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Finding Transit

How better maps can make
the Bay Area transit system
easier to understand
and navigate

www.spur.org/findingtransit

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Better Maps for a Better Transit Experience

Transit maps play a small yet critical role in helping people understand the value of a transit system and how to use it to get around. A transit map gives riders a sense of what is possible — how they can get there from here — and can have a strong, and lasting, effect on travel decisions. Research shows that transit maps that legibly display multiple transit services can increase ridership, improve passengers' understanding of the overall transit system and boost the perception of transit service and a transit agency.¹ Even in the age of smartphones, transit maps are valuable. They do things that trip planning apps either can't do or can't do as well: increase users' familiarity with transit, provide guidance and reassurance, offer credibility and promote choice, opening up new destinations for residents and visitors alike. Transit maps are there when a smartphone is inaccessible or runs out of data or power.

Many of the world's best and most extensive transit systems — London, Paris, New York — have been packaged into a legible rendering of lines and stops, simplified so well that the system map can be understood even by a visitor who doesn't speak the local language. In New York and London, the local transit map has taken on iconic status: Each city has come to be defined by its transit map, and in turn, transit defines the city. But we can't say the same about the San Francisco Bay Area, where the potential of the transit map has been cut short. Here riders juggle multiple maps and map styles. They can't refer to a cohesive regional transit map that knits the region's transit offerings together because such a map doesn't exist. This challenges the Bay Area's ability to maximize investments in new transit infrastructure and to grow transit ridership. If transit is to thrive and survive in a new era of mobility, it has to be easy to use, understand and transparent.

About the Regional Transit Maps Project

For these reasons, SPUR, the Metropolitan Transportation Commission (MTC) and the Silicon Valley Community Foundation (SVCF), in collaboration with public transit operators, have embarked on a project to develop MTC's next regional transit map as well as shared transit map design guidelines and a GIS-based transit mapping platform. The existing regional transit map is outdated, but it provides a foundation for the next iteration. The goal for the new regional transit map is to produce a commonly used public transit network map available both in print and online. The purpose of the guidelines is to establish a consistent design language that transit operators can adopt and apply to their transit maps and other pieces of transit information they produce. Creating a regional transit map and aligning graphic and information styles across operator maps were recommendations in the SPUR report *Seamless Transit*.²

¹ Margaret Carragher, "Innovations in Multi-Modal, Schematic, Transit Mapping: An Exploratory Survey," Dissertation, Georgia Institute of Technology, 2013. See also: Zhan Guo, "Mind the Map! The Impact of Transit Maps on Path Choice in Public Transit," *Transportation Research Part A: Policy and Practice* 45, no. 7, 2011, pages 625–639; and Jane Vertesi, "Mind the Gap: The London Underground Map and Users' Representations of Urban Space," *Social Studies of Science* 38, no. 1, 2008, pages 7–33.

² SPUR, *Seamless Transit*, 2015, <https://www.spur.org/publications/spur-report/2015-03-31/seamless-transit>

This paper provides background on the role of public transit maps in helping people to navigate transit, outlines how Bay Area transit maps are currently developed, presents principles for transit map coordination and offers recommendations for moving forward. The research process included interviews with transit riders and nonriders as well as transit operators in the Bay Area and across the globe, site visits to Bay Area transit hubs and reviews of case studies and academic research. This paper aims to provide a foundation for MTC and transit operators for the work ahead.

A patchwork approach to transit

Bay Area public transit is complicated. More than two dozen different operators provide services, including Muni, BART, AC Transit, the Santa Clara Valley Transportation Authority (VTA), Caltrain and many other bus, rail and ferry operators. Each transit operator has its own unique policies, procedures, operating practices, fare structures and funding sources. Fragmented transit makes our system less efficient and less usable: taking a trip using multiple operators requires navigating multiple maps, timetables and fare combinations; managing schedules not coordinated for transfers; and negotiating counterintuitive transit connections.

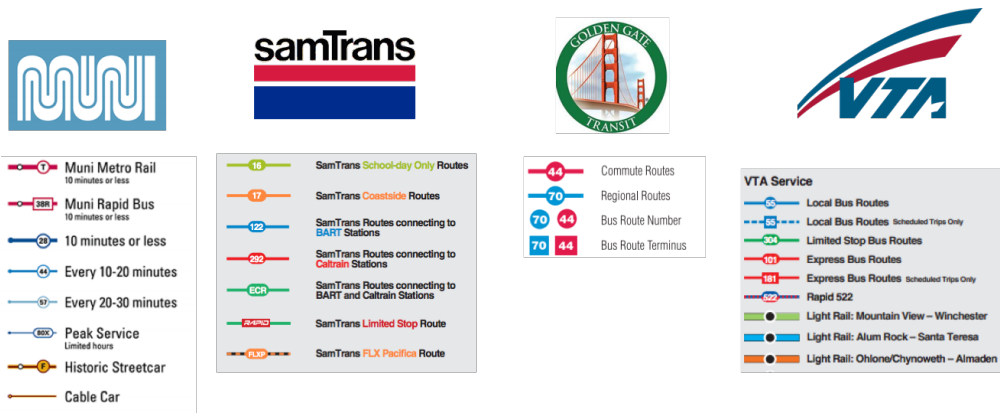
This patchwork of operators emerged from a combination of funding and state laws. Add to that the Bay Area’s long-running preference to let local municipalities handle most decision-making. While improvements to the region’s maps won’t solve transit fragmentation, they can help us start to knit the region and its transit together and be a catalyst for stronger coordination and cooperation among transit operators.



Bay Area transit information is disjointed, making it difficult for riders and nonriders to understand the value of the region’s transit system. Photo by Sergio Ruiz.

Disjointed transit information is a barrier to transit use

Each transit operator in the Bay Area develops its own maps, using a wide range of styles, symbols, graphics, language and nomenclature to describe and present transit service. (See photo below.) These variations in maps make it harder for riders to understand and use unfamiliar services, and they complicate the marketing of the transit system. Interviews with transit riders and nonriders in the Bay Area for this project found that many people find reading, following and decoding Bay Area transit maps to be a laborious and often stressful experience.³ For those surveyed, current maps were overly complex and difficult to read.



Bay Area transit maps use a wide range of styles, symbols, language, graphics and nomenclature to describe their transit service.⁴ Source: Operator websites

Individual operators' maps do not identify other transit services consistently if they do it at all. Bay Area transit maps offer a limited perspective — a sliver of what's possible on transit — even though riders must often use more than one operator for a single trip. Service boundaries, such as county lines, force riders to transfer from one service to another at arbitrary points in their trips. There are well over a hundred places across the region where two or more operators connect,⁵ and one-third of Bay Area workers cross a county line to get to work.⁶

The lack of information on transit connections can conceal opportunities for riders to make simple trips on public transit. In the interviews, riders expressed frustration at having to reference multiple transit operator maps to complete a journey and said they were reluctant to do the work to understand all of their options. This made them less likely to try a new or unfamiliar system and more likely to drive or use a rideshare when having to transfer. This may also mean that riders are perhaps relying on private vehicles more frequently than they need to or taking less-efficient routes that are frustrating and longer than need be.⁷ Only a quarter of the people who were interviewed and said they

³ City ID, a design consulting firm, was selected by the MTC as the consultant for this project. On November 17, 2017, City ID carried out intercept surveys at selected transit environments within the Bay Area. A total of 35 people, who included transit users and nonusers, were interviewed. For a copy of the report, contact Jay Stagi, jstagi@bayareametro.gov.

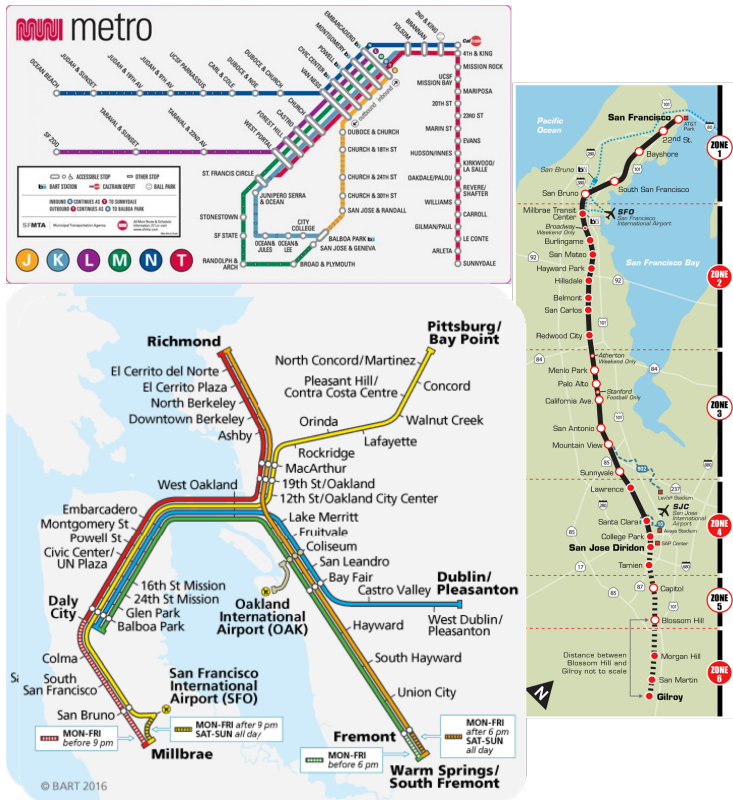
⁴ SPUR used the Map Assessment tool created by Jarrett Walker + Associates to explore the region's transit maps across four main categories: non-transit information, route distinctions, map details and trip planning. We found significant variation among Bay Area transit maps. See Appendix A for the assessment.

⁵ SPUR, *Seamless Transit*, 2015.

⁶ MTC, "Commuter Patterns," *Vital Signs*, 2010, <http://www.vitalsigns.mtc.ca.gov/commute-patterns>

⁷ This was a conclusion City ID reached as part of their research. See also: A. Cain, "Are Printed Transit Information Materials a Significant Barrier to Transit Use?" *Journal of Public Transportation* 10, no. 2, 2007,

knew the transit system either “very well” or “quite well” could name at least six of the region’s more than two dozen transit operators.



Transit operator maps do not acknowledge adjacent or overlapping service or do not do so in a way that facilitates connections. Top: Muni Metro. Bottom: BART. Right: Caltrain. All maps current as of August 2018.

Many will benefit from coordinated, comprehensive transit maps

Simple, fundamental improvements to transit maps would significantly improve the experience of using transit in the Bay Area, helping to improve riders’ perceptions about public transit and to grow ridership. Consistency in the graphic and information styles used by Bay Area transit operators in their maps, both digital and in print, would help transit users see how different services connect to one another and feel more comfortable when trying out new services or routes. A regional transit map that integrates the many public transit services into a single map so they appear as a rational, easy-to-use network would help current and potential transit users understand the region’s transit context more completely and make more informed trip decisions.⁸ Also,

pages 33–52. Cain found a correlation between how easy participants thought the wayfinding tasks in his survey were and whether the participants stated they would use transit more in the future.

