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SUBJECT: Notes on Productivity and Coverage Scenarios

Attached three maps show hand sketches of:

- The existing FAX system
- A scenario that shifts focus toward Productivity
- A scenario that shifts focus toward Coverage, primarily by expanding the coverage area in response to stakeholder requests.

BACKGROUND: AN OVERTAXED AND MASSIVELY PRODUCTIVE SYSTEM

Fresno Area Express is a fantastically productive transit system with very little identifiably unproductive service. In the industry-standard measure of Boardings per Revenue Hour, it outperforms Portland's TriMet, San Jose's VTA, and Sacramento RT, *even counting the rail ridership of those agencies.*

Peer Comparison from 2012 NTD -- All modes Excl. ADA Paratransit

	PRODUCT- IVITY	DEADHEAD	INVESTMENT	RELEVANCE
	Boardings / Rev Hour	Rev Hrs / Veh Hr	Rev Hrs / Capita	Annual Boardings / Capita
Fresno	47.52	0.96	0.66	31.549
San Jose	30.46	0.92	0.73	22.153
Sacramento	37.79	0.94	0.79	29.866
Las Vegas	42.67	0.93	0.69	29.415
Portland	46.13	0.94	1.51	69.601
Bakersfield	23.03	0.97	0.64	14.801

In per capita terms, its level of investment – measured in revenue hours – is low except by the standard of smaller Valley cities like Bakersfield, and of course it is lower than all of these agencies except Bakersfield in terms of the level of capital investment, including rail in several of these cities, BRT in Las Vegas, and an overall level of amenity.

FAX's tremendous ridership arises despite a transit system that presents major barriers to mobility:

- *There are lots of routes, but not a network.* The prevailing frequency of the network is every 30 minutes, which is insufficient for the easy connections that make it possible to get from anywhere to anywhere in the network. While a few connections are timed, there are many cases where a customer may wait 25 minutes for the bus and then 25 minutes to transfer to another bus. A few key routes run every 20 minutes.
- In a city where many people are employed in service industries – such as retail and medical – that generate intense evening shifts, the system shuts down too early to be relevant to people who must work these shifts. Similar limitations apply on weekends. These span limits are a major issue requiring people to own cars.
- There are many issues of pedestrian circulation and safety around stop locations, most of them entirely outside the control or responsibility of FAX, and yet an important determinant of outcomes.
- The network naturally converges at two points where off-street transit facilities are needed: Fresno State and the River Park area. River Park is a matter of particular urgency, as the routes in that area cannot be organized for easy connections without some sort of facility.
- The downtown transit center imposes serious capacity limitations that impose inefficiencies on the operation. Most comparable cities have a considerably more functional facility at the heart of their network.

It is easy to imagine that FAX's ridership is the result of a massively dependent population that must use the service despite its minimal service levels. This might sound like an argument for locking in the current level of investment. In fact, transit-dependence, like wealth itself, is a spectrum. Most people have some choices and some limitations. Transit ridership responds well to incremental improvement, especially when crossing known thresholds of quality like the 15-minute frequency, because each such improvement moves a number of people across the threshold to where the service is now the best choice for them *in their circumstances*.

One of the key circumstances that drives transit use is car ownership. For a low-income family, reducing the number of cars owned can be financially liberating, but requires that transit be of a certain quantity sufficient to meet one family member's needs at all times of day. The effect on car ownership is one of the ways that incremental improvement in transit quality can profoundly affect ridership – and a city's sustainability outcomes -- over the long term.

In short, FAX's massive productivity should be evidence of success only if the goal is to carry people as efficiently as possible – though of course the most efficient transit system by that measure is none at all. If the goal is to liberate people's lives, create economic opportunity through access to jobs, support transit-oriented development, or achieve reductions in vehicle trips, the overall ridership – not just its productivity – is the primary measure. Fresno's path to a more sustainable and opportunity-rich future is not to push productivity any higher – after all, it's already higher than Portland's – but rather to grow the quantity of service judiciously while keeping productivity high.

