PART 3

Intermodal

Integrated Timed Transfer
A European Perspective

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Integrated timed-transfer (ITT) systems are starting up in Switzerland, Austria, and many regions of Germany. They distinguish themselves from regular timed-transfer systems, in which vehicles arrive at and depart from a station at approximately the same time to minimize waiting times for passengers, by integrating the timed-transfer systems of individual metropolitan areas into one complete public transportation system for a region. Very little has been written about ITT in the English language literature, and the purpose here is to close the information gap. The advantages and disadvantages of an ITT system are illustrated by discussing a concrete example. Technical and economic aspects of ITT are discussed. Terms such as "symmetry time" and "optimal minimum headway" are defined. Early results of ITT systems in Europe are reported. The applicability of ITT to North America is demonstrated with the example of the San Jose–Oakland–Sacramento corridor. The public transportation system in this area is currently disjointed, and the introduction of ITT would increase the usability of public transit.

One of the main buzzwords in transportation planning in Switzerland, Austria, and Germany is "Integraler Taktfahrplan," translated literally as "integrated fixed-interval timetable," or, for the purposes of this paper, integrated timed transfer (ITT) since this concept is an extension of the already well-known principle of timed-transfer (TT) scheduling. Fixed-interval timetables have great appeal to the public because they guarantee train service at constant intervals (e.g., every 30 min) throughout the day, and always at the same time past the hour (e.g., :17 and :47), which makes it easy to memorize the schedule. *Integrated* fixed-interval timetable means almost immediate connections when switching lines. An extremely rich literature is available on this subject in Europe, and the concept is being sold to the general public in broad advertising campaigns, touting the virtues of an "Allgäu-Schwaben-Takt," broadly translated as fixed-interval scheduling for the Allgäu-Schwaben region (of Southern Germany), or with other similarly appealing names in other regions. Yet very little information is available in the English language literature. The main goal of this paper is to bridge the information gap.

In 1932 the Dutch Railroad introduced a fixed-interval timetable on its entire network with optimal connections at certain hubs such as Zwolle and s'-Hertogenbosch. Before World War II, Britain invented the term "InterCity" for fast and comfortable long-distance trains running on fixed-interval schedules (*1*), a concept that is now used throughout Europe. These were important building blocks for the ITT. However, it was Switzerland that perfected the principles of the ITT (*2*), and similar systems in Austria and some regions in Germany are all based on the Swiss model (*3*). The architects of ITT in Switzerland are Samuel Stähli and Hans Meiner (*4*).

The basic idea of ITT is that trains, buses, boats, and other means of local and long-distance public transportation not only operate on a fixed-interval schedule, but also connect with each other in a way to minimize transfer times. That is accomplished with the establishment of certain hubs, not dissimilar in principle to airline hubs, at which all vehicles arrive and depart at approximately the same time. But while a major airline may have to contend in its scheduling with only one or two major hubs, a passenger railway optimally would establish an almost unlimited number of hubs. The goal behind this type of scheduling approach is to "blanket" the country with hubs in order to minimize transfer times at as many places as possible.

Note that to have a TT system it is only necessary to have one hub for a single mode; however, an ITT has many (20, 30, or even 100) hubs at which different modes arrive and depart at the same time. Furthermore, the phrase "integrated timed-transfer," unfortunately, does not include the notion of fixed-interval scheduling. There is no short English word like "Takt," which is also used to describe musical beat and conveys the notion of a constant stream of trains, or buses for that matter, at regular intervals. Since this word is so hard to translate directly into English, it is sometimes used without translation—for example, "Towards a European Taktfahrplan" (*2,5*). It is important to remember that ITT includes the notion of fixed-interval scheduling. As shall be seen later, integration is not possible without fixed-interval scheduling.

Switzerland provides a good illustration of the basic principles. Notice in Figure 1 how geography makes it possible for the hubs in the basic triangle Basel-Zürich-Bern to be about 1 hr apart from each other. In 2005 the approximate running times between these cities will be 55 min. But also notice that to integrate most of the other cities into this system, a ½-hr headway is necessary. This will be discussed in detail in a later section.

In summation, for a TT system only one hub is needed, at which vehicles of a single mode arrive and depart at the same time at least once a day. For an ITT system, it is necessary to have a multitude of hubs, blanketing a whole region, at which vehicles of all modes arrive and depart at the same time at fixed intervals.