⁸ Ricardo Gallotti, Mason A. Porter and Marc Barthelemy, “Lost in Transportation: Information Measures and Cognitive Limits in Multilayer Navigation,” *Science Advances* 2, no. 2, 2016, pages 1–7. Gallotti, Porter and Barthelemy argue that human cognitive capacity is limited and transit networks have reached a level of complexity that is beyond humans’ processing capabilities. As such, to facilitate use of the services provided by transit operators, transit maps should be designed to decrease the amount of information to a level below the human processing threshold. Similarly, the transportation consultant Jarrett Walker argues that the goal of any map should be to reduce complexity so as to make the map useful. He argues that when a map is too complex most people won’t succeed in reading it and that ease of use should be prioritized over detail and accuracy. See: Jarrett Walker + Associates, “AC Transit Map Assessment,” 2016.

when we start to see the overall transit network as more integrated, we will plan it in a more integrated way going forward.

At the same time, it will take more than a map to grow and encourage transit use. To maximize the usefulness of a transit network, many components of the transit experience — the reliability and frequency of transit service, divergent fares and safety, among others — need to be addressed. Transit maps, for that matter, are but one piece of information needed to make transit welcoming, easy to understand and easy to use. The entire set of information and tools that people use to navigate from one place to another — everything from maps to schedules to the signs at stops and stations — has an impact on transit usability and the rider experience. That said, transit maps have unique features that support a more in-depth focus on their purpose, function and usability, such as their role in discovery, their ability to be taken home and used for planning and their general advertising value. In particular, it's important to consider how they can work best in coordination with other transit information.⁹

A need heightened by the growth in transit infrastructure

Today, the transit network in the Bay Area is expanding and being designed explicitly for connections among travel modes (and therefore among transit operators). The extent to which connecting will be a part of transit trips is poised to grow exponentially.¹⁰ Done well, connections can help maximize mobility. San Jose's Diridon Station is currently a key stop for Amtrak, Caltrain, Altamont Commuter Express and VTA's light rail and bus services. In the not-so-distant future, it will also serve BART and high-speed rail. Diridon Station is expected to see nearly as many transfers between transit operators in 2040 as there are transit trips today among all of the local and regional agencies that use the station.¹¹

In Marin County, the SMART train will extend to Larkspur to offer a direct connection to the ferry; the extension is expected to boost ridership on both systems. Also, several intercity bus operators converge with Muni at the Salesforce Transit Center in San Francisco's South of Market neighborhood, and Caltrain and high-speed rail are slated to terminate there.

The completion of these projects will provide millions of people in the Bay Area with faster, more reliable transit options. To maximize the value of our investments in new transit infrastructure, we will need to work to improve the *visibility* of the connections. Seamlessly integrated transit maps — based on a holistic, regional framework and designed to communicate journeys and not jurisdictions — will go a long way toward helping riders understand and take advantage of the growth in transit offerings.¹²

⁹ J. Roberts Maxwell et al., "Objective Versus Subjective Measures of Paris Metro Map Usability: Investigating Traditional Octilinear Versus All-Curves Schematics," *International Journal of Human Computer Studies* 71, no. 3, 2013, pages 363–386.

¹⁰ Not all transit trips start and end within one transit operator's district. In 2017, for example, more than half of all Clipper cards were used to complete a multi-operator trip. See: MTC Operations Committee Meeting Packet, Sept. 1, 2017, Item 3a, <https://mtc.legistar.com/LegislationDetail.aspx?ID=3143609&GUID=E6803531-940E-4D84-84C4-0A9AD27F479C&Options=&Search>

¹¹ Adina Levin, 2017, "San Jose Diridon Expects Nearly as Many Transfers in 2040 as Transit Trips Today," <http://www.greenaltrain.com/2017/04/san-jose-diridon-expects-nearly-as-many-transfers-in-2040-as-transit-trips-today>. For information on VTA's network redesign, go to <http://nextnetwork.vta.org>

¹² Tim Fendley, "Making Sense of the City," *Information Design Journal* 17, no. 2, 2009, pages 91–108.

A complicated problem to solve

Three reasons explain why the region has gone so long without an up-to-date cohesive regional transit map or regional transit mapping design standards. The first is geography. The nine-county Bay Area is vast — nearly 7,000 square miles— and there is a 60-mile-long body of water in the middle of it.¹³ It's also oblong — a shape that doesn't lend itself to being displayed easily north to south. This geography, coupled with the sheer number of transit operators, each with extensive service areas, has made it hard to develop a map that is legible across multiple scales. Second, while cities like New York and London have legible transit maps that offer a complete picture of their transit systems, those systems are primarily rail. Much of Bay Area transit is bus-based, making it more of a challenge to construct a single transit map that is truly representative. While advances in mapping technology can address these first two barriers to a degree, they don't eliminate the third reason: the lack of opportunities, options and incentives for coordination and cooperation among the region's transit operators. This reflects the overall realities of a fragmented regional transit system that doesn't serve the needs of a transit ridership base that commutes across counties and agencies.

Building on previous work

The Regional Transit Maps Project builds on the success of MTC's Hub Signage Program, which developed regional wayfinding standards and installed regional transit information systems at transit hubs across the region where multiple operators meet.¹⁴ The goal of the Hub Signage Program is to make it easier for riders to transfer between connecting operators at regionally significant stations in two ways: first, by creating a consistent look and feel, and second, by giving riders actionable information such as connecting agencies' fares and schedules and real-time information about the next-arriving buses and trains.¹⁵

The need for the Hub Signage Program was identified in MTC's Transit Connectivity Report (2006), which led to MTC's current Regional Transit Coordination Implementation Plan (Resolution 3866), adopted in 2011. Both the report and plan described the ways in which the lack of connectivity in the region impacts the customer experience and acts as a barrier to transit use. While the Hub Signage Program has certainly contributed to a more seamless transit system in the Bay Area, the signage is limited in quantity and availability and competes with information provided by the individual transit operators. It also gets outdated and lacks a regional map. The Regional Transit Maps Project aims to enhance and augment the maps and other materials developed by the Hub Signage Program, to bring a consistent look and feel to individual transit operator maps and to leverage technology to make it easier to develop maps and keep them up to date.

¹³ MTC, "Nine Bay Area Counties," <https://mtc.ca.gov/about-mtc/what-mtc/nine-bay-area-counties>

¹⁴ For more information on the Hub Signage Program, see <https://mtc.ca.gov/our-work/operate-coordinate/traveler-services/hub-signage-program>. Funding for the Hub Signage Program was provided in part by Regional Measure 2, the 2004 voter-approved measure to raise the bridge tolls on the seven state-owned toll bridges.

¹⁵ The Hub Signage Program develops, for each transit hub, maps designed to help passengers orient themselves and find their connecting transit services in the surrounding community. The program was tasked with developing maps and information displays that answered the following questions: 1) what service do I use for the connection to reach my destination?, 2) where do I find the stop?, 3) how do I pay for the connecting service and how much will it cost? and 4) when does the connecting service arrive? See: MTC, *Transit Connectivity Report*, https://mtc.ca.gov/sites/default/files/Transit_Connectivity_Report.pdf; and MTC, *Transit Connectivity Plan*, <http://www.reconnectingamerica.org/assets/Uploads/20060915mtcconnectivityplan.pdf>



The maps and information provided by MTC's Hub Signage Program help people navigate the region's major transit hubs. Photo of transit information at the Powell Street BART station by Noah Berger.

What success looks like

Making improvements to the region's maps will not happen immediately. Achieving this outcome will require sustained investment and interest from the region's transit operators and MTC. Bay Area transit operators and MTC will have succeeded in addressing the region's transit map problem when:

1. Transit riders have an iconic, legible map or maps of the region's public transit network that can be easily understood, used and trusted and that can function in print as well as digitally.
2. Members of the public have more information and the ability to see and understand transit options they didn't know about before, increasing their trust that public transit is a practical option.
3. Transit operators coordinate on transit information and mapping, shifting toward a customer-first approach and making decisions within a regional context in order to better serve current and future riders.
4. Transit operators share a common digital platform that can be updated easily for producing their own system maps.

Why We Need Standards: Lessons From the Manual on Uniform Traffic Control Devices

When cars began to proliferate in cities and urban areas, drivers faced the unfortunate task of making sense of a multitude of different road signs since there were no uniform standards yet. Each city and state government adopted its own approach to traffic signs, and signage on long-distance travel routes was installed by private automobile clubs, often with commercial motivations. Anyone could put up signs, which tended to promote a highway more than to provide directional assistance.¹⁶



Early traffic signs were developed by local governments, private automobile clubs and other constituencies. As a result, there was little regard for uniformity in appearance or consistency in use. Photo by Gene Hawkins.¹⁷

The resulting cacophony of signage was confusing for the nation's burgeoning driving population, contributing to collisions and overall unsafe driving conditions. In response, the Federal Highway Administration created the Manual on Uniform Traffic Control Devices, or MUTCD, in 1935. The document specifies the standards by which traffic signs, road surface markings and signals are to be designed, installed and used. The specifications cover the shapes, colors and fonts in all road markings and signs.¹⁸ All traffic control devices and street modifications in the United States are required by law to adhere to these standards or to standards the Federal Highway Administration endorses, such as the National Association of City Transportation Officials' *Urban Street Design Guide*.¹⁹

Imagine if there were no MUTCD and there were hundreds of different styles for stop and yield signs. It would be unnecessarily trying (not to mention dangerous) to travel to different places. Drivers — and pedestrians and cyclists — would be forced to learn new sign styles and terms every time they went somewhere new. The uniformity in traffic signs and road markings is what makes it possible for people to move about the country safely and efficiently.

Consistency can reduce confusion, improve safety and make it easier for people to get where they want to go. This is the lesson of the MUTCD — one that can readily be applied to transit maps.