SCENARIO SCOPING

The scenarios we have prepared show the consequences of moving the current network in one of two opposite directions within the constraint of existing resources:

- A Productivity Scenario cuts unproductive service and concentrates those resources where they would gain the most ridership, as additional frequency and span along the corridors where transit's potential demand is highest. This scenario does not expand the area of the network at all; in fact, the area contracts as unproductive areas are removed.
- A Coverage Scenario does the opposite. Responding to service requests from stakeholders – mostly for service around the edges of the service area – this scenario deploys more service to cover these areas. To pay for that, the network cuts frequencies on highly productive services. Because these are areas of low ridership potential (compared to the intensely productive existing system) the effect is that overall productivity goes down.

These scenarios are not as different as they would be in most comparable studies, because *there* is simply very little room to maneuver within the constraint of existing resources. The resources to expand coverage to the whole city limits do not exist short of cutting productive service to the point of overcrowding. Likewise, the resources to create a robust high-productivity network that would improve mobility for a huge share of the population also do not exist; while we have not dug into detailed scheduling, we find no evidence of waste.

PRODUCTIVITY SCENARIO (NO NEW RESOURCES)

The Productivity Scenario presumes that the main goal of the transit system is to serve as many people as possible given its resources. This is not merely a fiduciary goal. It also corresponds to touching as many lives as possible with service that is actually providing access to jobs and other opportunity. Maximum ridership also tends to correspond to maximum sustainability outcomes such as vehicle trip reduction.

Productivity at FAX is already astronomical for a city of its size. Still, a somewhat more productive system would be possible if this were the overriding goal. Productivity can be increased by:

- Deleting the least productive services and
- Adding service that, based on the agency's own experience, is likely to be highly productive.

Predictably high-productivity service takes the following forms:

- The service is frequent, usually every 15 minutes or better, which allows for easy connection and thus everywhere-to-everywhere travel, AND
- The service fits together into a network. This is primarily achieved by frequency – see above – but also by *clock headways* and where possible *timed connection*.
- The service runs an adequate service span – including evening and weekends – that it's useful for the 18/7 travel that most customers require. It is a common fallacy that easy savings can be had by cutting service at unproductive *times of day*. In fact, for a largely all-day demand pattern such

as FAX experiences, ridership at different times of day and day of week are highly interdependent. Because most transit customers need to use the service at two times of day, they cannot choose transit unless both times of day are served. That's why cuts to evening service routinely cause losses of ridership at other times of day. Likewise, a family can't choose to sell a car and rely on transit if they must commute five days a week including weekends, unless service works as well on the weekend days as on the weekdays.

- The network and schedules are as simple as possible.
- The above service features are focused on areas of high transit demand, signaled mainly by:
 - Density – How much activity is around each transit stop? This must be understood in aggregate over an entire proposed transit line, and for a band of 1/4 mile on either side. The density of a single parcel is of no relevance.
 - Walkability – How easy is it to walk out to a transit stop, and cross the street there?
 - Straightness – How straight is the transit path? Can a logical transit line link many destinations along what's perceived as a straight line, or are many deviations required?
 - Income. All other things being equal, income is also a factor. However, the built-form issues above are more influential than demographics in determining ridership.

This kind of high-productivity service can generate *voluntary transit-dependence*, in which people choose to own fewer cars – thus advancing their own economic circumstances – by relying on transit for a range of purposes. FAX service is mostly not adequate to really trigger these outcomes.

Specifics: Service Deleted

To achieve maximum productivity with fixed resources, the first step is to delete unproductive services so that resources are available to invest in more productive ones. The focus here is on *unproductive geographic areas*, NOT unproductive times of day or day of week.

NOTE: In this no-resource-growth scenario we deleted services that we would not delete if more resources were available. For example, we deleted Route 45, serving portions of West Herndon, Fruit, and East Ashlan. This route carries over 30 boardings per hour *which would be above average in San Jose or Sacramento*. In the context of FAX's system average of 47 boardings/hour, however, it's *relatively low* and it contains long segments with very little ridership. For that reason, a scenario attempting to push Fresno's productivity higher must delete it.

