Tracking the Deployment of the Integrated Metropolitan Intelligent Transportation Systems Infrastructure in Beaumont-Port Arthur, TX

FY04 Results

June 2005

For additional information, please contact:

Joseph I. Peters, Ph.D.
ITS Program Assessment Coordinator
ITS Joint Program Office, Room 3416
Federal Highway Administration (HOIT-1)
400 Seventh St., S.W.
Washington, D.C. 20590
PHONE: (202) 366-2202, FAX: (202) 493-2027
E-mail: Joe.peters@fhwa.dot.gov

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16. Abstract

This report describes the results of a major data gathering effort aimed at tracking deployment of nine infrastructure components of the metropolitan ITS infrastructure in Beaumont-Port Arthur. The nine components are: Freeway Management, Incident Management, Arterial Management, Electronic Toll Collection, Electronic Fare Payment, Transit Management, Highway-Rail Intersections, Emergency Management, and Regional Multimodal Traveler Information. Deployment is tracked through the use of indicators tied to the major functions of each component. In addition, integration of components is tracked through examining the transfer of information between agencies operating.

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Background and Purpose

In January 1996, former Secretary Peña set a goal of deploying the integrated metropolitan Intelligent Transportation System (ITS) infrastructure in 75[1] of the nation's largest metropolitan areas by the end of 2005.

> *"I'm setting a national goal: to build an intelligent transportation infrastructure across the United States to save time and lives, and improve the quality of life for Americans. I believe that what we do, we must measure . . . Let us set a very tangible target that will focus our attention . . . I want 75 of our largest metropolitan areas outfitted with a complete intelligent transportation infrastructure in 10 years."*[2]
>
> *-- former Secretary Peña, 1996*

In 1997, the United States Department of Transportation (U.S. DOT) initiated an effort to track progress toward fulfillment of this goal by conducting a survey of deployment in the nation's largest metropolitan areas. Traditionally, the product of a transportation infrastructure investment consists of a fixed asset such as a highway, bridge, or public transportation vehicle developed, constructed, or purchased by a single agency. Tracking the level of deployment for such traditional fixed assets can be accomplished by simply counting the number of such assets deployed. Measuring the deployment of the metropolitan ITS infrastructure is more complex because it consists of a set of systems, often deployed by multiple agencies, and integrated through a combination of complex institutional and technical arrangements. In brief, it is often difficult to simply count the number of systems deployed without first developing a measurement approach that captures the essential features of such systems in a consistent fashion across many deployment environments.

In order to track progress toward fulfillment of the Secretary's goal for deployment, the U.S. DOT ITS Joint Program Office developed the metropolitan ITS deployment tracking methodology. This methodology tracks deployment of the nine components that make up the Metropolitan ITS infrastructure: Freeway Management; Incident Management; Arterial Management; Emergency Management; Transit Management; Electronic Toll Collection; Electronic Fare Payment; Highway-Rail Intersections; and Regional Multimodal Traveler Information. Through a set of indicators tied to the major functions of each component, the level of deployment is tracked for the nation's largest metropolitan areas. In addition, the integration links between agencies operating the infrastructure are also tracked.

Data were gathered on deployment and integration in the 78 major metropolitan areas in 1997,1999, 2000, 2002, and 2004. However, ITS deployment in the nation's largest metropolitan areas, does not include coverage of deployments in medium sized cities and non-urban (rural) statewide areas. By doing so, the metropolitan survey effort misses important deployments and

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[1] Since former Secretary Peña's speech, the number of metropolitan areas that DOT will measure has been increased from 75 to 78. However, to maintain reporting consistency across the 10-year goal period, this report considers only the original 75 metropolitan areas.

[2] Excerpt of a speech delivered by former Secretary of Transportation Peña at the Transportation Research Board in Washington, DC on January 10, 1996.

falls short of presenting a truly national picture of the state of ITS deployment. During the spring and summer of 2002, the U.S. DOT undertook a new data collection effort for the purpose of examining ITS deployment progress in the nation's largest metropolitan areas and expanded the survey to include statewide and rural deployment as well as selected medium sized cities experiencing traffic management challenges due to rapid growth. Thirty medium sized cities were added to the survey effort.

The next section contains a summary of the results for the city of Beaumont-Port Arthur and for the nation as a whole. This is followed by detailed information on each infrastructure component for Beaumont-Port Arthur. Included in this report is a set of appendices containing tables with all the indicators, a list of local contacts surveyed along with a status of their response to the survey, and a summary of the data collected from the surveys.

Agencies are encouraged to review the data presented in this report for completeness and accuracy and to direct any comments or corrections to the contacts listed below:

Steve Gordon
Oak Ridge National Laboratory
P.O. Box 2008, 4500N, MS-6207
Oak Ridge, TN 37831-6207
(865) 576-8416 (voice)
(865) 574-3895 (fax)
gordonsr@ornl.gov

Jeff Trombly
Science Applications International Corporation
P.O.Box 2501, 301 Laboratory Road
Oak Ridge, TN 37831-2501
(865) 481-8563 (voice)
(865) 481-2941 (fax)
jeffrey.w.trombly@saic.com

