout Group Leads	**Breakout Groups Report-Back** - Summary of what was covered - Roadmap for next steps
3:45pm	Group Discussions	**Business Strategies** - Identify Key Barriers for Agency Adoption - Brainstorm, Discuss, and Prioritize Options and Solutions - Business Strategy (marketing, procurement processes, etc.) - Open Source Community Building Strategy
4:45pm	**Wrap-Up** - Key Observations - Summary and Conclusions - Identify Next Steps - Meeting and Conference Call Schedules - Draft Project's Scope, Plan and Schedule	
6:00pm	**FINISH**	

SUMMARY DAY 1

The first day of the workshop was focused on laying the groundwork for the OTP SUM project. This began with project introductions, with FTA describing the MOD Sandbox grant program, Booz Allen Hamilton overviewing the program evaluation process, and Trimet and IBI outlining the goals and objectives for the workshop. The remainder of the day was spent laying the groundwork for the OTP SUM project.

<u>OTP Vision</u>

During the morning session, discussion focused on developing a long range vision for OTP as an open source initiative. Through this discussion, we were able to identify what OTP currently does really well for agencies, where additional focus and development is necessary, as well as determine technical priorities for tackling those issues. Key priorities that emerged from this discussion include:

- The integration of SUM and FLEX services into the OTP trip planning engine
- Future integration (in some form) of transit and SUM fare and payment information
- Improved open source alternative for OTP dependencies such as map tiles, geocoders

<u>Technical Presentations</u>

The afternoon sessions featured members of the OTP SUM development team introducing their proposed technical approach and functional requirements for the

project. Conveyal introduced their proposed React/Redux architecture to update OTP to a modern, responsive design, as well as mock-ups of the UI elements that will help OTP users integrate SUM modes into their transit trips. Mapzen provided an overview of Pelias, their open source geocoding engine, describing opportunities for customization when implementing a local instance for a project such as OTP SUM. In addition to the two primary OTP SUM development teams, moovel introduced their fare payment applications, describing how they have integrated SUM modes into their mobile applications. Also, Trillium Transit and Cambridge Systematics introduced their development approach for the VTrans MOD project to integrate GTFS-Flex into OTP.

For additional detail on the technical presentations, please consult the following appendices.

Appendix 3: Conveyal_TriMet_MOD_Kickoff
Appendix 4: Trillium - TriMet workshop flex presentation
Appendix 5: MapZen - MOD Kick-off 2017
Appendix 6: moovel TriMet OTP Kickoff

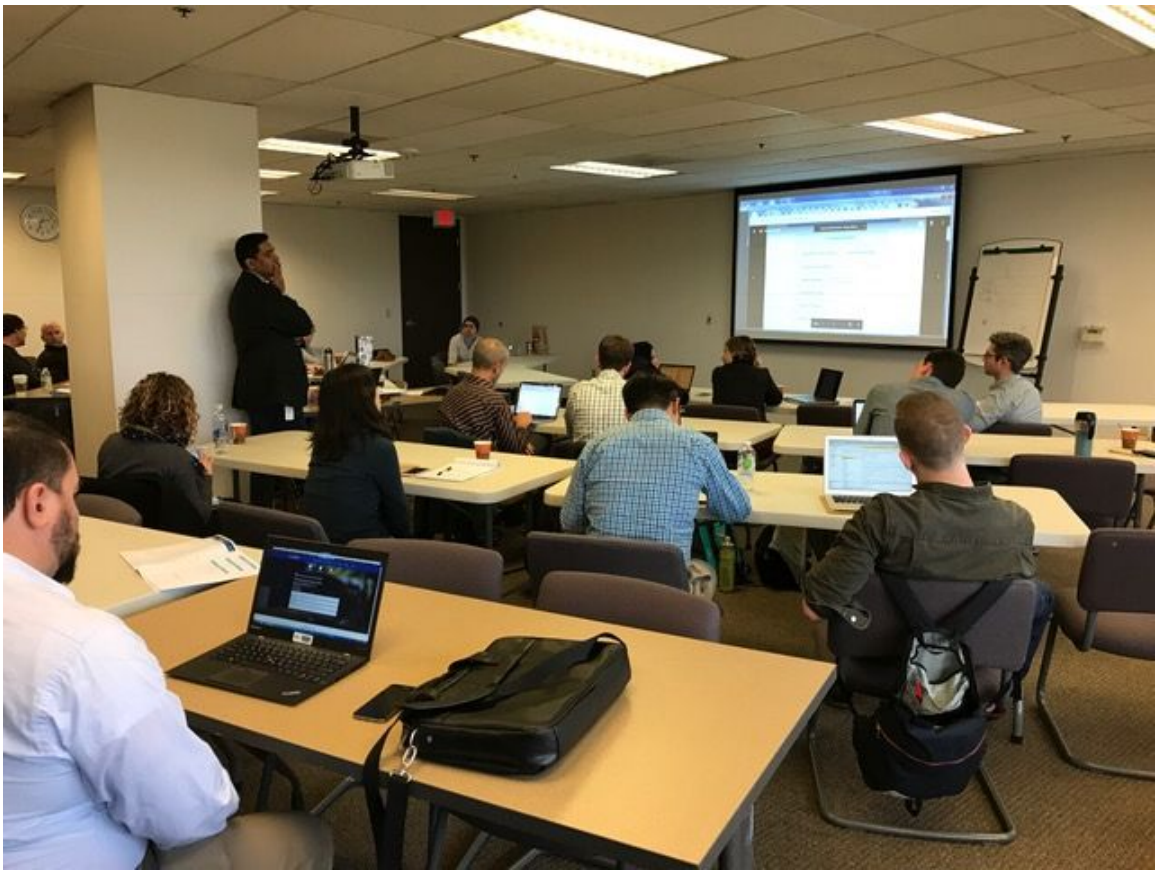
TriMet Technical Overview and Requirements