¹⁶ U.S. Department of Transportation Federal Highway Administration, "Manual on Uniform Traffic Control Devices: The Evolution of the MUTCD," 2017, <https://mutcd.fhwa.dot.gov/kno-history.htm>

¹⁷ "Back to the MUTCD Future," https://ceprofs.civil.tamu.edu/ghawkins/MUTCD-History_files/MUTCD-BacktoFuture.TexITE-June2015.pdf

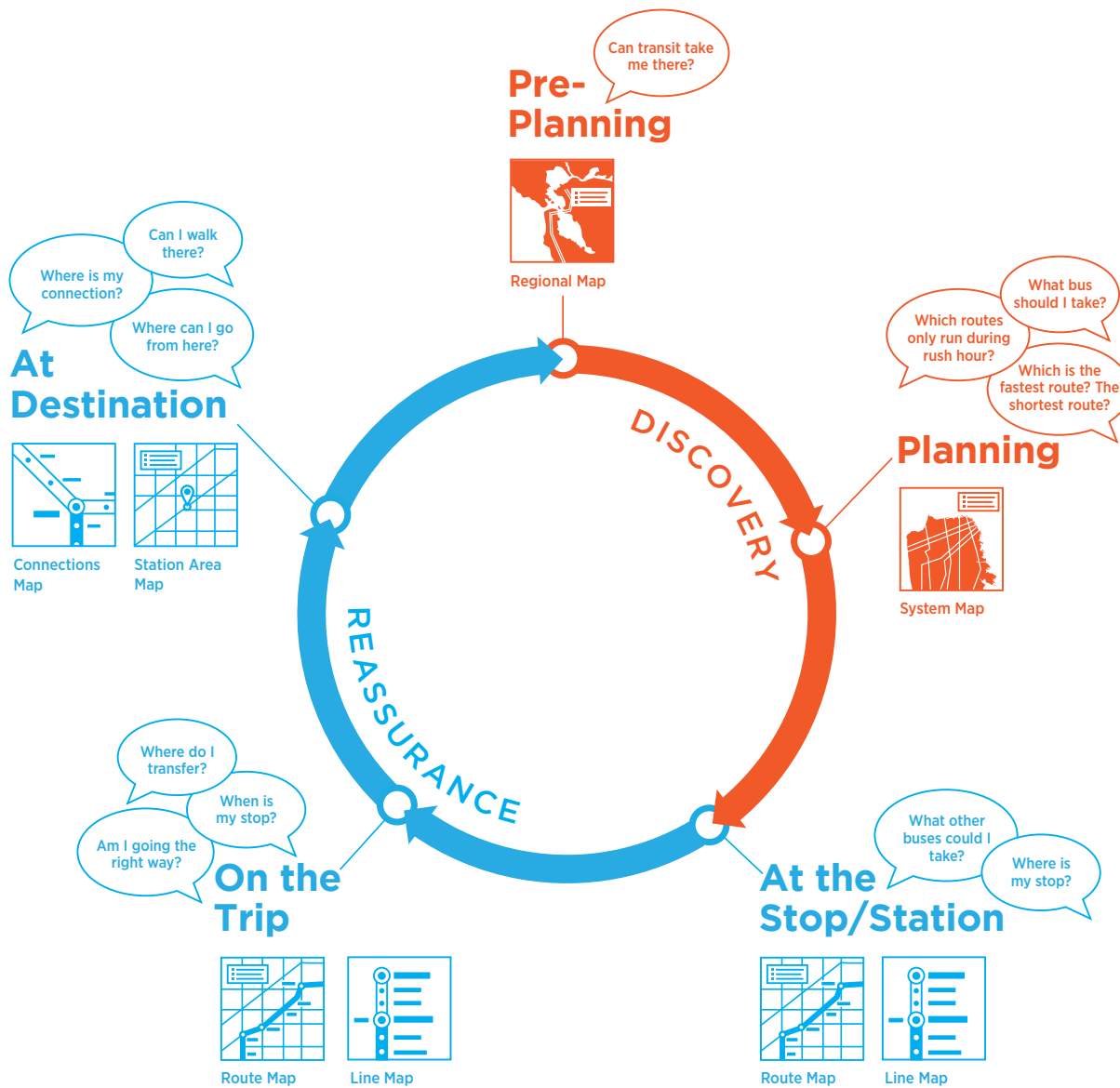
¹⁸ U.S. Department of Transportation Federal Highway Administration, "Manual on Uniform Traffic Control Devices: The Evolution of the MUTCD," 2017, <https://mutcd.fhwa.dot.gov/kno-history.htm>

¹⁹ National Association of City Transportation Officials, *Urban Street Design Guide*, <https://nacto.org/publication/urban-street-design-guide>

The Role of Transit Maps

How, why and when people use a transit map, and what they need from it, varies depending on which stage of the journey they're in. This means that transit maps themselves should vary depending on their purpose. Broadly speaking, the role of transit maps today falls into two main categories: discovery and reassurance. Figure 1 shows how these different functions manifest at different points in a rider's journey and which transit map or maps are most useful at each stage.

Figure 1: The design and function of transit maps differ at different points in a rider's journey



Transit maps serve two main functions: to promote discovery and provide reassurance. Different types of maps meet these functions at different points in a rider's journey. Source: SPUR analysis adapted from City ID

Transit maps promote discovery

For a long time, trip planning was the primary function of transit maps. But with the advent of online and app-based trip planning tools, this purpose is not salient for as many people. Instead, transit maps today serve best at helping to build “network awareness,” the understanding of all the possible origins and destinations accessible by transit. A transit map can bring the breadth and entirety of the transit network to life, offering options and helping to grow a rider’s general sense of how to get around.²⁰

Research conducted by AC Transit as part of an effort to redesign the agency’s system map found that riders use their system map primarily for discovery. They use it to get a general idea of where they are and could go, to see if there are multiple ways to get to a place, to learn how late or frequently the bus runs and to find out where else a bus could take them on their journey.²¹

Transit maps provide guidance and reassurance

For many riders, a trip planning tool might get them to their stop, but the experience on the ground can still be filled with uncertainty. But a transit map can confirm an itinerary and guide a rider during the trip, helping to answer questions like “Am I going the right way?” or “When is my stop?” A transit map also provides a visual reference to assess whether or not the route suggested by a trip planning tool is sensible. Riders trust maps — often more so than their own lived experience — to decide the “best” travel path.²²

Transit maps are there when a smartphone isn’t

Not everyone has a smartphone, is totally versed in its use or enjoys reading a map on a small screen; nor is it always advisable to have a smartphone out when you’re walking on the street. The Pew Research Center found that smartphone ownership is lower among those with low incomes,²³ and relying on a phone for information like trip planning is not as common among older populations.²⁴ Smartphones can and do run out of power, and a connection is not always available or reliable. It can be challenging to use a smartphone when you’re holding other things, when you’re not in a safe place or when you’re managing children.

Moreover, owning a smartphone isn’t the same thing as having the data needed to use a trip planning tool. For many smartphone owners, the ongoing cost of data can be a financial hardship.²⁵ Some Bay Area cities do provide citywide access to wi-fi, but they

²⁰ AC Transit commissioned Jarrett Walker + Associates in 2015 to lead a map redesign effort for the agency. The full report can be found here: <http://www.actransit.org/2016-map-assessment-report>. See also: Michael Southworth, “City Learning: Children, Maps, and Transit,” *Children’s Environments Quarterly* 7, no. 2, 1990, pages 35–48; and Zhan Guo, see *supra* note 1.

²¹ Jarrett Walker + Associates, “AC Transit Map Assessment,” 2016.

²² Zhan Guo, see *supra* note 1.

²³ While well over 90 percent of adults with incomes of \$75,000 or more own a smartphone, that figure drops to 74 percent for adults earning between \$30,000 and \$49,000 and 64 percent for adults who earn less than \$30,000. See: Pew Research Center, “Who Owns Cellphone and Smartphones?,” Jan. 2017, <http://www.pewinternet.org/fact-sheet/mobile>

²⁴ *Ibid.* Smartphone ownership is highest among younger Americans: Just 42 percent of Americans 65 and older own a smartphone compared to 92 percent of Americans ages 18 to 29.

²⁵ Victoria Rideout and Vicky Katz, “Opportunity for All? Technology and Learning in Lower-Income Families: A Report of the Families and Media Project,” 2016, http://www.joanganzcooneycenter.org/wp-content/uploads/2016/01/jgcc_opportunityforall.pdf.

are in the minority, and even then service can be spotty.²⁶ In the focus groups AC Transit conducted for its map redesign, lack of access to data was a key reason why riders consult a transit map.²⁷

Transit maps serve other key purposes:

Providing perspective. Trip planning tools provide an itinerary, maybe two, but what they don't do — and a map can — is give a larger perspective. What if the bus is late? A transit map can show how often a bus runs or help a rider plan a different route rather than relying on the bus that was supposed to arrive at the exact search time.

Supporting tourists and infrequent transit riders. Transit users navigate based on their experience. Tourists, infrequent riders and nonriders have limited knowledge of the transit system. These groups rely on the context, information and support provided by a transit map.²⁸ International visitors in particular may not have data plans for their smartphones and must rely on transit maps to assist with navigation.

Helping with land use decisions. Transit maps display where transit is and, in many cases, where it will be. (Transit maps often display planned or future service.) By doing so, transit maps can help inform decisions about where to live, locate a business or develop property.

Bridging the first/last mile gap. Getting to and from the region's transit stations has always posed a challenge. Transportation innovations like ride sharing and bike sharing are helping to solve the "first and last mile" problem, but in many areas transit operators already offer bus routes to and from transit stations. Unfortunately, many are unaware of these services or of the reliability of the connections. Transit maps can help people better understand the options available to them.

Connecting people to opportunities. Transit maps are a useful tool for determining how easy or challenging it is to reach different opportunities, such as a job or school, by transit. For example, a high school counselor helping a student find a job or a social worker signing someone up for an appointment needs to know how the location can be accessed. A transit map shows what's available and not available near transit and, in some cases, how frequent the transit service is.²⁹

Marketing transit services. A transit map is the public face of a transit agency. It is often a customer's first impression of the transit system. A legible transit map that clearly presents the transit network promotes the system as a practical option. This can build trust and give people confidence to use transit to explore and move about.³⁰

²⁶ For example, San Francisco and San Jose provide free internet outside in select locations.

²⁷ See *supra* note 21.

²⁸ David Rossman-Robinson, "Human Trip Planner: Wayfinding for Transit Users," Thesis, Eastern Washington University, 2013. Rossman-Robinson found that the knowledge of a transit user is accessed differently depending on the user characteristics (i.e., if they're a frequent user, commuter, infrequent user, new rider, tourist or rider with special needs).

²⁹ See *supra* note 21.

³⁰ An evaluation of the impact of Legible London, London's pedestrian wayfinding program, found that the system increased awareness of walking and transit opportunities and gave people the confidence to explore. See: Tim Fendley, *supra* note 11.

How Bay Area Transit Maps Are Made Today

To develop a deeper understanding of how Bay Area transit agencies approach mapping and the customer experience, SPUR, in collaboration with the project partners, conducted research interviews with Bay Area transit operators and MTC.³¹ In addition to the interviews, we conducted field observations and, where available, reviewed transit customer satisfaction surveys and reports. The key findings of SPUR's research are:

1. **Bay Area transit operators recognize the power and potential of transit maps.** A transit map plays a critical role in promoting transit use. Getting it right — making sure the map is easy to understand, professional and well organized — was identified by the staffers we spoke with as key to growing and sustaining riders, especially as the map often provides the first impression of an operator and its service.

Each transit agency develops its own maps, typically with the assistance of a consultant. MTC also produces rider-oriented maps for use in transit hubs (through the Hub Signage Program) and on the 511 website. Small changes and tweaks are typically handled in-house by the individual agency, although some smaller agencies rely on the consultant for this service as well.