Summary 2004 Survey Results

Component

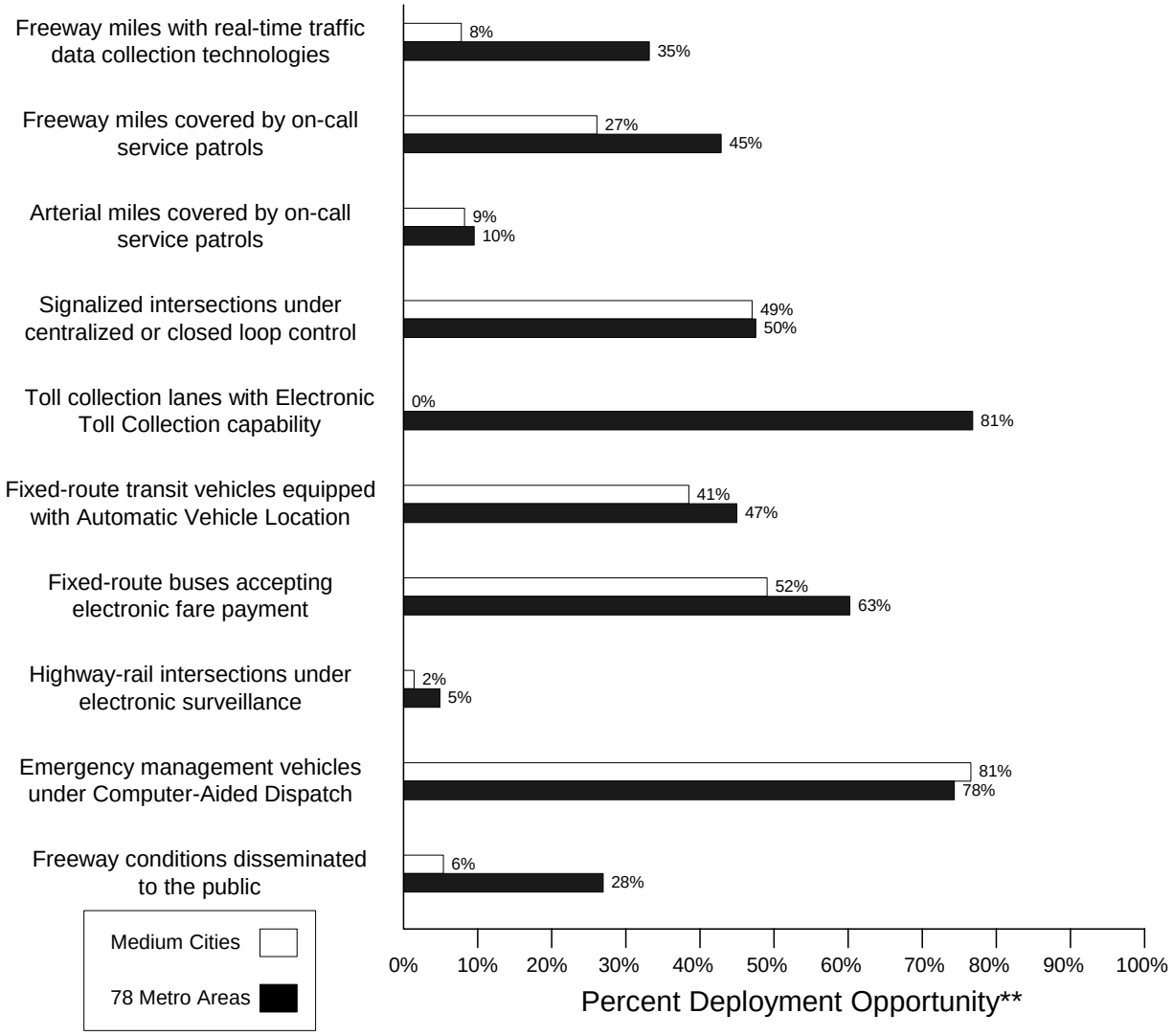
Deployment indicators have been developed for two broad areas of interest: (1) the individual components, including their basic functions and characteristics and (2) integration of components, including how these components work together to provide coordinated regional service. As mentioned earlier, these indicators are expressed as percentages of the possible deployment opportunity and not necessarily what should be deployed based on local needs. Requirements for deployment and integration between each component will vary based on local conditions and cannot be assigned without extensive coordination with individual metropolitan areas.

The following two figures portray the surrogate indicators for each of the nine components in Beaumont-Port Arthur and the same indicators at the national level. These are judged to be the single best representative of a component and are being used as summary indicators for each component. The summary indicators are expressed as a percentage; however, because deployment goals have yet to be established, these indicators should not be read as a comparison of what is deployed versus eventual deployment goals. Instead, they only reflect what is deployed compared to full market saturation (i.e., opportunity for deployment).

Each component indicator was selected to reflect a critical function of the individual components. For example, in the case of Freeway Management, three basic functions were defined: surveillance, traffic control, and information display. The three indicators developed to reflect these functions are: percentage of freeway centerline miles under electronic surveillance (surveillance function), percentage of freeway entrance ramps managed by ramp meters (traffic control function), and percentage of freeway centerline miles covered by permanent Variable Message Signs (VMS) or Highway Advisory Radio (HAR). The indicators are surrogates that do not necessarily reflect the full breadth of metropolitan ITS deployment activity.

Data are shown for each year surveyed and, in addition, an estimate for what the level of deployment will be in the year 2005.