Also deleted were a range of unproductive *segments* of productive routes, as identified by stop-level ridership.

Deleted segments are services in this scenario are as follows. All have very low ridership (identified by stop-level data) and their deletion would therefore have a net positive impact on productivity. The number in parenthesis is the route number currently serving this segment.

- Shuttle to Childrens Hospital (58H)
- Shuttle to neighborhoods north of Nees (58)
- Herndon west of Palm (45)
- Ashlan east of Cedar and social service destinations around Clovis & Shields.
- All service along Fruit Ave. (45)

- Service along West Ave north of Dakota (22) including the current 22 loop via Barstow, Marks, Bullard, West.
- Malaga and Maple south of Church (41)
- South Walnut between Fresno and Jensen (38)
- Kearney Blvd and Eden St west of Teilman (30)

Most controversially, we deleted Route 28's direct links from Fresno State U to Manchester Transit Center and downtown. Unlike the other deletions listed above, this does not eliminate anyone's service but does require people to transfer who did not before. However, the main additions to the network, outlined below, are designed precisely to make transferring easier, especially the transfers on which FSU access relies.

Service Added: Core High Frequency Grid

The key idea of the service additions is the high-frequency grid. Where east-west and north-south lines both run every 15 minutes or better, it becomes easy to transfer wherever they cross for anywhere-to-anywhere access.

No FAX services run at this threshold frequency today. The only segments served even at a 20-minute frequency are Blackstone, First, Cedar, and Ventura, and apart from Ventura these are parallel and thus do not provide opportunities for grid connections.

The proposed network introduces 15-minute frequencies, but given the extremely limited resources must focus them strategically. In fact, in our opinion, almost *all of the remaining services in the productivity scenario would support 15-minute service with little loss of productivity*. In short, the grid network shows the path toward future investments that would attract vastly more ridership at the high levels of cost-effectiveness that are already being achieved.

The key frequency changes are as follows:

- Apart from the services deleted due to low ridership above, all remaining services run at least every 30 minutes all day.
- 15-minute all-day service is introduced on:
 - Blackstone between downtown and Nees
 - First between downtown and Nees, ending in the River Park area.
 - Cedar between Butler and Shaw (FSU)
 - Shaw between Brawley and Willow (FSU)
 - Shields between Hughes and Chestnut
 - Ventura between downtown and Peach
 - South Pottle/MLK/Fig from downtown to North St.

Service Added: Evening and Weekend improvements

To improve the ability of customers to rely on transit throughout the day and week, judicious changes to evening and weekend service are made:

- On the 15-minute corridors listed above, 30-minute service extends to 11:30 PM (contingent on review of paratransit costs)
- On weekends, all routes now running at 45-60 minute frequencies are standardized at 60 minutes so that connection patterns are consistent.
- All routes running every 15 minutes weekdays standardized to every 30 minutes weekends.

The next priority would be the extension of minimal Saturday and Sunday service to 11:30 PM.

Stop Respacing

The other key productivity-enhancing step taken in the Productivity Scenario is systemwide stop respacing, especially in more suburban areas where there are relatively few safe places to cross the fast arterials on which transit operates.

Like most transit agencies, FAX stops anywhere from 1/10 to 1/4 mile.

While everyone will defend the stop closest to their home, Fresno's stop-level ridership clearly shows that ridership is massively concentrated at the intersections of the 1/2-mile grid, and secondarily at 1/4 mile points. It is relatively rare to see multiple consecutive stops all with high ridership. It is quite common to see high-ridership stops and low-ridership stops closely interspersed. In suburban areas especially we believe this reflects partly the difficulties of pedestrian access to stops on fast arterials. Some stops in these environments are accessible to very few people. More commonly, stops on opposite sides of the street will occur where it is impossible to cross the street safely. Since most transit cannot be used unless it can be used in both directions, these stops border on symbolic; they are not actually useful for anyone's two way trip.