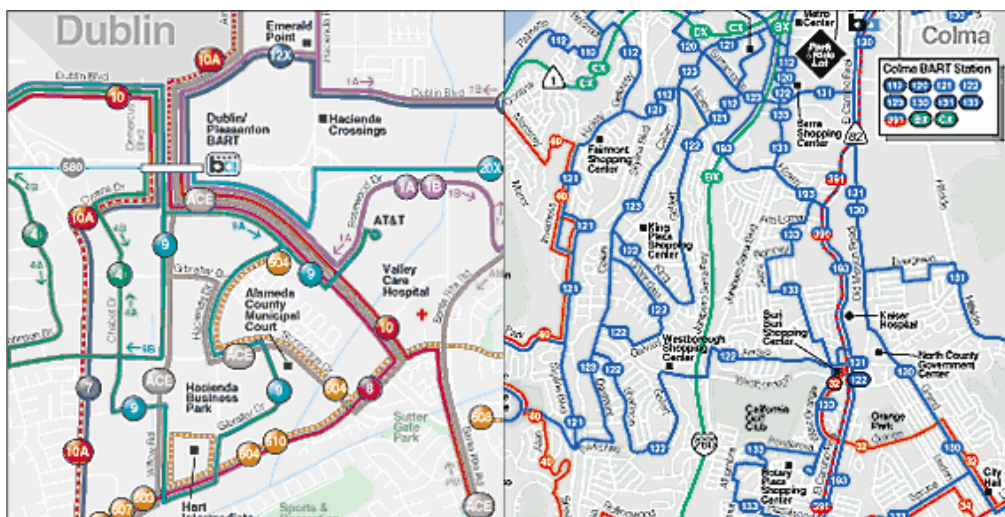
2. **Many operators do not use cartography software to develop their maps.** Geographic Information Systems (GIS) is a cartography software used to generate maps. GIS integrates many types of data into a single platform and allows the data to be visualized as a map. The benefit of GIS is that it's fully data-driven, which means that a change to the underlying data is immediately shown on the map.

Smaller transit operators with less complex systems draw their maps in Adobe Illustrator rather than using GIS. This means that all service changes must be corrected by hand. Maps that are based on GIS and then exported to Adobe Illustrator are more accurate and require less manual manipulation, which makes them faster and easier to develop. However, when a map is exported to Illustrator from GIS, often the route lines become slightly distorted or layered on top of each other. Without the right tools to clean and separate the routes, this process can be challenging. Even some large agencies, such as the San Francisco Municipal Transportation Agency

³¹ Interviews were held at the transit operator's offices and were typically conducted with the operator's marketing or communications staff and/or transit planners. We asked each transit operator the same 22 questions covering five topic areas: maps and design today, data and technology, coordination with other operators, policy and leadership, and user experience. Interviewees were also asked to describe their ideal mapping program and their desires and expectations for the regional transit map. Staff from the MTC and SVCF helped conduct several of the interviews. City ID, the project consultant, conducted the majority of the interviews with MTC staff. We elected to include an interview with Amtrak in the analysis because Amtrak provides service throughout the nine-county Bay Area and because the State Rail Plan envisions a more integrated future for Amtrak and Bay Area transit. Interviews were conducted between March and September 2017. See Appendix B for a list of the interviews and the interview questions.

(SFMTA), have a hand-drawn system map. Because the SFMTA's transit system is so complex, with frequent services changes, the agency intends to move to data-driven maps.

- To develop their maps, transit operators look to each other for guidance and assistance.** Designing and developing a transit map is a complex process. Transit agencies must consider a number of different factors, including which consultant to hire, which colors and symbols to use and how to display their services (for example, by frequency). To prevent the process from becoming overwhelming, many transit operators turn to each other for guidance. As a result, many transit maps look similar. For example, SamTrans, VTA, AC Transit, the Western Contra Costa Transit Authority (WestCAT) and Union City all used the same designer to develop their maps; thus, their maps share the same color scheme and overall look and feel. (See example maps below.³²) While there is value to the consistency, ultimately this way of doing things is uncoordinated and ad hoc. As soon as an agency chooses a new consultant or a new direction, the maps could end up looking very different. One person described this setup as a “loose house of cards.”



The previous transit map for Wheels (left) and the transit map for SamTrans (right) were both designed by Reineck & Reineck Design and share a similar look and feel as a result. Wheels has since selected a different consultant, and the look and feel of its map has changed while SamTrans has continued to use the same design. Source: Reineck & Reineck Design

- Nearly every transit operator produces a system map.** Beyond that, there is great variation in the types of maps transit operators produce. Most bus operators provide a system map and individual route maps separately, with the route maps and schedules printed together in a brochure. The exceptions are Marin Transit, Golden Gate Transit and Petaluma Transit, which each produce a Rider Guide booklet that includes the system map, route schedules and maps, and information on fares and paratransit.

³² These agencies all worked with Reineck & Reineck Design. Reineck & Reineck Design also designed the existing regional transit map. See: <http://www.reineckandreineck.com/reineck/maps/transitmaps/transitmaps.html>

Sonoma County Transit and the SF Bay Ferry do not offer a system map. Instead, they produce individual route brochures only. Muni and Santa Rosa City Bus are the only bus operators in the region that indicate frequency (i.e., how often a bus arrives) on their maps.³³ For a list of the maps each transit operator produces, see Figure 2.

Figure 2. Bay Area transit operators produce different types of maps

System Map + Individual Route Maps	System Map Only	Individual Route Maps Only	Rider Guide
AC Transit	ACE	San Francisco Bay Ferry	Golden Gate Transit
County Connection	Amtrak	Sonoma County Transit	Marin Transit
FAST	BART		Petaluma Transit
LAVTA	Caltrain		Tri Delta Transit
Muni	City Coach		BART
Santa Rosa City Bus	SamTrans		
SoTrans	Vine		
Solano Express	SMART		
	Union City Transit		
	WestCAT		

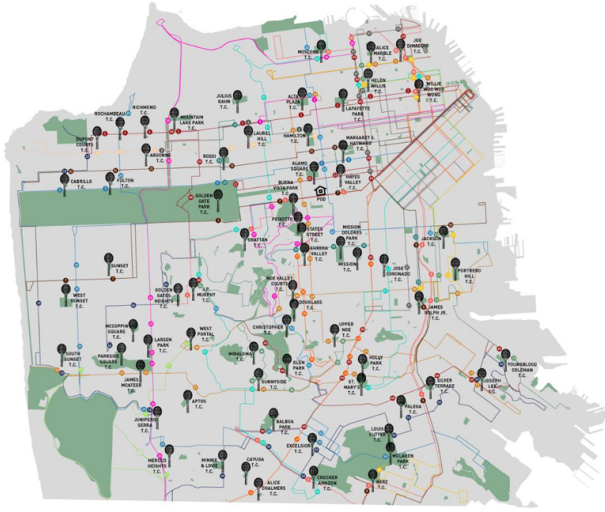
* Rio Vista Delta Breeze does not produce a map.
Source: SPUR analysis; current as of 2018

Customers benefit from tailored, specific information; transit information does not have to be limited to the conventional system or line map (see the illustration below for an example of a tailored approach to transit mapping).³⁴ However, most Bay Area transit operators do not have the time and funding to develop, maintain and update multiple map products outside the traditional offerings. If a transit operator develops maps in addition to its system and route maps, it is to zoom into a specific area or to indicate a special service, such as late-night service. Even though the Bay Area is a popular tourist destination, Bay Area transit operators do not make specific maps for visitors; rather, these maps are created by visitor bureaus and tourist agencies.³⁵

³³ When VTA redesigns its service, its new map will show routes by frequency. The new map is expected in 2018.

³⁴ Margaret Carragher; see *supra* note 1. Carragher found that maps for riders with different trip purposes and travel times can help encourage transit use by different segments of the population. She recommends transit operators develop different maps for different groups of riders, such as regular riders and tourists, one being more frequency-based and the other, destination-based.

³⁵ The National Association of City Transportation Officials identified network and route maps, as well as schedule and route information, as the critical pieces of transit information that should be at every transit stop. See: National Association of City Transportation Officials, "Passenger Information and Wayfinding," *Transit Street Design Guide*, <https://nacto.org/publication/transit-street-design-guide/station-stop-elements/stop-elements/passenger-information-wayfinding>



Transit maps can be fun, creative and informative all at the same time. A designer at IDEO created this map to show tennis enthusiasts the Muni line that will take them to a tennis court. Map by Sean Hewens <https://www.ideo.com/blog/a-cartography-nerds-guide-to-custom-map-making>

5. MTC has created a regional transit map, but hasn't updated it in over 30 years. A regional transit map does exist (see below), but it is woefully outdated and insufficient: It doesn't include SMART or other new services and does not depict transit in the three major cities. Initially, it was a stand-alone foldout map, and then it became a book and was later included in *Getting There on Transit*, a booklet created by MTC. The booklet, now discontinued, provided detailed maps for each transit system in the Bay Area and included the regional transit map on page 1 for a high-level overview of the region's transit offerings, with the assumption that people would then turn the page to learn more. Because the regional transit map offers the only comprehensive overview of Bay Area transit, it continues to be used even though the booklet is no longer available and even though it is no longer current. This map is not available online and can only be found on signage installed at Bay Area transit hubs.



The current MTC regional transit map is outdated and awkward: it never solved the problem of how to display the transit services in dense city centers as well as the dispersed routes outside the city centers. Source: MTC

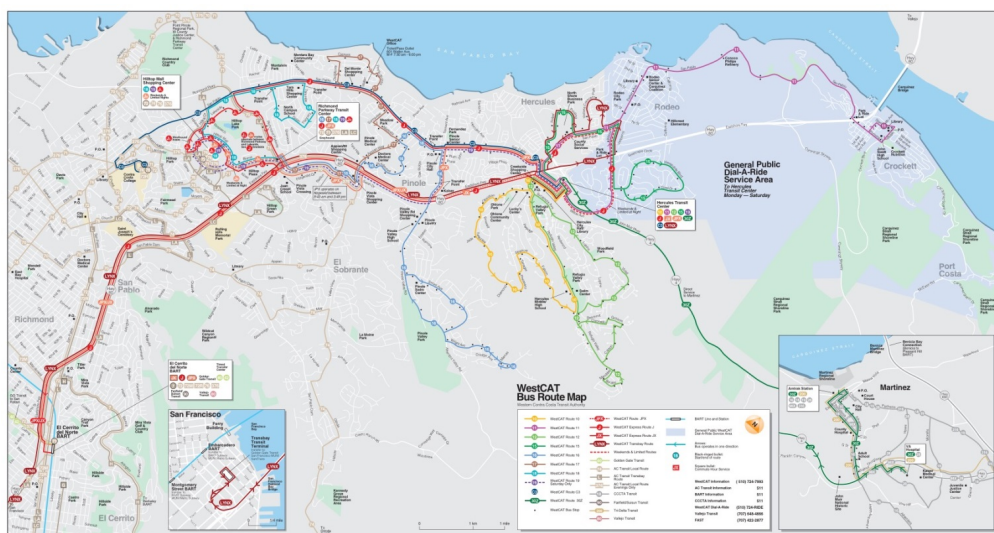
6. User research and user testing of transit maps are rare. Few transit agencies conduct user research or seek feedback from the public about the usability and appeal of their transit maps. Instead, transit operators tend to rely on their knowledge and experience, typically as a transit operator and not as a rider, to guide map development. Yet, research has demonstrated that there is little to no correlation between an individual's opinion about a map and how usable that map actually is. It is important to test the usability of a map before committing to a certain style or presentation.³⁶

³⁶ Research has demonstrated that there is little to no correlation between an individual's opinion about a map and how usable that map actually is. It is important to test the usability of a map before committing to a certain style or presentation. See: Maxwell J. Roberts, Hannah Gray and Jennifer Lesnik, "Preference Versus Performance: Investigating the Dissociation Between Objective Measures and Subjective Ratings of Usability for Schematic Metro Maps and Intuitive Theories of Design," *International Journal of Human-Computer Studies* 98, 2017, pages 109-112.