Bibiana McHugh provided a technical overview of Trimet's objectives and functional requirements for their implementation of the new OTP SUM front and back end. This included discussion of the functionality of existing geocoding solution used by TriMet (SOLR), which will need to be matched/surpassed by Pelias as part of OTP SUM. In addition, topics for future discussion emerged including the desired development process/approach for OTP/SUM and Pelias, defining a roadmap for integration of OTP SUM with the existing website, and ADA and other accessibility requirements on system design. This session closed with an overview of the management and collaboration tools and communication channels that will be used by the OTP SUM team.

For additional information, please see Appendix 7: TriMet Trip Planning Roadmap and Requirements

The day concluded with collaborative planning of the next day's technical work sessions.

SUMMARY DAY 2



TECHNICAL BREAKOUT SESSIONS

The workshop's second day consisted primarily of working sessions to tackle the technical questions and issues identified during the previous day's discussions, and leverage having so many OTP stakeholders and developers together to jump start design and development of the components of OTP SUM. Over three one and a half hour sessions, eight different working groups met. Each of these is described below.

1. Fares/Incentives in OTP

The Fares and Incentives working session focused on how to best incorporate fares into OpenTripPlanner, as well as the challenges of fitting fares into a data model such as GTFS. The discussion drew from the experiences of agencies such as LA Metro, who built a separate fare database and logic to handle fares during trip planning. In addition, they discussed the issue of how to handle fares in the OTP Graph. Solving for minimum fares would often yield cheap, but impractical trips. Instead, sorting by fare after identifying trips that best fit user preferences would be a way to better reflect how users incorporate consideration of fare into their trip planning process. Finally, the group

touched on integration of fare payment and potential for incentives within OTP, looking at moovel's deep link integration of ride-hail trips with Lyft as an example.

2. Geocoding: Integration with OTP/TriMet Website

The geocoding session began with participants describing their agencies' experience with current geocoding solutions, emphasizing challenges such as complexity (incorporating transit-specific locations and price [high API license fees]). This pivoted to a discussion of requirements for Pelias, including address interpolation, location bias, and accounting for spelling errors in user input. The session concluded with a discussion of what needs to happen to update Pelias from its current state to meet TriMet's requirements, with a focus of incorporating custom data into the Pelias ElasticSearch data store.

3. OTP Infrastructure & Testing

a. Build Management Decisions

During this session, representatives from TriMet and Conveyal discussed the development process and build management tools for OTP SUM. TriMet and Conveyal both outlined how they each currently approach development and builds. In addition, Mapzen gave an overview of their development processes for the Pelias geocoder to inform Trimet's local install. This session ensured that the development teams and TriMet will be working in the same environments and frameworks during the OTP development process.

b. Test Procedures, Change Management, and Component Integration

This session established a testing and change management strategy for the OTP SUM project. TriMet will establish build, stage, and production environments, which will be consistent across project components. Integration testing and and acceptance tests were discussed. A variety of acceptance testing approaches were described, and future discussion among the project team will be necessary to finalize the OTP testing plan. Security considerations were also discussed including sensitive information (not an issue during current phase, but becomes a challenge with payment integration) and system stability concerns (rate limiting, load balancing, etc.).

4. OTP Web Services/Middle Tier

This session focused on whether UI's should interface directly with the server-side OTP routing engine or rely on a middle tier service to intercept API calls. Considerations for a middle tier included the ability to plan multi-leg (i.e. trip chaining) trips as a "stitched itinerary" as well as flexibility for what trip planning engine powers a particular UI instance. Several agencies shared their experiences using trip planner middle layers including RTD, whose middle tier filtered landmarks and other transit specific locations, and LA, whose middle tier ran fare calculations for planned trips. Key to this discussion was what aspects of a trip should be handled in the back end (common to all OTP

implementations) and what should be handled by a middle tier (configured for each implementation).