Summary Indicators*



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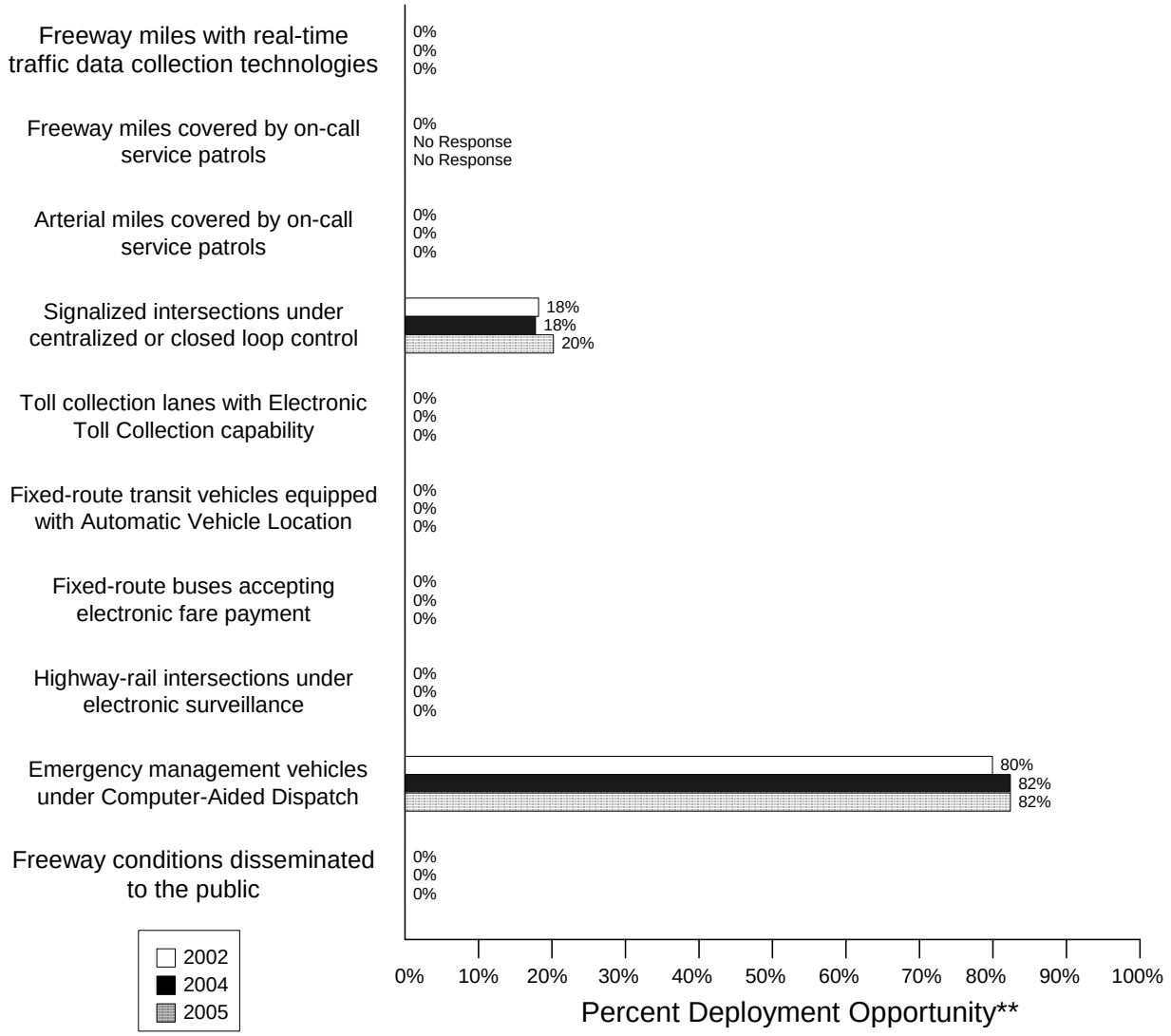
Beaumont-Port Arthur

Summary Indicators*



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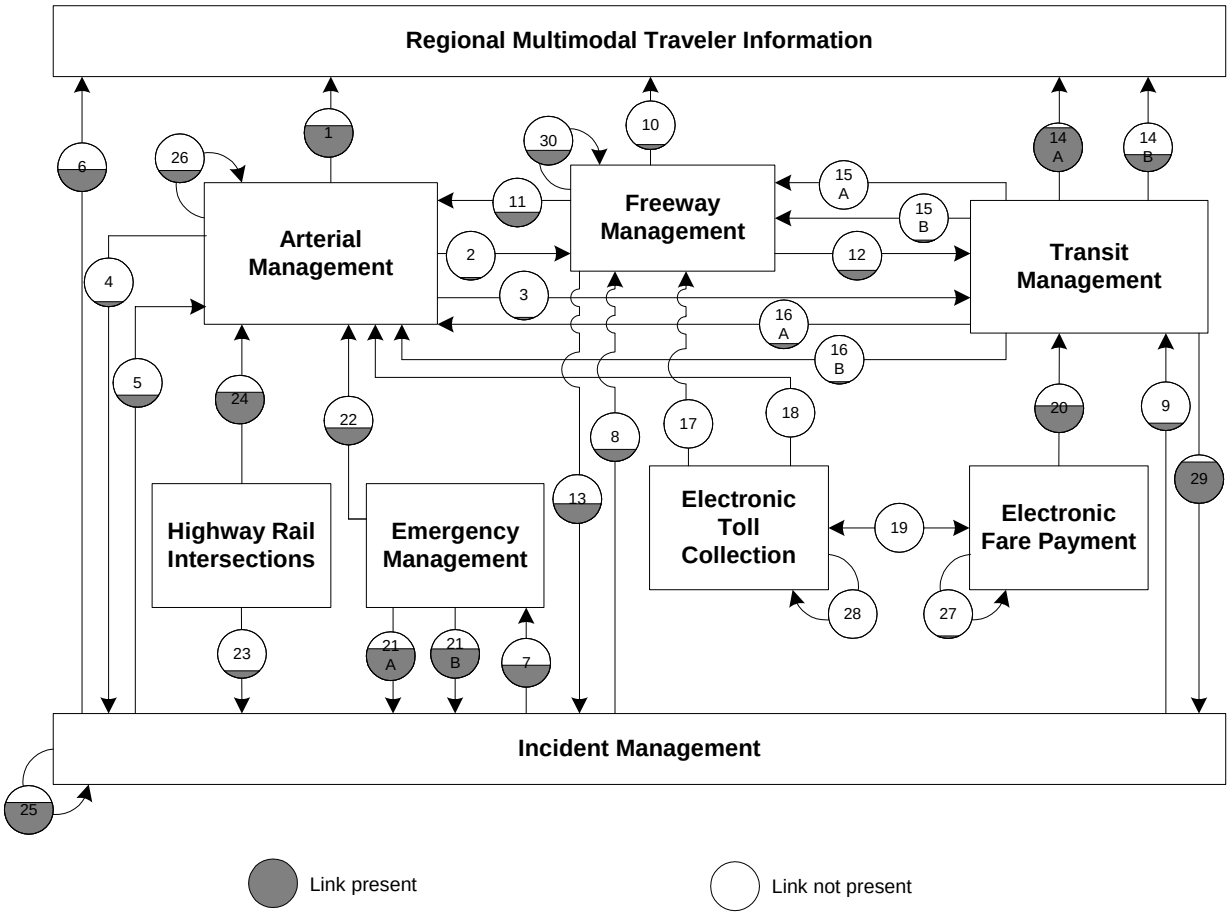
Integration

A critical aspect of ITS that provides much of its capability is the integration of individual components to form a unified regional traffic control system. The individual ITS components routinely collect information that is used for purposes internal to that component. For example, the Arterial Management component monitors arterial conditions to revise signal timing and to convey these conditions to travelers through such technologies as variable message signs and highway advisory radio. Other ITS components can make use of this information in formulating their control strategies. For example, Transit Management may alter routes and schedules based on real-time information on arterial traffic conditions, and Freeway Management may alter ramp metering or diversion recommendations based on the same information.