User research can help unearth what current and potential riders generally need — and are not getting — from transit information. Once a draft map is developed, user testing should assess how well current and potential riders understand the transit map, from what the colors suggest to what the symbols indicate to what the line markings signify. Testing allows for iteration and improvement before deploying a final map.

We have learned that transit operators value user research and user testing but don't feel they have the time or the capacity to do it. Typically, user testing is only considered necessary for bigger projects, such as a transit network redesign. If user testing is employed, it is usually an afterthought, squeezed in as part of another effort for which an agency is seeking feedback. Otherwise, transit agencies tend to abide by the “no news is good news” mantra. As one interviewee put it, “If it works, we'll get no feedback. If it doesn't, we'll hear complaints.”

- 7. Transit operators find it difficult to show other operators' routes on their maps.** Most transit information available today focuses on the offerings of an individual service provider. The way transit operators currently show other operators on maps — if they do so at all — usually doesn't help riders make connections to those services. For example, on the BART system map, Caltrain, Muni and Amtrak are depicted as gray lines. More information would be needed to make a connection.



The WestCAT system map includes the transit service of six other operators. Source: WestCAT

From our conversations, we learned that the reluctance to show other operators' service stems primarily from the fact that there are no systems in place to facilitate information sharing. Transit operators change their schedules at different times and do not coordinate updates. Many interviewees were concerned that if they showed another operator's routes on their map, those routes could quickly become out of date and they would have no way of knowing. Some transit operators that show other operators' routes have addressed this concern through regular meetings or check-ins with the other operators in their service area, which can be time-consuming.

The majority of operators that elect to show other operators' routes have resigned themselves to displaying out-of-date information; connections often go years without being verified.

There's also the challenge of displaying so much information clearly. Many people we spoke with found that they couldn't show other operators' routes without the map looking like a tangled mess.



The existing regional transit map is featured alongside information about schedules and fares in a display case at the Vallejo Transit Center. Photo by Christopher Ulrich.

- 8. The Hub Signage Program is a working model to build on.** MTC launched the Hub Signage Program in 2011 to make it easier for riders to transfer between services and navigate major transit hubs. AC Transit, under contract with MTC and working on behalf of the region, is responsible for updating and maintaining the Hub Signage maps, as well as the additional information included in the transit information displays. Transit operators are expected to notify AC Transit of changes to their schedules and routes. Prior to printing new maps, AC Transit is responsible for following up with the transit operators in the adjacent service areas to see if they have any changes or updates. Several transit operators admitted that they sometimes forget to notify AC Transit of changes, which means that the Hub Signage maps can be out of date. Nevertheless, the transit operators we spoke with indicated that they appreciate the service AC Transit provides. Several people noted that the Hub Signage Program has had insufficient resources and support beyond the initial implementation. The process to update the maps is ultimately labor-intensive, costly and inefficient because all updates are done by hand instead of by a centralized, automated system. The Hub Signage Program does offer a model for regional transit mapping but will need to evolve in order to ensure success.

9. Transit operators want the opportunity to share resources and collaborate on mapmaking. Despite the challenges of information sharing among transit operators today, we learned that the majority are eager to make better maps, get more support and coordinate more with each other. Not all transit operators have the time, resources and skills to develop and update their maps as much as they would like. Good designers are expensive and need management; staff and budgets are often too small. While the current flexibility afforded to each transit operator can have its advantages, it is also isolating, making it difficult to leverage economies of scale in identifying and sharing best practices. The time, energy and resources a transit operator invests in its maps aren't shared, even though many aspects of the mapmaking process are standard across operators.

Several transit staff members indicated that they would welcome assistance that simplified and streamlined the mapmaking process. Transit operators expressed a desire to produce maps on the fly, when there is a detour caused by a special event, for example, but said they lack the tools, skills, expertise and time to do so. Skills were often identified as a bigger barrier than cost: Operators are interested in learning how to use Adobe Illustrator and InDesign to make maps and templates for schedules. A common theme in the interviews was the need for better processes to communicate service changes in order to display other operators' route on maps. A Bay Area Map Working Group, organized by MTC, was proposed as a potential solution.

For some operators, a standard transit map was an ideal solution. Those who championed a map template for the Bay Area recognized that their map would not be as personalized as a result, but they saw gains in being able to provide more timely, accurate and clear information to their riders. Several people we spoke with wanted help thinking through larger, more existential questions about the future of transit maps. For example, several questioned whether it's still necessary to indicate timed stops or print the schedule on the map given the extent to which people now use trip planning tools and real-time apps.

It should be noted that not everyone we spoke with desired additional support or resources. Many were happy with and proud of their maps and thought it would be too difficult to serve the needs of their riders while also meeting regionwide expectations.

Principles for Transit Mapping Coordination

Many regions besides the Bay Area have multiple transit services, each with its own brand and graphic style. Several regions have attempted, or are currently attempting, to harmonize transit information across operators to improve the customer experience and make it easier for people to choose transit. SPUR interviewed staff at transit operators that were working on such projects, reviewed case studies from around the world and explored academic research to understand the elements necessary to successfully coordinate transit mapping. Based on our conversations and research, we've identified five guiding principles for coordination on transit mapping.

1. **Lead with the customer.** The most compelling way to make a case for change is to articulate the impact of today's maps on people's ability to comfortably and efficiently use transit. Metrolinx, the planning agency for the Greater Toronto and Hamilton area, has been working with the region's 10 transit operators to develop regional network maps. The design team at Metrolinx has put its singular focus on understanding what solutions best serve transit customers, especially infrequent transit users, people using multiple services and people with special needs. To find out customers' needs, wants and preferences, the design team employed four different research tactics:

Interviews: Passengers, staff management and leadership were interviewed in both formal and informal settings to understand the barriers to using existing maps and signs to navigate transit.

Field research: The design team traveled the transit network, experiencing it as a new customer trying to make reasonable journeys across the region, to further understand the shortcomings of existing transit information.

Customer journey maps: Members of the public were asked to document their journey and provide uninhibited feedback about their experience.

Focus groups: The design team conducted focus groups with people from around the region to explore reactions to new maps, signage and wayfinding.

The user research brought to light the challenges riders and nonriders face navigating transit with currently available maps, signs and information. By identifying user pain points, in particular at locations where multiple agencies come together, Metrolinx was able to show that changes and improvements were in the best interest of customers — and therefore transit operators — and could help the region maximize its growing investments in transit

infrastructure. This helped Metrolinx secure buy-in and improved its understanding of how to optimize wayfinding to grow transit use, in particular across operators.



Transit information in the Greater Toronto and Hamilton area, as in the Bay Area, is disjointed, lacking in network diagrams or other signs that indicate how different services relate to each other. Source: Metrolinx, “Seamless Network: Transit Wayfinding Harmonization in the Greater Toronto Hamilton Area”, Project Overview, 2015.

- 2. Build champions to calm skepticism.** Concerns about funding and ongoing maintenance can overwhelm discussions about the benefits of improvements to transit maps and signs. Similarly, inertia can be a barrier, given that operators and riders have tolerated the status quo for so long. Doing nothing can be easier than trying something different and potentially unearthing a whole new set of challenges.

According to our interviews and research, the success of such a project depends on high-level endorsement. Support from senior leadership and decision-makers at each operator is key to mitigating resistance, building trust and giving staff permission to experiment. Workshops can provide the opportunity for these actors to better understand the issues, engage in the processes, learn and grow their commitment.



At a workshop hosted by City ID and MTC, transit staff participate in an exercise to identify the core values and components of the next regional transit map. Photo by City ID.

Metrolinx recognized that not bringing senior leadership in earlier made it challenging to get buy-in at critical junctions. The Regional Transit Authority (RTA) in Illinois, which had embarked on a similar project to harmonize maps and wayfinding across the region's three transit operators, included key players early, articulated the opportunity cost of not doing the work and deeply involved the senior leadership in the decision-making. This helped to build champions, and as a result, each operator felt ownership of the finished products.

- 3. Be flexible and proceed from common ground.** The staff and experts with whom we spoke emphasized that finding common ground and working within existing constraints can help facilitate coordination on transit mapping. A key strategy is to first develop guiding principles grounded in shared beliefs and understandings. The guiding principles can help ensure that the design process remains focused on user needs, rather than simply following the path of least resistance to reconcile different sets of design standards. In addition, transit operators will need to define shared key terms and establish criteria.³⁷ For example, if the regional transit map is to include “regional bus routes” or “frequent routes,” transit operators will need to work together to define these terms.

For Metrolinx, maintaining balance and not creating new practices are key parts of its process. To the extent that it makes sense, the agency has incorporated established conventions, such as existing colors and numbering, into the new transit maps. Metrolinx intends to update and change its maps based on user feedback and will make more significant changes down the line

³⁷ For example, the Massachusetts Bay Transportation Authority (MBTA) decided to add 15 “key” bus routes to its subway network map to promote the bus system. The MBTA decided that key bus routes had to meet three criteria: 1) they must run seven days per week, 2) they must have a frequency of 15 minutes or less during peak hours (7 a.m. to 9 a.m., 5 p.m. to 7 p.m.) on weekdays and 3) they must start and end at a rail station or bus depot.

once operators align their terminology and route numbers, both of which are additional project goals.

- 4. Be prepared for the limitations caused by transit fragmentation, but don't let them define the mapmaking process.** Inevitably, a complete map of the Bay Area's transit offerings will reveal the seams in the transit network: places where connections are insufficient or absent or where differences in fares limit riders' ability to connect. At the end of the day, the regional transit map is not a replacement for integrated transit services.

Other regions that have faced this issue advise acknowledging at the beginning of the process that there will be limitations due to transit fragmentation but not allowing them to become a roadblock that compromises the purpose of the map. No one should assume that discrepancies in service or fares will be resolved through the map development process. A facilitator can help keep the project within scope and identify how the regional transit map can honestly portray transit in the region without copious amounts of detail and notes; legibility should not be compromised. Because it will put the region's transit limitations on display, the completed regional transit map may very well provoke conversations about why these shortcomings exist and how they can be overcome.