In the Productivity Scenario, a rigorous stop spacing standard is imposed, one that generally asks *a few people* to walk *further* to *faster service* with *better amenities*. The policy would be that:

- Standard stop spacing is 1/4 mile. Stops are always at the 1/2-mile grid intersections, with one stop between these intersections located at the safest location for crossing the street that is roughly midway between the other two stops.
- A key goal of this standard is not just increased operating speed and reliability, but to stop only where it is reasonably safe to cross the street.
- Exceptions are made when:
 - Serving a site with high senior or disabled needs.
 - Operating through a commercial district where the pedestrian is a dominant presence.
 - On streets where more frequent stop spacing is both safe (due to abundant safe places to cross) and will not impact speed because the bus never stops at most stops. This is an interim consideration requiring continuous review as ridership rises and more stops are served.

COVERAGE SCENARIO (NO NEW RESOURCES)

This scenario's goal is to respond to public demands for new coverage without increasing the total operating resources.

It is important to observe that in our opinion, none of the areas requesting service have the potential to generate productivity comparable to the high-demand parts of Fresno on which the Productivity Scenario focuses. This assessment arises from reviewing these areas in context of the known features of built form that are known to drive transit ridership, and which can be validated using Fresno's own ridership data.

For example, there are many areas comparable to West Herndon or to the neighborhoods north of Nees that could argue for new service. However, existing services in these areas perform poorly, and more importantly, the land use pattern – especially the relatively poor walkability – is a known indicator of low ridership for purely geometric reasons: without a regular local street grid, fewer people can walk easily to a bus stop, so transit has a smaller market.

Similar observations apply to the idea of expanding coverage in Highway City, or around Malaga or east of Clovis Avenue. All these areas are growing but (a) the aggregate density is low partly because the areas are only partly built, (b) the walkability is much less favorable to transit than in the core areas and (c) in some cases, notably Highway City, awkward circuitous routings are needed to cover the area effectively.

For that reason, given the high productivity of the existing system and the features of the areas requesting new coverage, *all coverage expansions should be presumed to be productivity reductions.*

The Productivity Scenario began, necessarily, by cutting low-ridership coverage. The Coverage Scenario, whose goal is expanded coverage despite low ridership, has no choice but to cut relatively high-ridership service.

Increased Role of Transit Centers

An important consequence of the Coverage Scenario is that transit centers – locations where many buses can meet for timed connections – become more critical to the functioning of the network. Timed transfer is more important as frequencies get worse, and low frequencies are a basic feature of a scenario that tries to cover more area without more resources.

The existing facilities at Manchester and downtown are heavily used, but in addition a critical one must be added in the River Park area where many major north-south lines reach their northern endpoint. This transit center would be very helpful in the Ridership scenario (and the existing system) but it becomes critical in the Coverage scenario because several feeder routes logically focus there.

Another site that becomes more important is adjacent to the Wal Mart near Shaw & Brawley. This site requires four routes to terminate in order to organize connections optimally. This can be accommodated with a modest on-street facility at the current layover site of Route 20.

Specifics: Service Deleted

To create resources for new coverage, the Coverage scenario cuts midday frequency from 20 minutes to 30 minutes on all of the current 20-minute services except Blackstone (30 north of downtown) and route 28, which covers East Ventura, Fulton/Van Ness, and the direct link from Manchester TC to FSU. In other words, we retain frequent service on the most productive route, and on major straight routes that are candidates for BRT.

A brief period of 20-minute service is retained during school peaks to handle overcrowding on First (34) and Cedar (38).

These cuts will cause significant ridership losses and may cause further incidents of overcrowding, but compared to other things that could be cut, these cuts will cause the least ridership loss and hardship.

A few other modest efficiencies are made:

- North First service (32) on longer ends in a large one-way loop north of Herndon. Instead, it ends in the River Park area. The senior citizen and medical destinations on that loop are served by revised feeder route 58.
- Route 41 Shields-Chestnut no longer extends south of Jensen Ave to Malaga. Instead, Malaga is served by a new route identified below.
- Route 9-Shaw's Highway City segment is replaced by an extension of Route 39-Clinton. This route is slightly streamlined to complement the newly added 60-Highway City route.