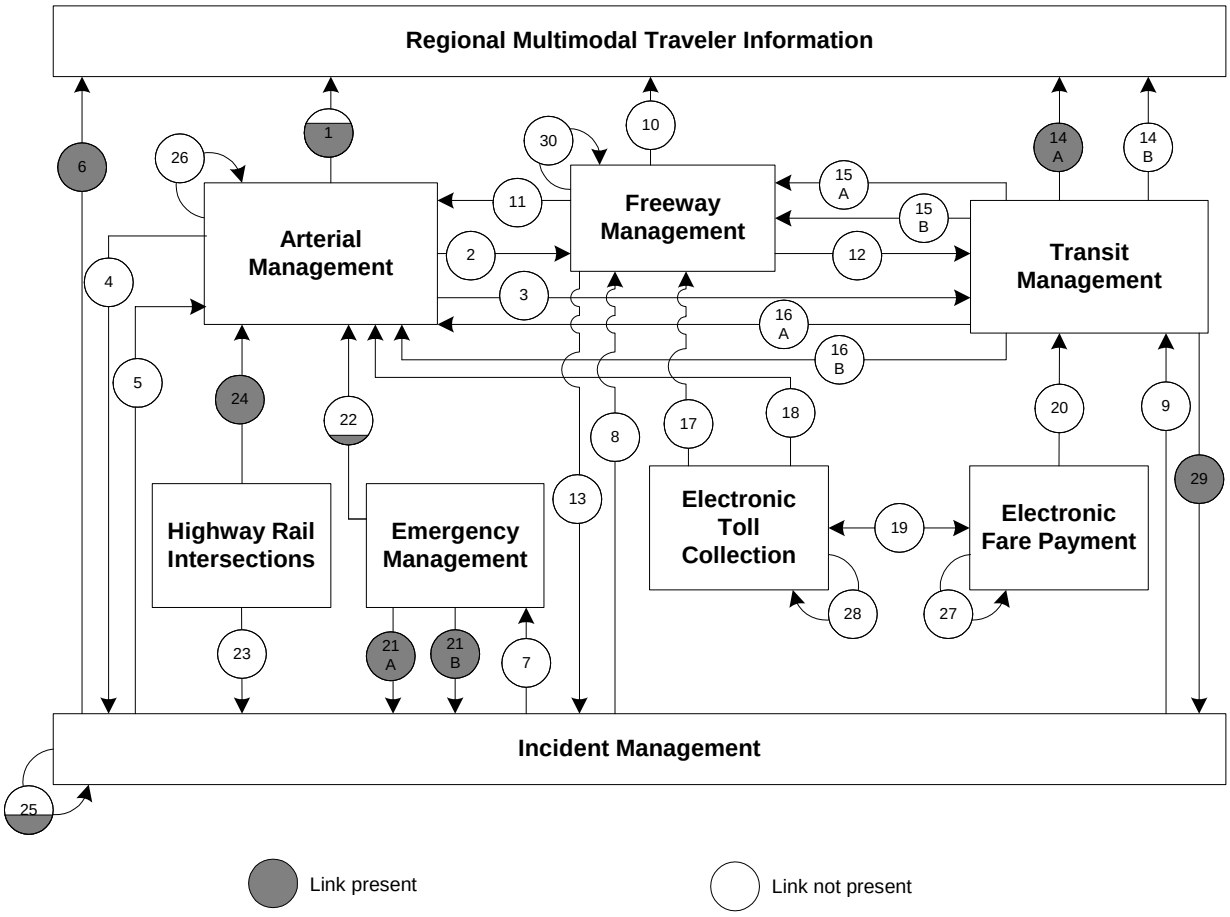
As with the component indicators, definitions for inter- and intra-component integration were developed for each component, and indicators, derived from these definitions, were produced for each component. A total of 34 individual integration indicators was specified and is portrayed in the third figure that follows. Each integration indicator has been assigned a number and an origin/destination path from one ITS infrastructure component to another. For example, the number “10” identifies the integration of information from the Freeway Management component to the Regional Multimodal Traveler Information component. The following two figures portray the national integration indicators and the integration indicators for Beaumont-Port Arthur as of 2004.

Medium Size Metropolitan Areas Integration Links



Note: Shading indicates the value of the link. For example a circle half shaded equals 50%

Beaumont-Port Arthur Integration Links



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Link	Description	Purpose
1	Arterial Management to Regional Multimodal Traveler Information	Arterial travel time, speed, and condition information are displayed by Regional Multimodal Traveler Information media.
2	Arterial Management to Freeway Management	Freeway Management Center monitors arterial travel times, speeds, and conditions using data provided from Traffic Signal Control in order to adjust ramp meter timing, lane control or HAR in response to changes in real-time conditions on a parallel arterial.
3	Arterial Management to Transit Management	Transit Management adjusts transit routes and schedules in response to arterial travel times, speeds, and conditions information collected as part of Traffic Signal Control.
4	Arterial Management to Incident Management	Incident Management monitors real-time arterial travel times, speeds, and conditions using data provided from Traffic Signal Control to detect arterial incidents and manage incident response activities.
5	Incident Management to Arterial Management	Traffic Signal Control monitors incident severity, location, and type information collected by Incident Management to adjust traffic signal timing or information provided to travelers in response to incident management activities.
6	Incident Management to Regional Multimodal Traveler Information	Incident location, severity, and type information are displayed by Regional Multimodal Traveler Information media.
7	Incident Management to Emergency Management	Incident severity, location, and type data collected as part of Incident Management are used to notify Emergency Management for incident response.
8	Incident Management to Freeway Management	Incident severity, location, and type data collected by Incident Management are monitored by Freeway Management for the purpose of adjusting ramp meter timing, lane control or HAR messages in response to freeway or arterial incidents.
9	Incident Management to Transit Management	Transit Management adjusts transit routes and schedules in response to incident severity, location, and type data collected as part of Incident Management.
10	Freeway Management to Regional Multimodal Traveler Information	Freeway travel time, speed, and condition information are displayed by Regional Multimodal Traveler Information media.