5. Routing Engine: Flex+SUM+RT+Accessibility

This session focused on how to best integrate SUM, flex-service, real-time, and accessibility data into the OTP back-end routing engine. For accessibility, OTP can already leverage OpenStreetMap tags, which are being updated as part of this project to better map pedestrian and wheelchair accessibility. For SUM modes, the focus was on reaching consensus on what information is necessary to help OTP users plan a trip that includes a SUM mode. While additional discussion is needed to finalize SUM data requirements, key considerations were identified, including availability and time/space granularity of data. Whatever format the SUM data is provided in, it needs to be able to translate lat/long and time into availability and price information for that mode. Further discussion focused on user preferences for SUM trips, as well as the different types of trip planning scenarios (ie- real time data for planning a trip right now, or aggregate data for exploratory, narrative trip planning).

6. UI/UX: Flex+SUM+RT+Accessibility

This session focused on incorporating SUM and flex services into the OTP user experience. One particular challenge for both SUM and flex trips is communicating the complexity/details of these services (i.e.- the need to book a trip, or be on a certain side of the street to flag a stop), without overwhelming the user with text, particularly if the user is accessing OTP on a mobile device. This included discussion of what information about SUM trips (availability, wait times, estimated price) should be communicated to users, as well as graphic design considerations for how to display SUM or flex portions of trips. Next steps include: further developing icon sets and message sets for SUM and flex trips, and figuring out narrative directions vs. map visualization for SUM and flex trips.

7. UI/UX: Integration with TriMet

This session focused on how to integrate the new React/Redux OTP components into the existing TriMet website. Currently the homepage functions as a three task “app” with the trip planner, transit tracker, and service alerts. With the implementation of the new OTP, keeping the tool as integrated as possible is a priority. In addition, the interaction between OTP and Pelias was discussed, with OTP components passing user search inputs to TriMet’s Pelias instance for geocoding.

8. UI/UX: Journeys and Scenarios; Testing Process

The final UI/UX work session focused on identifying user “journeys and scenarios.” By mapping out how users will interact with OTP SUM, from first awareness to exiting the trip planner, the design team can tailor the application’s UI to best meet user needs and expectations. A major consideration during this discussion was how to get people to use something they’re less familiar with. The UI/UX must emphasize the “added value” of the updated OTP SUM over other trip planning tools. In addition, different users will have different preferences about taking multimodal trips. Getting the default setting for these preferences correct will be critical, as well as finding a balance between making it

easy for users to change their preference settings and not overwhelming users with choices/options/complexity. This session also touched on an initial discussion of the user testing that will occur during this project's second year.

9. Technical Work Session Debrief

Following the technical work sessions, representatives from each session gave a brief (5-10 minute) report back to the full group of workshop attendees. This gave everyone a level of familiarity with what was accomplished over the course of the day. In addition, teams were able to recognize areas of overlap or interaction between project elements that would benefit from additional discussion or meetings.

BUSINESS STRATEGIES DISCUSSION

To close out the kickoff workshop, all attendees reconvened for a discussion and brainstorming session about business strategies for OTP. This included strategies for both the broad OTP initiative, as well as individual agency implementations of OTP. Agencies in attendance explained their primary reasons for implementing OTP, including:

- The desire to not rely on third-parties for core agency services,
- Critical functionality is missing from 'out of the box' trip planning tools
- High cost of other (proprietary) trip planning options.

In addition, the group identified key barriers to further adoption of OTP by more agencies, which include:

- Procurement processes not designed to handle open source projects
- Lack of resources to do OTP build and integration
- Perception of IT as secondary service

Considering these two perspectives, the group discussed what OTP stakeholders could do to encourage adoption and improve the experience for agencies, with the end goal of making OTP the go-to option for agencies looking to implement a first trip planner or upgrade their trip planning capabilities. Peer exchanges and skill shares between agencies could help increase familiarity with and reduce uncertainty/anxiety over open source solutions such as OTP. In addition, the possibility of an OTP consortium of agencies, consultants, and developers, along with a clear visual branding of OTP could help spread familiarity of OTP amongst agency executives. An OTP consortium could also provide a structure for oversight and coordination across various OTP initiatives. The experience of other transit tech consortia was discussed, raising the questions:

- Are we headed towards consortium overload? With the proliferation of transit technology/data consortia, will stakeholders have enough bandwidth/capacity to meet the goals of these consortia?
- Are resources stretched to thin/diluted because of this?
- A lot of these groups are asking:
    - How do we fund this?
    - What value are we bringing to members?
    - How do we make it a durable initiative?

The current collaboration among the MOD Sandbox OTP projects, as well as the other active OTP initiatives is a critical first step to build an active network of stakeholders contributing to OTP. This will lay the groundwork for any future more formal OTP organization.

CONCLUSIONS

Key Observations

- There is momentum behind making significant changes and improvements to OTP in the coming few years, and especially as a result of the MOD grants
- The various parties - agencies, consultants, and vendors - involved in the various OTP improvement efforts need to, and are coordinating their effort
- TriMet, as the convenor of this workshop, can and is willing to help coordinate the various OTP improvement efforts

Next Steps

- Set up regular coordination calls/meetings for the various streams of activity for the TriMet OTP SUM project
- Set up coordination calls/meeting between the various other OTP improvement projects