Specifics: Service Added

There are many ways that new coverage could be designed. However, because the goal here is basic access, and because all of the areas to be covered lack the conditions that drive high ridership on the core network, this scenario deploys hourly service in order to get minimal service to as many areas as possible. Another approach would be to offer a higher level of service to the new coverage areas, at the expense of not being able to extend any service to as many of them.

To maximize the amount of coverage provided, the network uses hourly service as the basic coverage tool. The areas covered are as follows:

- 45. The existing route is retained except that Fruit Ave service extends north to River Park TC and then onward to Childrens Hosp. The route's deviation southward goes only to Shields instead of McKinley. West Herndon is covered by new feeder route 50
- 50. New West Herndon feeder extending west from River Park TC to just past Blythe, replacing 45.
- 58. Revised NE feeder as two-way hourly loop, also replacing coverage to the senior and medical areas near Spruce & Milbrook and St Agnes now served by the 34 loop.

- 60 Highway City. New radial from downtown through neighborhoods west of Hwy 99 as far north as Bullard & Grantland, ending at Brawley & Shaw for connections to other services.
- 61. E Church St, between East and Chestnut. This radial route covers an area once served by Route 12, and continues south, replacing Route 41 to cover Malaga.

CONCLUSION

The Productivity and Coverage scenarios are both rough sketches of what might happen if the system were adjusted in either the Productivity or Coverage directions. Both are likely to be politically unacceptable, but are presented to help guide understanding of what is possible given the current constraints. The Productivity scenario increases productivity only by shrinking the coverage area further – cutting off remote social service and medical destinations who generate severe need but not high ridership. The Coverage scenario does the opposite, responding to most stakeholder requests only by cutting high-ridership service at the risk of further overcrowding and a net ridership loss.

There are a small number of improvements that are recommended regardless of scenario. These are:

- Capital improvements that would improve the efficiency and utility of the connections on which the network relies, notably expanded capacity at the downtown transit center and a transit center in the River Park area. Almost as important (for both ridership and efficiency of operations) is an off-street facility at FSU, although the university must lead on that issue. *What little "waste" there is in the current operations is the result of inadequate facilities.*
- Weekend service should be standardized to *clock headways*, so that connections occur on a consistent pattern. This means changing 45-minute and 50-minute headways to 60 minutes, if 30 minutes cannot be afforded. The memorability of repeating clockface headways tends to be of greater value to ridership than the minor increase in service quantity that these irregular headways represent.
- The presentation of the network – in maps and information materials -- should highlight frequency and the timing of connections. Uncertainty about connections and frequency are the primary barriers to understanding and having confidence in the FAX system.
- Some minor improvements in ridership could arise from reducing service to hourly on low-ridership half-hourly segments, and redeploying this service in more productive ways. For example:
 - Line 41 south of Church street could be replaced by an hourly route between Malaga and downtown, similar to the route 61 sketched in the Coverage scenario. This could be a possible no-cost response to the "restore Route 12" request. Malaga is a low-ridership area but would need to be queried re whether it values access to downtown more or less than to the Chestnut corridor.
 - Some streamlining in SW Fresno is suggested by the low ridership along the SW segment of Line 38, which follows Jensen and Walnut through this area. It may be appropriate to bring Line 38 into downtown on a higher ridership path, such as that of Route 34. It may even make sense to bring Line 38 into down on MLK/Pottle and extend Line 34 via Elm to replace the (high ridership) Ivy Center loop.

- Line 34 on North First needs to be extended to the River Park transfer area, so that it makes a connection with 58 and 58E, as well as with the other north-south services that are useful for local distribution in the northern area. To do this, look for alternatives to the Millbrook / Spruce / Herndon loop. This is a lower ridership area of Line 38, so Line 38 could be split with half of service going via Cedar & Nees to the River Park area and the other half via (as described northward) Cedar, L/Spruce, L/Millbrook, R/Herndon, R/Fresno to River Park.