Link	Description	Purpose
11	Freeway Management to Arterial Management	Freeway travel time, speeds, and conditions data collected by Freeway Management are used by Traffic Signal Control to adjust arterial traffic signal timing or arterial VMS messages in response to changing freeway conditions.
12	Freeway Management to Transit Management	Transit Management adjusts transit routes and schedules in response to freeway travel times, speeds, and conditions information collected as part of Freeway Management.
13	Freeway Management to Incident Management	Incident Management monitors freeway travel time, speed, and condition data collected by Freeway Management to detect incidents or manage incident response.
14a	Transit Management to Regional Multimodal Traveler Information (static route information)	Transit routes, schedules, and fare information are displayed on Regional Multimodal Traveler Information media.
14b	Transit Management to Regional Multimodal Traveler Information (schedule adherence information)	Transit schedule adherence information are displayed on Regional Multimodal Traveler Information media.
15a	Transit Management to Freeway Management	Freeway ramp meters are adjusted in response to receipt of transit vehicle pre-emption signal.
15b	Transit Management to Freeway Management (transit vehicle probes)	Transit vehicles equipped as probes are monitored by Freeway Management for the purpose of determining freeway travel speeds or travel times.
16a	Transit Management to Arterial Management	Traffic signals are adjusted in response to receipt of transit vehicle pre-emption signal.
16b	Transit Management to Arterial Management (transit vehicle probes)	Transit vehicles equipped as probes are monitored by Traffic Signal Control for the purpose of determining arterial speeds or travel times.
17	Electronic Toll Collection to Freeway Management (ETC equipped probes)	Vehicles equipped with electronic toll collection (ETC) tags are monitored by Freeway Management for the purpose of determining freeway travel speeds or travel times.
18	Electronic Toll Collection to Arterial Management (ETC equipped probes)	Vehicles equipped with electronic toll collection (ETC) tags are monitored by Traffic Signal Control for the purpose of determining arterial travel speeds or travel times.
19	Electronic Fare Payment and Electronic Toll Collection	Transit operators accept ETC- issued tags to pay for transit fares.
20	Electronic Fare Payment to Transit Management	Rider ship details collected as part of Electronic Fare Payment are used in transit service planning by Transit Management.

Link	Description	Purpose
21a	Emergency Management to Incident Management (incident notification)	Incident Management is notified of incident location, severity, and type by Emergency Management for the purpose of identifying incidents on freeways or arterials.
21b	Emergency Management to Incident Management (incident clearance)	Incident Management is notified of incident clearance activities by Emergency Management for the purpose of managing incident response on freeways or arterials.
22	Emergency Management to Arterial Management	Emergency Management vehicles are equipped with traffic signal priority capability.
23	Highway-rail intersections to Incident Management (crossing status)	Incident Management is notified of crossing blockages by Highway-rail intersection for the purpose of managing incident response.
24	Highway-rail intersections to Arterial Management (crossing status)	Highway-rail intersection and Traffic Signal Control are interconnected for the purpose of adjusting traffic signal timing in response to train crossing.
25	Incident Management intra-component	Agencies participating in formal working agreements or incident management plans coordinate incident detection, verification, and response.
26	Arterial Management intra-component	Agencies operating traffic signals along common corridors sharing information and possibly control of traffic signals to maintain progression on arterial routes.
27	Electronic Fare Payment intra-component.	Operators of different public transit services share common electronic fare payment media.
28	Electronic Toll Collection intra-component	Electronic Toll Collection agencies share a common toll tag for the purpose of facilitating “seam less” toll transactions.
29	Transit Management to Incident Management (incident reporting)	Transit agency operators or dispatchers report traffic incidents (e.g. stalled vehicles, crashes) as part of an organized regional incident management program.
30	Freeway Management intra-component	Freeway travel time, speeds, and conditions data collected by Freeway Management agencies are used by other Freeway Management agencies in response to changing freeway conditions for the purpose of adjusting ramp meter timing, lane control or HAR messages in response to freeway or arterial incidents.

Detailed 2004 Survey Results

The following figures summarize the complete set of component and integration indicators developed for the Beaumont-Port Arthur metropolitan area. In some cases a decrease in deployment or integration over time occurs. This may be due to differences in reporting from year to year, agencies responding one year and not the other, or an actual decrease in the level of deployment. The figures summarizing the component indicators consist of a bar chart portraying the deployment levels for 2002, 2004, and 2005 estimates.

Example: Calculating Component Indicators for Freeway Management

Consider a metropolitan area with 100 miles of freeway and 25 freeway entrance ramps. The area has no ramp meters, 10 freeway miles for which traffic data are collected electronically, and 5 freeway miles, which are covered by highway advisory radio.

The component indicator for electronic surveillance is calculated as (10/100) or 10%.

The component indicator for ramp meter control is calculated as (0/25) or 0%.

The component indicator for HAR coverage is calculated as (5/100) or 5%.