ADVANTAGES

The backbone of long-distance public transportation in Germany consists of five lines of hourly InterCity trains that meet each other at five different hubs to exchange passengers. However, since InterCity trains arrive and depart at the same time only with other InterCity trains and not at the same time as InterRegio or local trains, Germany does not have a systemwide ITT. It is instructive to examine issues involved in the introduction of ITT in German long-distance traffic to better understand the advantages and disadvantages of ITT (*6*).

The advantages of the ITT are more obvious than its disadvantages. For this reason politicians often see it as a cure-all, which it

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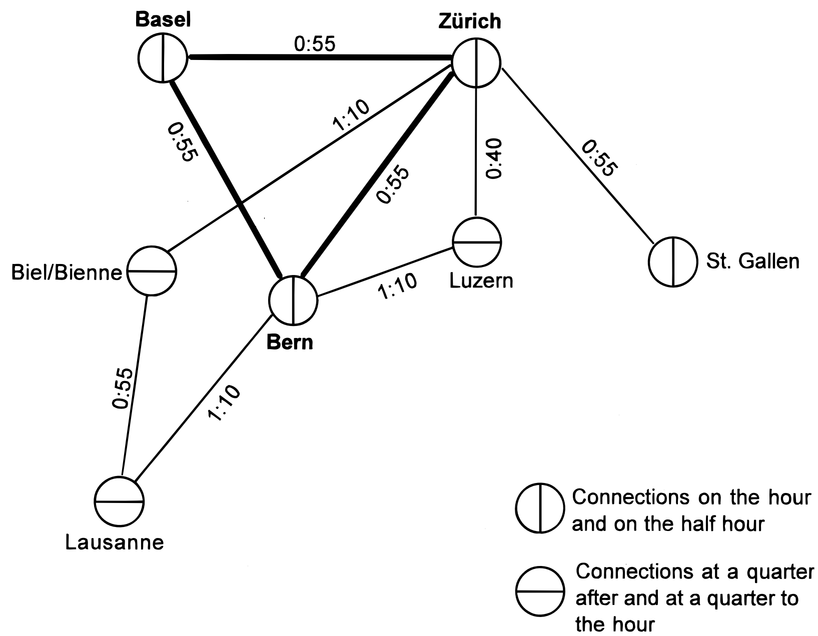

FIGURE 1 Illustration of basic principles of ITT scheduling—Swiss example.

certainly is not. To understand the advantages, consider two different surveys on what people consider important in long-distance travel [Table 1 (*7*)] and on why people use or do not use rail, [Table 2 (*8*)]. To summarize Tables 1 and 2, business travelers say rail is too slow, leisure travelers say it is too expensive, and both say it is not flexible enough. It is this complaint of lack of flexibility, in the sense of both more frequent service and better spatial coverage, that ITT addresses.

Figure 2 depicts a proposed bus stop sign that may also be seen as an invitation sign to get on board the ITT. The top line shows that the destination is Rastatt with connections to InterRegio and Metro trains. Every passing driver can tell, for example, that the first bus leaves weekdays at 6:17. If a passenger knows that the bus stop is 1 hr 13 min away from the nearest "megahub," (Karlsruhe, the hub where InterCity trains meet) and that Karlsruhe is exactly 3 hr away from Hannover, the passenger knows he or she would arrive in Hannover at 10:30 if he or she left from that bus stop at 6:17. This scenario assumes a certain amount of knowledge of the travel times and routes on the part of the traveler—an assumption that is not unrealistic considering the high importance given to public relations and advertising campaigns during the introduction of regional ITT systems in Germany (*9*). This bus stop sign makes passing motorists aware of their alternatives. It would begin to overcome one of their main objections: "I am not going where the bus goes." With ITT, passengers do not get on board only a single line, but a whole system.

Note that the bus stop sign in Figure 2 does not already exist; it is being proposed by the author. It is language-independent and could be used, as is, in every country in Europe. It could be easily adapted to North America by changing the 24-hr time into the a.m./p.m. format and by writing out the days of the week instead of denoting them by numbers (e.g., 1–4 would become Monday–Thursday).