- 5. Start small and scale over time.** The Chicago Transit Authority (CTA), working with the Illinois RTA to harmonize wayfinding, focused first on updating the neighborhood maps at their rail stations (see photo below). Some stations had these maps and some didn't; the map design styles weren't consistent and the maps didn't show other operators' routes. While the RTA and CTA's to-do list was long, by starting with the redesign of the neighborhood maps, they could enjoy the success of accomplishing a discrete task and learn lessons to apply to future project phases.

Forest Park

Forest Park



The CTA updated the neighborhood maps displayed at transit stations to include the routes of adjacent operators. Updating the maps was the first step in a multiphase process to harmonize transit information across the Chicago region. Source: Graham Garfield, Chicago Transit Authority

Likewise, Metrolinx selected three multimodal hubs as pilots for their new regional transit map and wayfinding system. Feedback from the pilots will inform wider implementation, which is slated to begin when a new light rail station opens in the early 2020s. Like the CTA, Metrolinx is prioritizing learning and iterating by starting where there is interest and potential — and not necessarily with the busiest stations or largest transit providers — and scaling implementation from there.

Emerging Tactics and Technologies in Transit Mapping

The expectations of transit riders are shifting. Transit riders — in particular those who have grown up immersed in technology — expect dynamic, relevant and responsive customer communications like real-time service information or maps that adjust to reflect a street closure or service interruption. In response, transit operators and the cities they serve are embracing and harnessing a host of new technologies. to help demystify transit and provide additional value for riders.

Digital interactive maps at transit hubs

Transit operators are venturing into displaying maps digitally at transit stops and stations. New York Governor Andrew Cuomo identified improving the transit customer experience via modern amenities as a key component of his 2016 agenda. Modern amenities, according to the governor, are about “building the 21st century transit system New Yorkers deserve.” Over the last five years, New York City’s Metropolitan Transportation Authority (MTA) has installed over 300 interactive touchscreen “On the Go” kiosks at station entrances, mezzanines and platforms across 66 stations³⁸ The kiosks provide agency information (such as safety notices or service changes), advertisements, real-time train arrival countdowns, interactive transit maps, neighborhood maps and trip planning tools. Riders can drag the map to see their destination, and tapping any destination brings up directions for how to get there. (See photo below.) The map interface was designed to mirror how people interact with paper maps — touching where they are and then tracing the route to their destination.³⁹

The MTA entered into a public-private partnership with two private-sector partners to fund the design and development of the kiosks. The agency covered installation and maintenance costs and shares in advertising revenue with the partners.⁴⁰



Tapping any destination on an On the Go kiosk map brings up directions and highlights the fastest route to get there.

Source: *PC Magazine*⁴¹

³⁸ See: “8th Proposal of Governor Cuomo’s 2016 Agenda: Bring the MTA into the 21st Century to Dramatically Improve the Travel Experience for Millions of New Yorkers and Visitors,” 2016, <https://www.governor.ny.gov/news/8th-proposal-governor-cuomo-s-2016-agenda-bring-mta-21st-century-dramatically-improve-travel#top>. See also: “On the Go Network by Vendor,” http://web.mta.info/nyct/OntheGoAds/MTA_Kiosk_Ridership_OTG.pdf. Some have questioned if the enhancements are right for the region right now given the system’s maintenance and repair needs. See: Jamison Dague, “Is the Enhanced Station Initiative a Good Idea?,” *Citizens Budget Commission*, 2017, <https://cbcny.org/research/enhanced-station-initiative-good-idea>

³⁹ Mario Aguilar, “NYC’s Touchscreen Subway Maps Are Finally Here, and They’re Amazing,” *Gizmodo*, Feb. 12, 2014, <https://gizmodo.com/nycs-touchscreen-subway-maps-are-finally-here-and-the-1520953121>

⁴⁰ “On the Go Travel Station Network,” <http://web.mta.info/nyct/OntheGoAds/>

⁴¹ “MTA to Install Touch-Screen Maps in NYC Subways,” *PC Magazine*, March 20, 2013, <https://www.pcmag.com/article2/0,2817,2416861,00.asp>

In-car digital line map

New train cars include digital line maps (also known as “electronic strip maps”) that use LED lights to display the location of a train along its route. BART’s “Fleet of the Future” vehicles will have updated passenger information panels on 27-inch LED screens. The digital map will indicate the train’s direction and current location, dim stations that have been passed and highlight upcoming stations. (See photo below.) Digital line maps improve the passenger experience by helping riders gain confidence in where they are and where they are going.⁴²

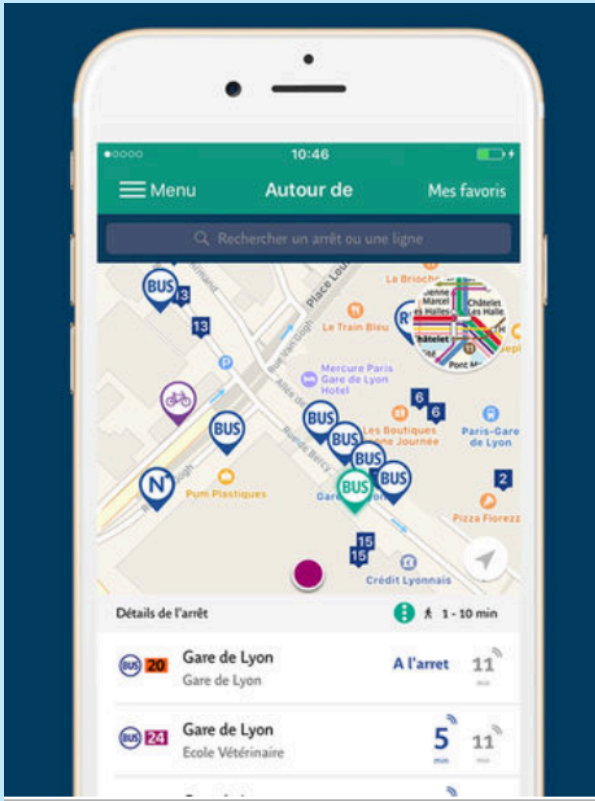


BART’s “Fleet of the Future” vehicles will have updated passenger information panels on 27-inch LED screens. Photo by Sergio Ruiz

⁴² Melissa Jordan, “Meet the Fleet: Passenger Information Systems Get a Big Upgrade on New Trains,” BART, March 29, 2016, <https://www.bart.gov/news/articles/2016/news20160329>

Transit maps optimized for smartphones

Several transit operators and private companies are developing transit maps optimized for use on a smartphone. For example, Next Stop Paris — the official app of the RATP, which operates the Paris metro as well as buses and suburban trains — includes maps of the metro and buses, a trip planning app, tourist information and more. (See image below.) The maps are available even without an internet connection, which is handy for people who do not want to be charged data-roaming fees, especially tourists.⁴³ On New York’s KickMap, an app that offers a redesigned, easy-to-understand map of the city’s subway, users can scroll, zoom and pinch the map or access trip planning information. The app offers different maps that show day service and night service. Like the RATP app, the KickMap app works without an internet connection.⁴⁴



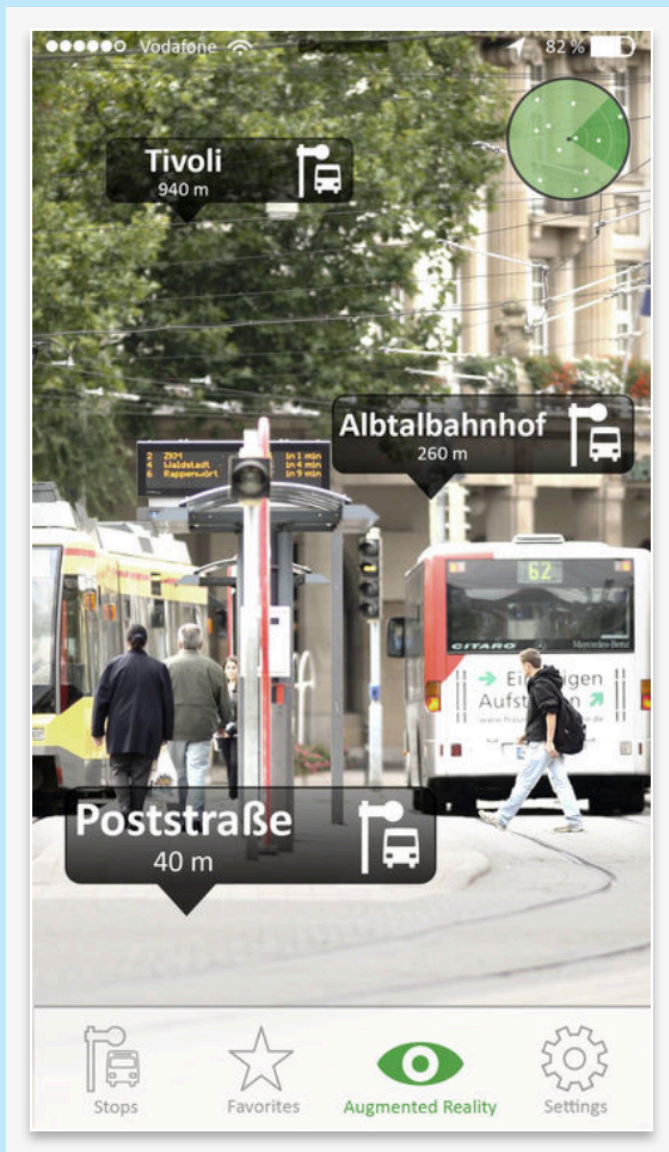
The Next Stop Paris app includes bus and subway maps optimized for use on a smartphone.
Source: Apple Store, “Next Stop Paris – RATP”

⁴³ For more on Next Stop Paris, see: <https://www.youtube.com/watch?v=LrCoCTTY58>

⁴⁴ For more on KickMap, see: <http://kickmap.com>

Augmented reality

Advanced technologies like augmented reality (AR) are emerging as a tool to simplify transit systems and networks. AR uses a smartphone's GPS, cameras and motion sensors to overlay digital imagery on what a person sees.⁴⁵ The lines between the physical and digital worlds are, in effect, blurred, and the smartphone becomes an intelligent guide, revealing customized directions, interactive maps, nearby bikeshare stations and bus stops, along with real-time arrival data or bus schedules. There is great potential for AR, because it supports simplified and personalized transit information to make it easier for people to understand and access transit.⁴⁶ It remains to be seen how, and how fast, it will be adopted, in particular by the public sector.⁴⁷



The DEPARTURESlive trip planning app, developed by Innovations in Transportation, uses augmented reality to provide the user with live views of all the nearest stops, live departure information, arrival and departure alerts, pedestrian navigation and more. A screenshot of the app in use in Cologne, Germany. Source: INIT

⁴⁵ A well-known example of augmented reality is the smartphone game “Pokémon Go.” See: Nick Wingfield and Mike Isaac, “Pokémon Go Brings Augmented Reality to a Mass Audience,” *New York Times*, July 11, 2016, <https://www.nytimes.com/2016/07/12/technology/pokemon-go-brings-augmented-reality-to-a-mass-audience.html>

⁴⁶ Civic Connect, “Augmented Reality in Urban Mobility,” May 2016, http://civicconnect.com/wp-content/uploads/2017/01/Augmented-Reality-in-Urban-Mobility_05.11.16.pdf; and Krish Kupathil, “Augmented Reality in Public Transport: An Effective Channel to Deliver Information the Traveler Needs,” *Mass Transit*, Dec. 12, 2016, <http://www.masstransitmag.com/article/12265322/augmented-reality-in-public-transport-an-effective-channel-to-deliver-information-the-traveler-needs>

⁴⁷ Deloitte, “Augmented Government: Transforming Government Service Through Augmented Reality,” 2016, <https://www2.deloitte.com/us/en/pages/public-sector/articles/augmented-government.html>

Recommendations

The purpose of SPUR's recommendations is to provide guidance to MTC and transit operators as the Regional Transit Maps Project moves forward.