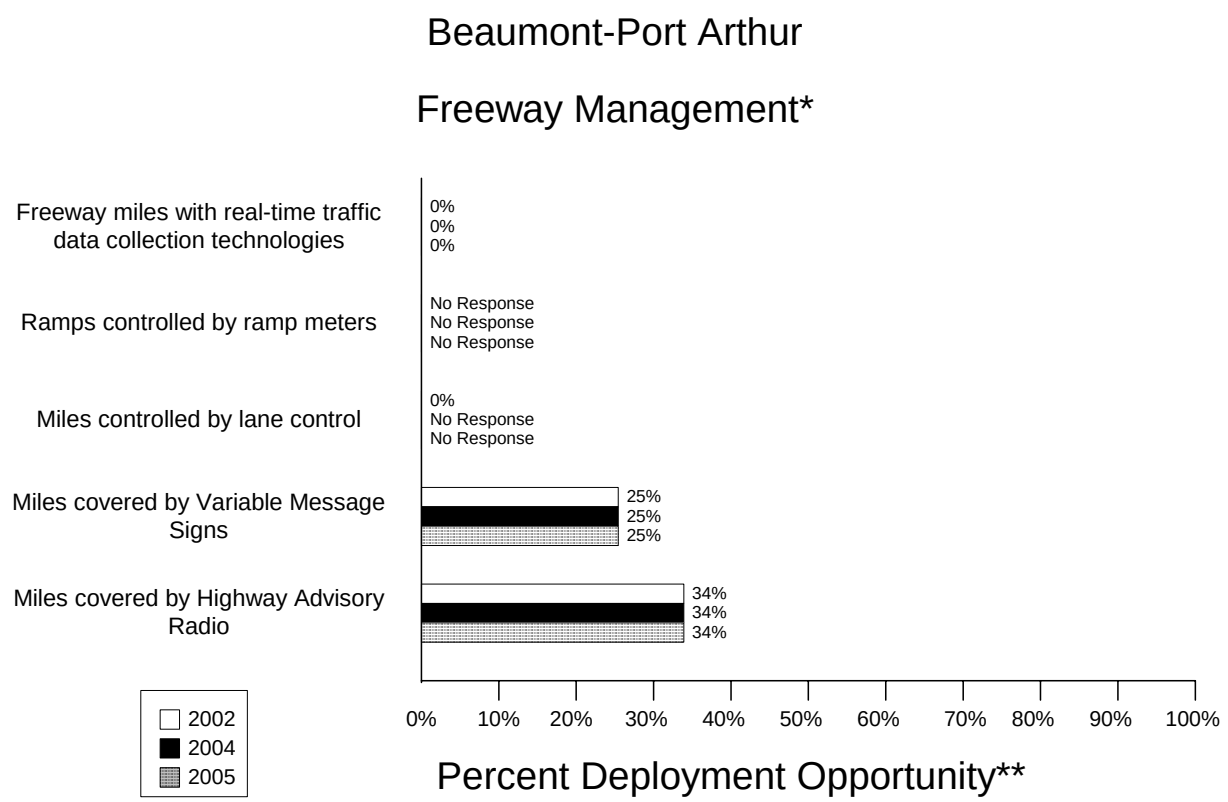
The summary indicator for the metropolitan area is calculated as (10%+0%+5%)/3 = 5%.

The figures summarizing the integration indicators consist of a diagram for each of the nine metropolitan ITS components portraying the integration level for 2004. Each diagram portrays the proportion of agencies providing information to a component (e.g., the flow of incident information from Incident Management to Freeway Management) and the proportion of agencies providing information from one component to other components (e.g., the flow of freeway travel condition information from Freeway Management to Arterial Management).

Example: Calculating Integration between Arterial Management and Regional Multimodal Traveler Information

Consider a metropolitan area with three arterial management agencies. One out of three provides information to the public using a Regional Multimodal Traveler Information Media (e.g., internet, kiosk, pager, etc...). The integration indicator is 1/3 or 33%.

Freeway Management Components



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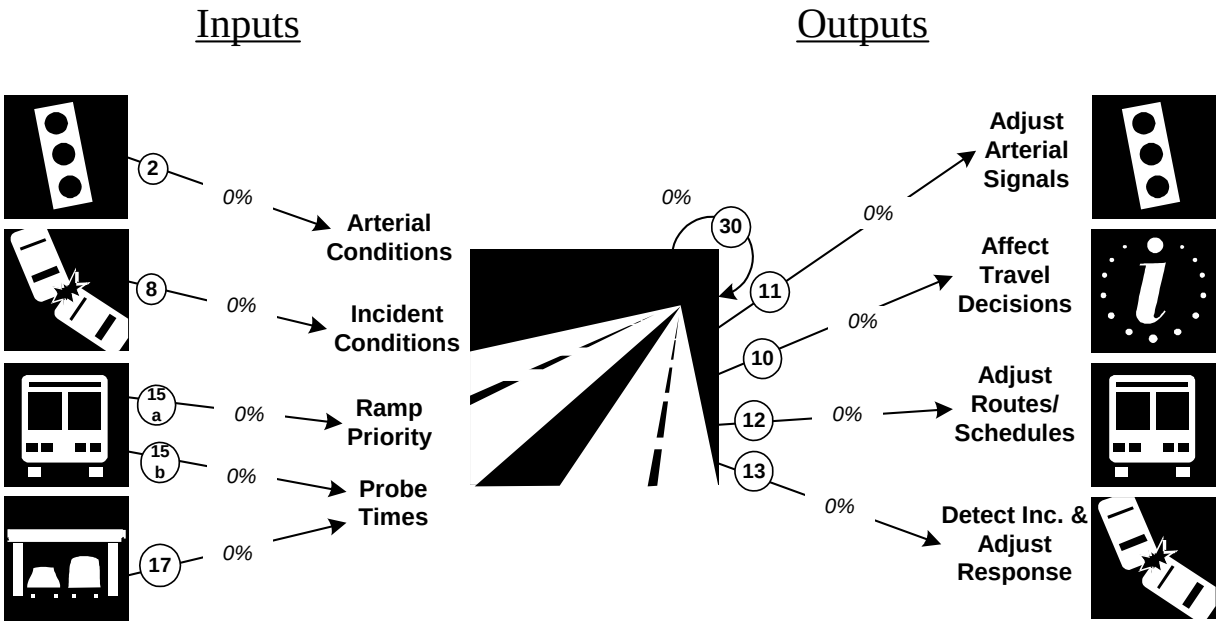
Freeway Management Integration