Many routes that are unprofitable on their own may become profitable if integrated into a system like the ITT. Sometimes, a simple TT system might make routes feasible that otherwise could not be served. After the introduction of the hub-and-spoke system for airlines, many small communities received improved air service by being connected several times a day to a major hub with quick transfers to a multitude of domestic and international flights.

ITT is also a logical complement to high-speed rail service. It makes little sense to spend $100 million to cut travel time by 1 min, only to let passengers wait 40 min to connect to their destination stations.

DISADVANTAGES

With all its advantages, ITT does have serious disadvantages. In the Frankfurt region, 85 percent of all passengers per day per direction use the system during only 1.5 peak-hr. By design, ITT assumes a relatively uniform usage of the system throughout the day. With a simple pulse timetable, the headway can be easily adjusted to the demand, maybe every 60 min during off-peak hours and as often as every 5 min during peak hours. That is not as easily done with ITT, since it might require running a 30-min pulse all day in order to make the system work.

Another survey in the Frankfurt region showed that 70 percent of daily commuters never change trains. For these 70 percent the ITT would be completely irrelevant. If some trains were slowed down in order to make hubbing possible at certain points, it would even mean a downgrade of service for these commuters. Of course, the possibility should not be overlooked that the current percentage of commuters who do not have to change trains may be high only because, without an ITT, public transportation is not attractive enough for those who would have to transfer.

The introduction of ITT in Germany, Switzerland, and Austria often included enhancements such as regular service all day Saturday and Sunday on minor routes. With centralized train control, fixed cost may not increase significantly to provide this service.

TABLE 1 Significance Attributed to Different Service Categories in Long-Distance Travel, Business Versus Leisure Travelers (*7*)

Service Category	Business Travelers	Leisure Travelers
Speed	1	4
Temporal Flexibility	2	5
Spatial Accessibility	3	2
Station Accessibility	4	3
Reliability	6	10
Punctuality	7	9
Comfort	5	6
Information	8	8
Baggage Service	9	7
General Service	10	11
Fares	11	1
Safety	12	12

(1 = most important, 12 = least important)
Shaded service categories are specifically addressed by Integrated Timed Transfer systems.

TABLE 2 Reasons of Motorists for Not Using Rail (*8*)

	Multiple Responses	Single Response
Flexibility / Several Destinations	43%	31%
Baggage Transportation	33%	21%
Rail too Expensive	28%	15%
Rail too Slow	22%	7%
Generally against Rail	20%	9%
Transfers	15%	3%
No Station near Destination	12%	6%
No Station near Origin	9%	5%
Don't Know / Miscellaneous	3%	3%
		100%

Shaded reasons for non-use are addressed by Integrated Timed Transfer systems.

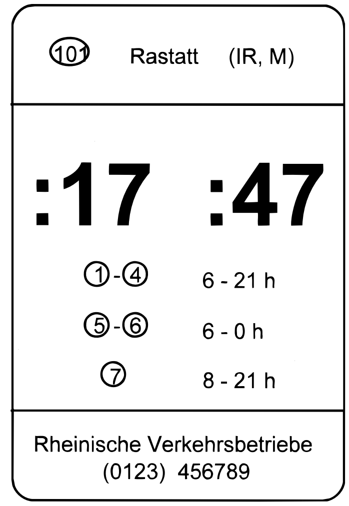

FIGURE 2 Proposed bus stop sign.

However, many of these minor routes were not well automated, which meant an increase in cost that could not be offset by increased revenues. In an extreme case the Austrian railroad had the following experience with its "Austro-Takt": 30 percent increase in service, 20.4 percent increase in cost, 11.5 percent increase in demand, and 6.8 percent increase in revenue (*10*).

ITT is not immune to the general disadvantages of TT systems. Schedule reliability is reduced, since a delay on a single line may have a "snowball effect" on all connecting lines. Experience with airline hubs shows that in case of a weather problem at a major hub, schedule reliability disintegrates.

The Achilles' heel of the ITT is that it does not use present facilities very efficiently—although, again, that is the case with any TT system. All vehicles descend on the hub at the same time, stay for only a short while, and then leave. The hubs are empty for the rest of the time. To continue the comparison with air travel, to make a hub-and-spoke system work, mega-airports like Dallas/Ft. Worth, Chicago, or Denver are needed; New York's LaGuardia is much too small. Many European rail stations could not simultaneously accommodate trains from every line passing through it. The only alternative is to operate the hub schedule in three waves. First wave: all trains terminating at that station drop off passengers and wait in a holding area away from the main terminal area. Second wave: all trains passing through the station as an intermediate stop exchange passengers. Third wave: trains from the holding area come back to the main terminal, pick up passengers, and start their return trips. The all-cargo airline Flying Tigers used a similar system at its temporary hub in Chicago before moving to its permanent facility in Columbus, Ohio.