Recommendation 1: Develop a cohesive regional transit map and a supporting suite of maps that depict the region's transit systems.

Who: MTC, transit operators

While sophisticated mapping technology makes it possible to develop multiple maps, including maps at different scales, the region should not forgo the opportunity to develop a single, universal transit map that is widely known and understood. Uniting all the region's transit into a single map will be a challenge, but places like London, New York and Paris demonstrate that it is possible and worthwhile. The program should also create sub-regional maps and other maps with specific purposes, such as a map that shows only regional transit routes (i.e., those routes that cross a county line) or a map that shows only routes that offer a certain level of frequency. A tourist planning a trip to the Bay Area or a new rider curious to know whether transit can take her to her new job shouldn't have to look at dozens of operators' maps to understand how transit works in the Bay Area.

MTC and transit operators should keep in mind that the regional transit map a rider folds out at home or explores online does not have to be the same as the regional transit map displayed at a transit stop. The principle of "progressive disclosure" recommends presenting people with only the information they need at any given time rather than overloading them with more than they can take in.⁴⁸ The regional transit map displayed at a transit stop could provide a global perspective, whereas the regional transit map a rider looks at home, whether in print or online, should have the greater level of detail needed to support learning about the region's transit options.

A transit map is, ultimately, a set of key choices, and these choices are the most important — and often the most difficult — to make before designing a transit map. To guide the development of the regional transit map, we recommend that MTC and transit operators consider the following questions provided by the consultancy firm Jarrett Walker + Associates, which is recognized for its expertise in transit mapping:

- What is the role of the map in the public information system?
- If distinctions among services are shown on the map, what are they? Why show those distinctions and not others?
- How should detail and accuracy be traded off against clarity and ease of use?
- Should each agency's service be shown? How?
- How should the maps be published, displayed and distributed?

⁴⁸ City ID, "Interconnect: Improving the Journey Experience," http://www.cityid.com/assets/publications/interconnect_improving_the_journey_experience.pdf

Recommendation 2: Develop a regional transit network brand.

Who: MTC, transit operators

A strong brand can create a sense of consistency, continuity and trust, and in the world of public transit, trust is critical. Without trust in the system, people are less likely to choose transit and more likely to drive instead.

Regional transit information is currently branded with an “i,” an international symbol for “information.” MTC should retire the “i” brand and work with transit operators to develop a distinct regional network brand. The “i” signifies to the rider that they can find information, whereas a regional network brand would offer much more. A regional network brand would be a symbol of interconnectivity with the regional network and, above all, a mark of high-quality, coherent, clear and consistent transit information. It would provide reassurance to riders that they are accessing trusted information.



Bay Area transit brands: Each transit operator in the Bay Area has its own brand, as does the 511-transit information system and Clipper. The Bay Area needs a single recognizable identity that speaks to transit users at a regional level in order to make connections easier and more intuitive. Source: City ID

The regional network brand should be simple, recognizable and memorable. It should rise to iconic status. The brand should be featured across all touchpoints in the transit system, from on-street signage to printed material to digital media. To achieve this aim, it is imperative that the regional network brand not simply be a symbol or letter, but something that is meaningful to riders and operators. MTC and transit operators should be careful when developing this brand to not add yet another brand to the existing cacophony of brands. One idea would be for Clipper or 511 to become the regional network brand, since they are already regional brands with regional recognition. As part of this process, MTC should also identify which brands could be retired.

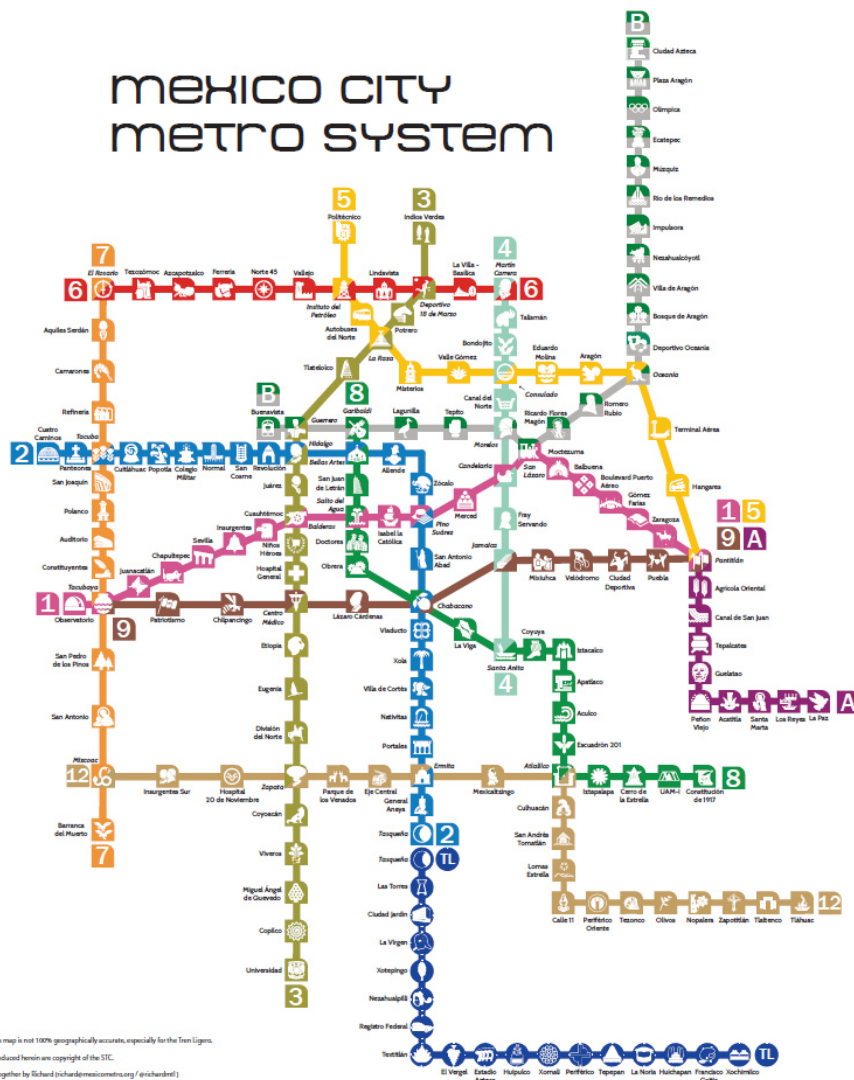
Recommendation 3: Streamline existing terminology and establish a glossary of terms and symbols.

Who: MTC, transit operators

Harmonization requires more than just coordinating visual styles. It also requires aligning the terminology, codifications, symbols and naming conventions transit operators use to describe their services. Currently, each transit operator has different definitions and terminology. For example, a “local” service in one area might only run for a few hours a day, but “local” could mean around-the-clock service in another area. Likewise, a “regional” service in one area might run during commute hours only, but in other areas it could run all day. Services that cross a county line during commute hours are referred to by a range of names, including “express,” “regional” or “Transbay.” It can be challenging

for riders, and in particular for visitors, to decipher operator-specific nomenclature and terminology. There are also instances of duplicate route numbers — places in the region where different bus routes with the same number, operated by different agencies, serve the same stop. This causes confusion for riders.

MTC and transit operators should collaborate with design experts to develop consistent terminology, codifications, symbols and naming conventions, striving for recognizable terms that can be used uniformly across the region. In some cases, icons may work better than words. For example, Mexico City’s metro system uses icons to identify metro stations because icons are intuitive and easy to understand, even for those who don’t know Spanish. Customers must trust that a term used in one service area means the same thing that it does in another. The goals of the effort should be to eliminate redundancies and excess terms and phrases and to develop a set of terms and symbols that is unambiguous, make senses to the widest audience, translates into other languages easily and does not require specific knowledge of an operator’s processes.



Mexico City’s metro systems uses icons to identify metro stations. Source: Mexico City Metro System

Recommendation 4: Establish a GIS-based shared software platform for creating transit maps.

Who: MTC, transit operators

SPUR's research found that for many of the region's transit operators, developing and updating transit maps is a laborious experience, one that requires a lot of time and resources as well as a specific skill set. Many transit operators struggle to update their maps for major events and temporary service changes; these tasks often stretch internal resources and leave riders without information. Because each agency makes its own maps, the region is missing opportunities to leverage economies of scale and identify and share best practices.

Regional transit mapping should be institutionalized and coordinated from a central point. Technology and design have evolved to the point where it is possible to create a GIS-based mapping platform that can scale up for a large number of end-users and products. While it is not yet feasible to develop auto-generated maps that are fully designed and aesthetically pleasing, much of the process can be automated. A mapping platform (see image below) would support consistency in mapping and provide transit operators with the means to create different map products, including both customer-facing maps and internal maps for planning purposes. Transit operators would continue to have ownership over their own data and maps, but it would be easier for them to make maps and to ensure that their maps meet the regional transit mapping design guidelines. The mapping platform would further support the development of a dynamic digital regional transit map that could be scaled up for a regional overview, and down for a more detailed look at routes.

A regional transit mapping platform could save the region money (because the operators would consolidate their mapping resources) and could improve planning and communication. Ideally, such a system would allow transit operators to populate the database with route changes and line additions, saving MTC the trouble of trying to keep on top of ever-changing routes and schedules, as AC Transit currently struggles to do to update the maps for the Hub Signage Program. By being able to automatically incorporate changes, the platform would ensure the longevity of its maps.