Beaumont-Port Arthur
Freeway Management Integration*



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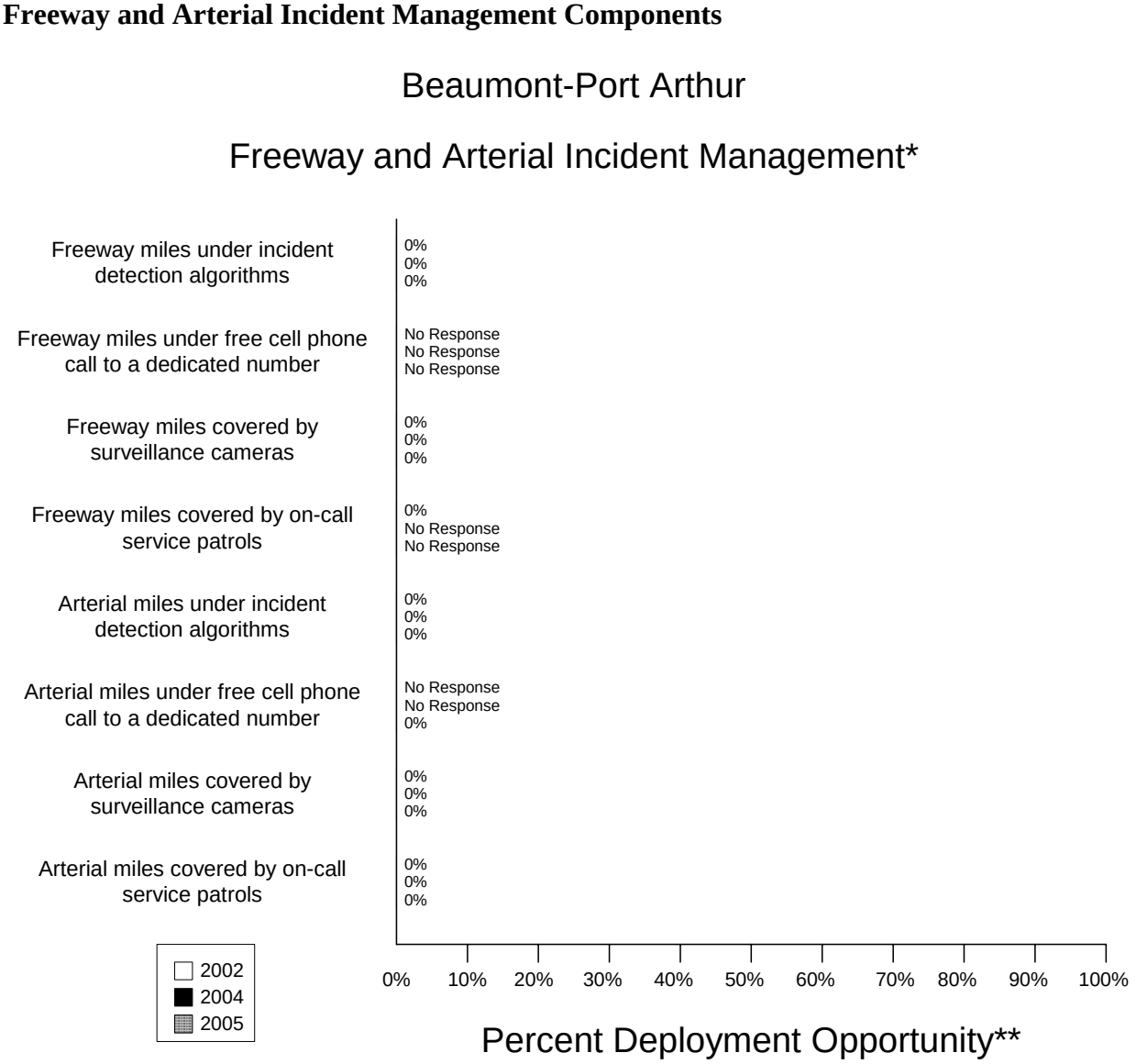
Freeway and Arterial Incident Management Components



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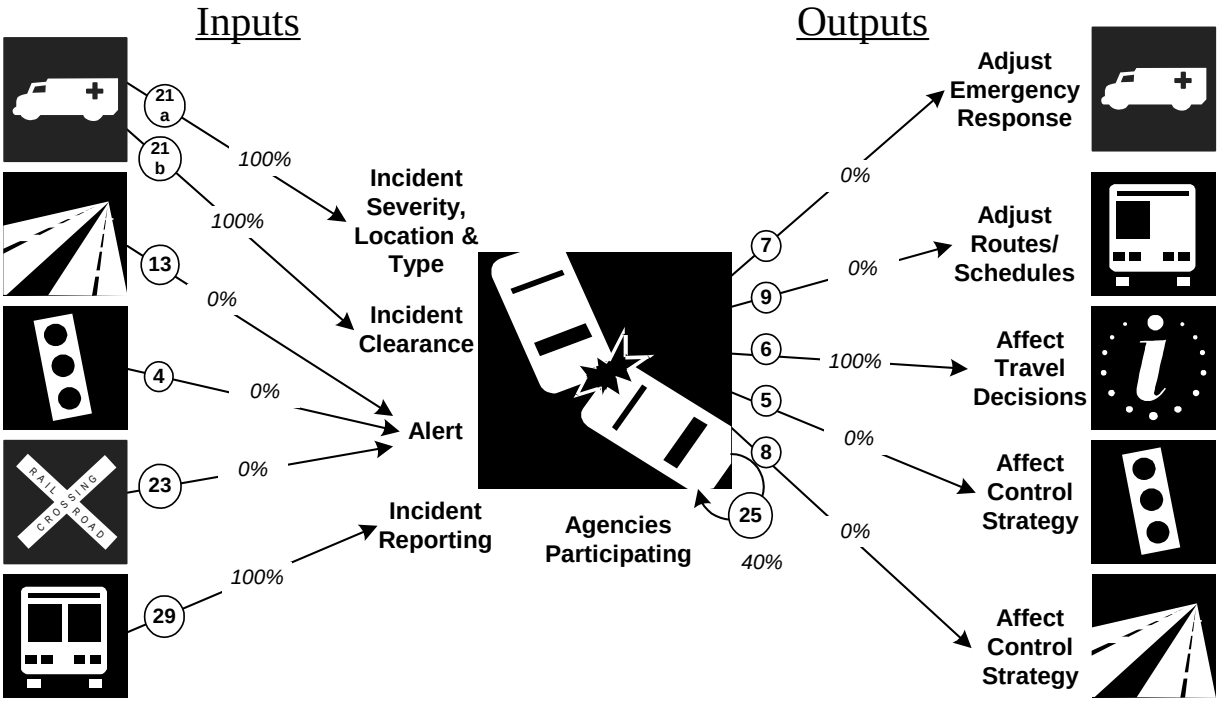
Incident Management Integration