Also note that the ITT is supply- and not demand-driven. First, it is important to figure out what kind of timetable with which pulse would make hubs possible in those cities where hubs are desired. That is a theoretical exercise. The second step is to find riders for the theoretical system.

One way railways have found to overcome these disadvantages is to use multiple units instead of locomotive-hauled trains. Multiple units can be easily combined and separated during the day to adjust to different demand levels. Another way is to use yield management in order to induce passengers to travel during off-peak hours. A third way is to realize that a 100 percent level of ITT implementation would be inordinately expensive and, therefore, to be satisfied with a lower level of implementation. Some minor routes in Switzerland are served only every 4 hr. That might mean some passengers traveling cross country from a station on one minor route to a station on another minor route might not be able to connect without waiting a substantial amount of time. That is unfortunate, but unavoidable for at least some travelers.

OPTIMAL MINIMUM HEADWAY

In a TT system with multiple hubs, a minimum headway needs to be maintained during all operating hours. Reducing the pulse below the minimum headway would mean that immediate connections would not be possible at some hubs. It is done only in extraordinary circumstances, as the example with the minor routes in Switzerland shows. The minimum headway of a TT system is also referred to as pulse headway (*11*), schedule module (*12*), or timetable module (*13*).

The main train categories in Europe are InterCity (IC) trains for long-distance travel [high-speed trains like the ICE (InterCity Express) belong to this category], InterRegio (IR) trains for regional travel, and local trains. Most countries have more than these three categories. Using a constant-interval timetable, trains of the same category always meet at the same time and at the same location. For example, InterCity trains running every 1 hr meet an InterCity train running in the opposite direction every ½ hr. The location where these trains meet is always the same. Symmetry time is defined to be that time when trains of the same category meet (*2*, p. 245; *14*). The symmetry time in Switzerland and Germany, for hourly trains, is minute :00 and minute :30. In the Netherlands it is :17 and :47. Note that trains from Brussels arrive in Amsterdam at :04 and leave at :30. The dwell time is 26 min, half of which is 13 min. Adding 13 to :04, or subtracting it from :30, gives the symmetry time :17.

Assuming an hourly pulse and symmetry times of :00 and :30, meeting points are located corresponding to a symmetry time of either :00 or :30, but not both. An important conclusion is that the time between hubs always has to be a multiple of half the minimum headway. With an hourly pulse schedule, hubs need to be 30, 60, 90 (and so on) min apart. Conversely, with a 2-hr pulse schedule, hubs need to be 60 min apart (symmetry time :00), or a multiple thereof. On the other hand, with a ½-hr schedule, there is the increased flexibility of locating hubs corresponding to four symmetry times :00, :15, :30, and :45. The importance of this increased flexibility can be illustrated with the following example.

Between Frankfurt and Hannover, ICE trains need about 2 hr, perfect for an ITT based on a minimum headway of as little as 2 hr. However, Kassel is an important regional center and an intermediate stop on this line. Unfortunately, ICEs take about 1:15 hr between Frankfurt and Kassel, and 45 min between Kassel and Hannover. If one is restricted to an hourly pulse with symmetry times of only :00 and :30, the only alternatives are to (*a*) speed up the trains between Kassel and Frankfurt to less than 1 hr (at a considerable expense in new line investment) and, at the same time, slow down the ICE between Kassel and Hannover, so it takes almost 1 hr, or (*b*) forget about making Kassel an ITT hub. On the other hand, with an ITT based on a ½-hr pulse and symmetry times of :00, :15, :30, :45, :00 and :30 could be used for Frankfurt and Hannover, and :15 and :45 for Kassel. So all trains would meet in Frankfurt on the hour and on the half-hour, and in Kassel at a quarter after and at a quarter to the hour.

Referring to Figure 1: if only Basel and Zürich were to be ITT hubs, the minimum headway would be 2 hr. To expand this to the triangle Basel-Zürich-Bern, a minimum headway of 1 hr is necessary. However, to include Luzern, Biel/Bienne, and Lausanne, the minimum headway needs to be 30 min.