Other regions have developed a central, constantly updated mapping database that is a master tool, capable of supporting the creation of maps, wayfinding and other signs: London did so to support Legible London, its pedestrian wayfinding system, and Toronto is in the process of developing a mapping database to support the city's new wayfinding system, Toronto 360.⁴⁹

To establish a regional mapping platform, MTC should work closely with transit operators to identify governance and maintenance structures and to develop systems for technology and data needs. Maintaining a regional platform should get dedicated attention. For the Hub Signage Program, AC Transit has developed a system for sharing schedule changes and updates, but it is not foolproof. Sharing updates and changes to

⁴⁹ Toronto created the Toronto 360 (TO360) Wayfinding Strategy in 2012. TO360 provides consistent wayfinding information through a unified signage and mapping system. For more information, see: City of Toronto, "Toronto Wayfinding Strategy," <https://www.toronto.ca/services-payments/streets-parking-transportation/walking-in-toronto/wayfinding/>

schedules and routes requires a robust system, either automated or through in-person meetings. Transit operators should agree to align their schedules for adjusting and updating their maps so that multiple changes can be made at the same time. It is important to consider if any laws or MTC funding allocation specifications would need to be changed or adopted to support this.

Recommendation 5: Pursue digital maps at transit hubs — after developing great static maps.

Who: MTC

Several transit agencies are starting to place interactive digital touchscreen displays at transit stations. These displays allow the transit operator to develop and maintain the customer relationship — as opposed to outsourcing data to a third party to use in an app or website, as is the case with most trip planning tools. These digital displays also fulfill a placemaking function, helping make transit stops and stations friendlier and more appealing places.⁵⁰ In the current model, most of the software development, installation and maintenance costs are covered by a third party, and the transit agency shares in the revenues from advertising. This arrangement has enhanced the appeal of digital touchscreen displays among transit operators.⁵¹

But touchscreen maps are not a replacement for paper maps. While multiple people can look at a paper map at the same time, a digital touchscreen is monopolized by a single person. Furthermore, the success of touchscreen maps depends heavily on the quality of the software.⁵² Most people already have a faster and less clunky digital concierge in their pocket. Investing in digital touchscreen maps at transit hubs should only be pursued once the region has great static transit maps and a set of design guidelines covering both digital and static maps.⁵³

At the same time, digital maps that can be updated in real time could save the region money and time. Not only would this eliminate the need to replace physical transit maps at hundreds of stations every quarter that updates are made, it would also allow for more instantaneous updates when there is a detour, a convention or major issue. Such maps, however, would need to be connected to the mapping platform and enabled for wi-fi, so they would not be a feature available to the Bay Area until the mapping platform is developed.

⁵⁰ David Block-Schachter and Beaudry Kock, “Bus Stops and the Future of Digital Placemaking,” *CommonWealth Magazine*, Aug. 30, 2017, <https://commonwealthmagazine.org/opinion/bus-stops-future-digital-placemaking/>

⁵¹ Several transit agency staff we interviewed for this project said they were reluctant to put agency funds toward digital displays. The potential for private-sector partnerships made the idea more appealing.

⁵² The MTA had to cancel the first version of its digital mapping kiosks because the touch screen was too clumsy and choppy. According to sources, the newer version is only marginally better as it requires a heavy pound or flick to make the map move. See: Mario Aguilar, “The Indestructible Touchscreen Kiosks That Will Take Over New York’s Subways,” *Gizmodo*, April 2, 2013, <https://gizmodo.com/5993221/the-indestructible-touchscreen-kiosks-that-will-take-over-new-yorks-subways>

⁵³ Here the airlines offer analogous experience. For decades, movie screens have been ubiquitous on airplanes. Many airlines are now removing the screens because they’re not worth the installation and maintenance costs given that the majority of travelers own some sort of personal screen device. See: Justin Bachman, “Your In-Flight Movie Screen is Going Extinct,” *Bloomberg*, Feb. 3, 2017, <https://www.bloomberg.com/news/articles/2017-02-03/your-in-flight-movie-screen-is-going-extinct>

Recommendation 6: Provide transit operators technical assistance on transit mapping.

Who: MTC

Transit operators that are shorthanded should be able to leverage resources from the region. Assistance from MTC would make it easier for transit operators to develop their maps and would support sharing of ideas and resources, outcomes that are beneficial to riders and transit operators alike. MTC should work with transit operators to prioritize opportunities and options for technical assistance.

SPUR's research found that many Bay Area transit operators would welcome assistance from MTC on transit mapping. Some of the suggestions for what MTC could do include:

- Host or provide funding for trainings on map development software such as InDesign, Illustrator or ArcGIS.
- Buy software product licenses that can be shared among transit operators.
- Help fund a third party to assist with the installation and maintenance of transit maps in the field.
- Support user testing and usability testing of transit maps.
- Create forums for transit operators to share best practices in transit mapping.

Recommendation 7: Secure funding and establish capacity to support regional transit mapping and wayfinding.

Who: MTC

SPUR's research found that while the Hub Signage Program has been an impressive achievement, it is stymied by its limited staffing and budget. To provide technical assistance to transit operators on transit mapping, to manage a regional transit mapping system and to continue supporting the development of maps and wayfinding for the new infrastructure the region is building, MTC will need to have multiple staff members dedicated to these goals and will need to secure funding to support their tasks and projects. MTC should staff a Regional Transit Mapping Program dedicated to developing a regional transit mapping system, fostering collaboration on transit mapping among transit operators and improving and enhancing existing maps. This program should be part of a mobility experience program that also focuses on other factors that impact the customer experience, such as a public transit fares and transit safety. Possible sources of funding include Regional Measure 3, State Transit Assistance Funds, Senate Bill 1 and the Transportation Fund for Clear Air.

Bay Area Transit Map Assessment

Background

In June of 2016, SPUR staff used Jarrett Walker + Associates' Map Assessment as a guide to assess the region's transit maps. The Map Assessment is a tool the consultancy uses to assess the purpose, need and design of agency transit maps. The purpose of this exercise was to better understand the ways in which the region's transit maps are similar and in what ways they diverge.

Introduction

Why is it so difficult for so many Bay Area travelers and commuters to navigate our regional transit system? To start, we have 27 transit agencies, each with its own schedules and unique maps. In addition, users must also decipher the varying fares and methods of fare collection. These obstacles may deter one from using transit to get to work, school or to explore new places. Creating standards for our region's maps is a necessary step in creating a more simple and efficient regional transportation network.

Before creating unifying standards, we must understand the current situation. For this reason, we completed an assessment of local transit maps. This memo will explain our process.

Others have studied the Bay Area's fragmented transit network. SPUR's 2015 report *Seamless Transit* describes the many challenges users face; a dearth of information on completing a multi-operator trip, poor station design and the many challenges in paying for the trip. Although the report tells us that our maps are inadequate, it does not describe each map's design and informational choices.

What makes an effective map? Jarrett Walker + Associates' Map Assessment includes transit maps from around the world. The massive differences, both aesthetic and technical, illustrate the difficult choices mapmakers face.

Methodology

To start, we downloaded high resolution pdf files of each transit map. Using the Map Assessment as a guide, we decided what metrics needed to be considered when creating a regional transit map. We then created a spreadsheet with the metrics broken down into four main categories:

- 1. Non-Transit Information**

This category covers all map details that are not directly related to transit
Metrics include: street grid, parks, waterways, places of interest and cycling infrastructure

- 2. Route Distinctions**

This category covers how the routes are illustrated on the map
Metrics include: route colors, destinations, frequency, vehicle type and handicap access, among others

3. Map Details

This category covers details of the map itself

Metrics include: detail vs regional view, geographic vs diagrammatic, scale and transfers, among others

4. Trip Planning

This category covers what trip planning features are included in the map

Metrics include: schedule, customer service number and real time departures, among others

Analysis and Recommendations

The analysis found massive variation between transit operator maps. It is clear that many difficult choices must be made when creating a transit map. These variances can be explained by a number of factors, including but not limited to:

- How extensive is a particular network?
- Whereas Petaluma Transit, with its low number of bus routes, can use a different color for each route and have an easy to read map, VTA's map would be intelligible using the same method
- How frequent do vehicles run?
- Does frequency change according to time of day?
- Does frequency change depending on the bus route?
- Is there high pedestrian traffic near transit?
- This may dictate how much pedestrian wayfinding to include on a map
- Do two or more agencies share a service area?
- How does an agency differentiate between modes?

Defining the key similarities and differences between our region's transit maps is a good first step. Now that the terms are defined, an analysis must be done to identify what information is most important and what can be left out.

See the results of SPUR's Bay Area transit map assessment at

<https://spur.org/transitmapassessment>

Interviews With Bay Area Transit Operators

Overview

To develop a deeper understanding of how Bay Area transit agencies approach transit mapping and more broadly, the customer experience, SPUR, in collaboration with partners, conducted research interviews with Bay Area transit operators as well as the Metropolitan Transportation Commission. Interviews were held at the transit operator's office and were typically conducted with the operator's marketing or communications staff and/or transit planners. We asked each transit operator the same 22 questions covering five topic areas: maps and design today; data and technology; coordination with other operators; policy and leadership; and user experience. Interviewees were also asked to describe their ideal mapping program and their desires and expectations for the regional transit map.

Transit operators interviewed

Operator	Date of Interview
AC Transit	3/8/2017
Amtrak	3/1/2017
BART	4/6/2017
City Coach	7/26/2017
County Connection	3/29/2017
FAST	4/13/2017
Golden Gate Transit	3/28/2017
LAVTA	3/21/2017
Marin Transit	4/12/2017
Metropolitan Transportation Commission	10/10/2017
Petaluma Transit	6/2/2017
SamTrans	3/9/2017
Santa Rosa City Bus	6/2/2017
SFMTA	3/29/2017
SMART	6/2/2017
Solano Express	7/26/2017
Soltrans	4/13/2017
Sonoma County Transit	7/6/2017
Union City	6/27/2017
Tri Delta Transit	3/29/2017
VTA	3/15/2017
VINE	4/13/2017
WETA	4/27/2017
WestCAT	6/2/2017

Interview Questions

Maps and Design Today

- What maps do you provide transit users with today?
- Who develops and maintains these maps?
- How often are your maps updated?
- How do you fund your mapping program?
- Do you have a design scheme for transit maps, transit information and transit stops/stations?
- If yes, how was this developed?
- What are your mapping challenges and opportunities?

Data & Technology

- What data do you use to develop your maps? How often is your data updated?
- What data and/or technology would improve your maps?

Regional/Local Relationship

- In what ways, if at all, do you coordinate your maps with those of other transit operators?
- How do you work with adjacent/overlapping operators on providing cohesive traveler information?
- What do you think of a Clipper as a regional information brand? 511? Other?

Policy/Leadership

- What are your ridership goals?
- What goals does your organization have to improve the transit rider experience?
- Does your board or leaders wish to grow transit ridership, increase transit usage, or improve the transit rider experience?

Users

- What information do you have about the information needs/preferences of your users/ nonusers?
- How do you segment your users?
- Are there particular types of travelers that you think need better maps and information?
- What user testing have you done with your transit maps/information?

Regional Transit Map Project

- Describe your ideal mapping program.
- What do you think is the role of a static regional transit map? A digital regional transit map?
- What issues, concerns or ideas do you have a re a regional mapping program?
- How would you/your agency like to be involved in the project?

Through research, education and advocacy, SPUR promotes good planning and good government in the San Francisco Bay Area. We are a member-supported nonprofit organization.

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