The preceding examples illustrates an important trade-off that must be made:

- Increase investment expenses to accelerate trains so they fit into the mold of a predetermined pulse, or
- Increase operating expenses to cut the minimum headway in half.

On the basis of this trade-off, every system has an optimal minimum headway.

Arguably, the optimal pulse for Germany is 30 min. Almost all stations are already being served by two hourly InterCity lines, which means two InterCity trains per hour are already a reality in most parts of the country. Other train categories would need to be combined to make a ½-hr pulse possible. But this may create political problems. Combining train categories would mean that some communities would only be served by a lower-grade train category than they are now. Though seemingly trivial, this would almost certainly hurt their communal self-image and thereby cause political problems. The reader is reminded that after the introduction of the hub-and-spoke system, airlines abandoned their “milk runs,” and many medium-sized communities that previously received through jet service were downgraded to only be served by commuter flights to the nearest hub. The principle is clear: with a TT system, real small and real big communities are the winners, but some of the medium points may end up being losers.

Note that every hub needs a symmetry time, but not every symmetry time has a hub. In the previous example of ICEs between Frankfurt and Hannover, a 10:00 train leaving from Frankfurt would pass a train in the opposite direction at 10:15, 10:30, 10:45, etc., at full speed outside of stations. On the other hand, with local trains, as many symmetry times as possible should be used to blanket the country with hubs. With a 30-min minimum headway, a single-track line needs a siding spaced every 15 min. Every symmetry point then is a candidate for a hub also served by a bus line running perpendicular to the direction of the rail track. This makes spatial coverage possible.

The advantage of symmetrical train graphs is that operations can be analyzed and cost-effective solutions implemented for just one time period. The schedule repeats itself hourly, half-hourly, or whatever the period of the minimum headway is. If solutions are found for the peak schedule with the shortest headways, the rest of the day is automatically solved (*15*).

MINIMIZATION OF NUMBER OF TRANSFERS

It is important to note that while an ITT system is designed to minimize transfer times, it should also be designed to minimize the number of transfers. This is because passengers do not like to change vehicles en route. It is well known that there is a penalty associated with a change of trains in long-distance travel.

After the introduction of the TGV Atlantique, some conventional trains from Paris to Atlantic seaboard cities were replaced with a combination of high-speed TGV trains and diesel trains. Conventional trains have the advantage because at the end of the electrified line, the electric engine at the front of the train can be switched to a diesel engine. Passengers can stay on the train. On the other hand, if a TGV high-speed train set is used for the electrified portion, at the end of the electrified line, passengers must change from the TGV across the platform to a diesel train. Researchers have found the transfer penalty to be equivalent to between 40 min and 1 hr of in-vehicle time (*16*).

The German long-distance train timetable for the year 2000 was tested against an origin and destination matrix with 185,124 cells. The simulation showed that 61.6 percent of long-distance travelers never have to change trains, and 79 percent of those having to change only need to change once. This was made possible because of line switching. Even though the headway is 60 min, InterCity trains, for example follow the same route only every 4 hr (*17*).

ECONOMICS OF ITT

For a long time, transportation planners in Europe were faced with a downward spiral in public transit. In order to reduce subsidies, infrequently used services were cut. The decrease in service reduced ridership and revenues. Previously well used services were now underused, and the cycle began anew.

Switzerland's Rail 2000 concept, which was approved by the voters in a special referendum in December 1987, showed a way out of this dilemma. The basic idea is that, because of economies of scale and network effects, it is possible under certain circumstances to reduce public subsidy by increasing service.

Network effects can most easily be explained by an airline example. Adding one spoke to a hub-and-spoke system adds more revenue to the system than just the additional revenue generated by the origin-destination traffic between the end of the new spoke and the hub. New traffic will be generated between the new city and all of the points that the airline has been serving all along.

Economies of scale can be illustrated with the following example. The additional cost of adding service in the late evening or on weekends is considerably lower than that of adding the same service during peak hours. For new rush-hour traffic, additional vehicles would have to be purchased and maintained, while new service during off-peak hours can be provided with existing equipment. Magnifying the difference in economics between peak and off-peak services is the fact that most peak-hour travelers use reduced-rate tickets like monthly commuter passes or student discount cards, whereas most off-peak customers pay full fare. Summarizing the combined effect, it is claimed that, for example, the Series 628 diesel multiple unit with 15 passengers during off-peak hours is economically equivalent (in terms of marginal revenues minus marginal costs) to the same unit fully occupied during rush hour (*18*, p. 35). This shows the fallacy of trying to reduce subsidies by eliminating services during off-hours. In many instances the marginal revenue decrease will exceed the marginal cost savings and the subsidy increases.

Because of economies of scale and network effects, it is possible to reach a point from which marginal revenues exceed marginal costs and the subsidy decreases while service is being increased. In Switzerland, additional revenues covered only 73 percent of the variable cost of service improvements in 1991. Most recently, this ratio has increased to nearly 100 percent (*18*, p. 33). Substantial parts of the Swiss ITT system will not be operational until 2005, so the system is still far from reaching all its network effects.

Of course, there is a limit to how long service improvements will result in reduced subsidies. From a certain point on, increasing frequencies and adding spokes to a system will increase marginal cost more than marginal revenues. At that point the ITT potential has been exhausted (*18*, p. 34, Figure 1).

It is difficult to obtain exact statistics on the performance of ITT systems in Germany. First of all, the systems have been operating only in preliminary phases; in addition, passenger and cost figures are considered proprietary. The following information, though, is available from the literature: An introductory phase of ITT began operation in the southern part of Rheinland-Pfalz in May 1993. Service was increased by 37 percent, resulting in a 47 percent increase in passenger-kilometers and a 20 percent increase in revenue within 1 year (*18*, p. 34). The full effect of service improvements is generally not seen until after 3 years, so the first-year increase in passenger kilometers is encouraging. The increase in passenger kilometers over 2 years was 60 percent (*19*). ITT was expanded statewide in May 1995 and covered 80 percent of the state rail network by June 1996. Performance results of this expansion are not available yet. Regarding the first-year increase in revenue, it should be noted that German rail offered systemwide (not just in Rheinland-Pfalz) unlimited travel on weekends for up to five people on short-distance trains first for DM15 then for DM30 (about U.S. $20). This, unfortunately, confounded the performance results.

Most of the newly generated passenger-kilometers were the result of induced travel by people with limited access to the automobile (*20*). Since new phases of ITT in Rheinland-Pfalz will include significant travel time reductions, changes in modal split are expected.

POSSIBLE APPLICATIONS IN NORTH AMERICA

How important it is to include ITT in the planning and decision-making process in the United States is illustrated with an example from the San Francisco Bay Area. ITT clearly is not possible without intermodal stations. Yet, two brand new Amtrak stations have just been built in Emeryville and at Oakland's Jack London Square that do not interface with the region's primary rapid transit system, BART (Bay Area Rapid Transit). Amtrak operates three daily "San Joaquin" (Oakland-Bakersfield) and four daily "Capitol" (San Jose–Oakland–Sacramento) trains. Until recently, they passed only 100 m (300 ft) away from the West Oakland BART station. Here, BART's Richmond, Concord, and Fremont lines all merge onto the same track to run underneath the bay to San Francisco. Travelers cannot only catch a train to San Francisco every 5 min (!), they can also reach every single BART station from here without transferring. Yet, the new Amtrak station was not built in West Oakland. New stations were built 4 km (2½ mi) north at Emeryville, and 2 km (1¼ mi) south at Jack London Square in Oakland. The station locations were based on issues of urban renewal, not ridership analysis. Note that neither station is located anywhere near BART, and both stations are served by only a few bus lines.

Rail lines form the backbone of both the long-distance and local public transportation system in Europe. They connect the different hubs served by buses and other modes of transit in different cities. In North America, even many small and medium-sized urban areas have well-functioning public transit services. But the backbone, the skeleton of a public transportation system that ties all these distinct local transit services together into one whole public transportation system, is missing. In many instances, these intercity or interregional services may not be feasible because of low population densities. An ITT, even one based on a 120-min minimum headway, may not be desirable in those cases. However, it is the multicentered urban agglomerations like the Bay Area or the rapidly expanding, congested corridors like San Jose–Oakland–Sacramento, which the Capitols were supposed to serve, where ITT would improve the overall transportation system dramatically.

San Jose and Sacramento have gone through great pains to integrate their new light rail systems with their existing bus services. Yet, the Capitols do not connect with either the San Jose or the Sacramento light rail systems. In the San Francisco/Oakland/East Bay area served by BART, their only connection is in Richmond, at the northern end of the system. While it is fairly easy to travel *within* the San Jose, or Sacramento, or the San Francisco/Oakland/East Bay area, it is difficult to travel *between* them.

The result for potential passengers is that the Northern California public transportation system continues to be so disjointed that it is almost unusable for many interurban connections. Experience shows that people who do not already own an automobile have to rent one when they travel between Berkeley and San Jose. It is important to see this statement in the context of the 1994 Regional Transportation Plan projecting annual expenditures of $1 billion for mass transit operations (*21*). Note also that there are more than 30 independent public transit operators regionwide (*21*, p. 8).

The political basis for implementing ITT systems in Germany is entities called "Verkehrs-verbund," roughly translated as transport association, or transit federation (*22*). The first one was formed in 1965 in Hamburg (*23*). They are combinations of all public transit agencies in a given region, including all the local and regional services of the German railroad. It is these entities that decide fare levels and timetables. The customer deals only with one ticket that can be used on all public transportation modes in the entire region. For the passenger it is not apparent that the services are operated by different companies. Membership in this association is not always what the companies that provide the service would really prefer, since they obviously lose a lot of power to the higher entity. But all public operating subsidies and capital improvement funds are routed through these transport associations, so individual operators have to join. The transport associations provide the political framework in which ITT implementation is made possible.

The first steps in the right direction have been taken in Northern California. Effective January 1, 1997, 27 agencies are to work together to consolidate ticketing and telephone operations (*24*). They will also have to consolidate other services (e.g., eliminate overlapping bus routes). The bill authorizes the local metropolitan planning organization, the Metropolitan Transportation Commission (MTC), to withhold money from agencies that refuse to eliminate redundant services. The bill was strongly opposed by transit unions and some operators. Some opponents warned that a superbureaucracy would be created, usurping power from local districts. The bill certainly did not create a Bay Area Transit Federation. Passengers do not go to the MTC to buy tickets and timetables. It remains to be seen how effective the bill is in tying the different transit services together into one system and adding needed checks and balances to the system to make construction of white elephants like Oakland's Jack London Square station less likely in the future.

Also, a joint powers board (JPB) has been created to oversee the management of the Capitols and San Joaquins. BART is a member of this JPB and, as of March 1997, public hearings were being held on the future of these intercity trains. At that time, a final agreement between the state of California and the JPB had not been reached.

BART's membership in the JPB theoretically would make a future intermodal station at West Oakland more likely. However, in the meantime the Southern Pacific/Union Pacific track was moved much farther from the station to make room for the realignment and reconstruction of the earthquake-damaged Cypress Freeway. Another option for BART to serve the I-80 commuter corridor from downtown San Francisco in the same way that the Long Island Rail Road serves Eastern Long Island from Penn Station would be hard to implement because BART does not use standard gauge (1435 mm). BART's gauge (1676 mm) is wider than even that of Spain (1668 mm).

As a last point, note that in 1992 Amtrak carried 0.1 percent and intercity buses 0.6 percent of total passenger miles (*25*). The numbers indicate that there may be a point at which competition stops being effective. The animosity between Amtrak and Greyhound is reminiscent of U.S. railroads fighting each other for a shrinking passenger base some 50 years ago. Instead of working together to compete against automobiles and airlines, they decided to do everything on their own. History tends to repeat itself. Cooperation—for example, in a regionwide ITT system—may serve Amtrak's and Greyhound's customers and ultimately the operators themselves much better. Cooperation in ITT systems would give travelers for the first time in almost 30 years an alternative to renting cars for virtually any medium-distance trip away from home, and thereby increase the passenger base substantially. Amtrak does have its own feeder bus service, but the idea behind ITT is not for every competing company to operate its own feeder service; on the contrary, the idea behind ITT is to integrate the services of all agencies in a way that makes transfers appear seamless to the customer.

SUMMARY

Integrated timed transfer is a scheduling concept being introduced in more and more regions in Europe. It is applicable to large, multicentered metropolitan areas and heavily congested corridors in North America. Establishing German-style transit federations will most likely be necessary to create the political framework for ITT implementations.

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