Beaumont-Port Arthur
Incident Management Integration*



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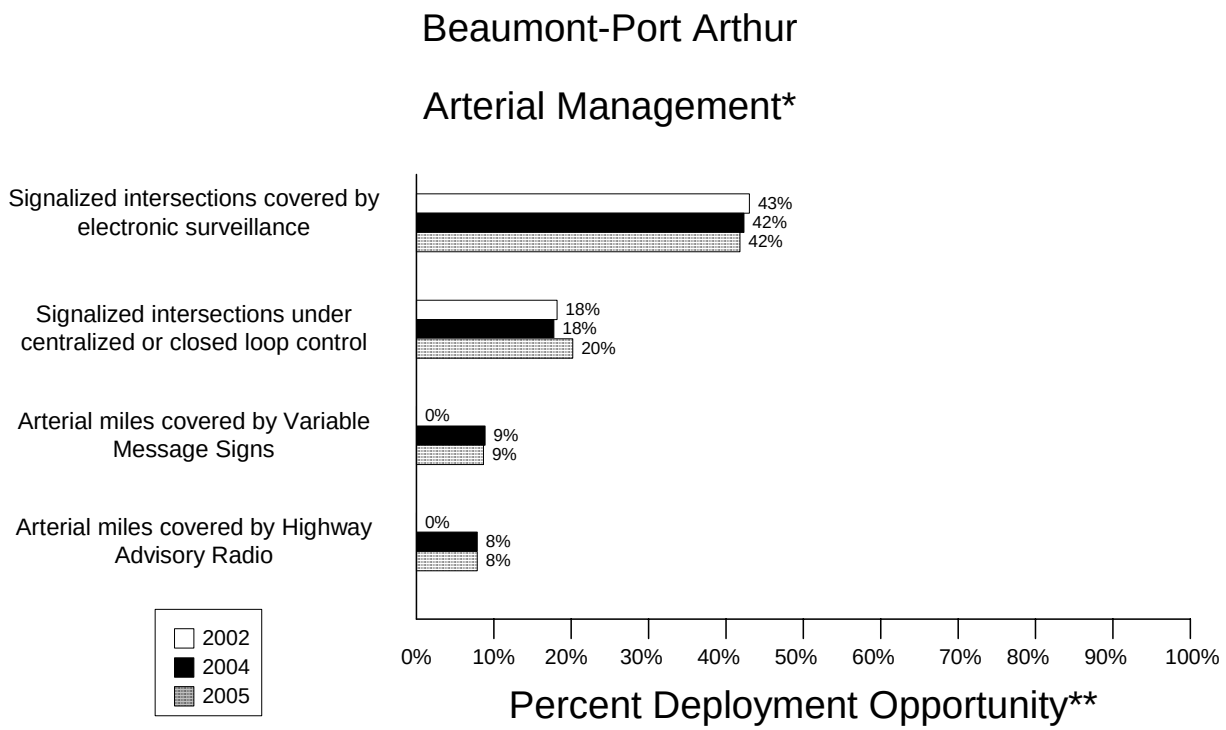
Arterial Management Components



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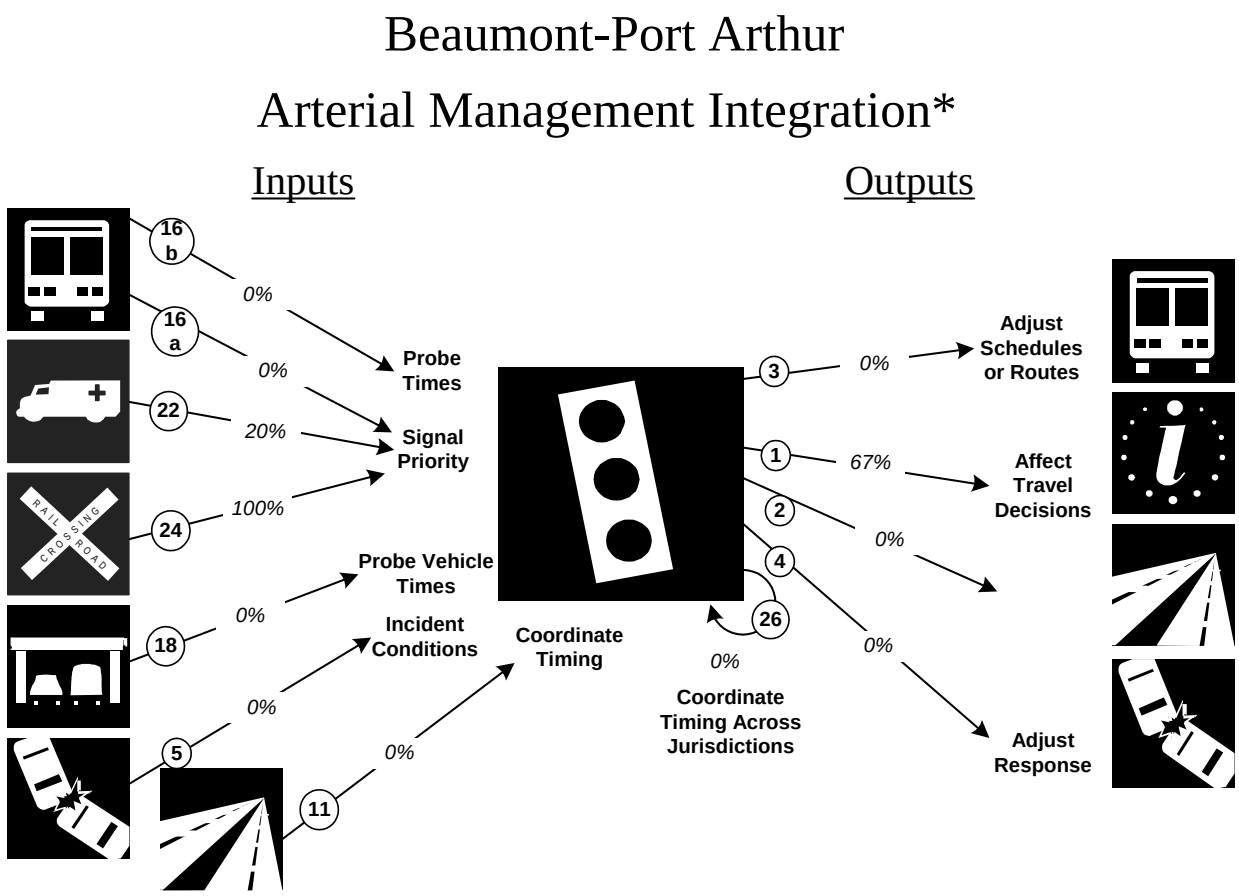
Arterial Management Integration



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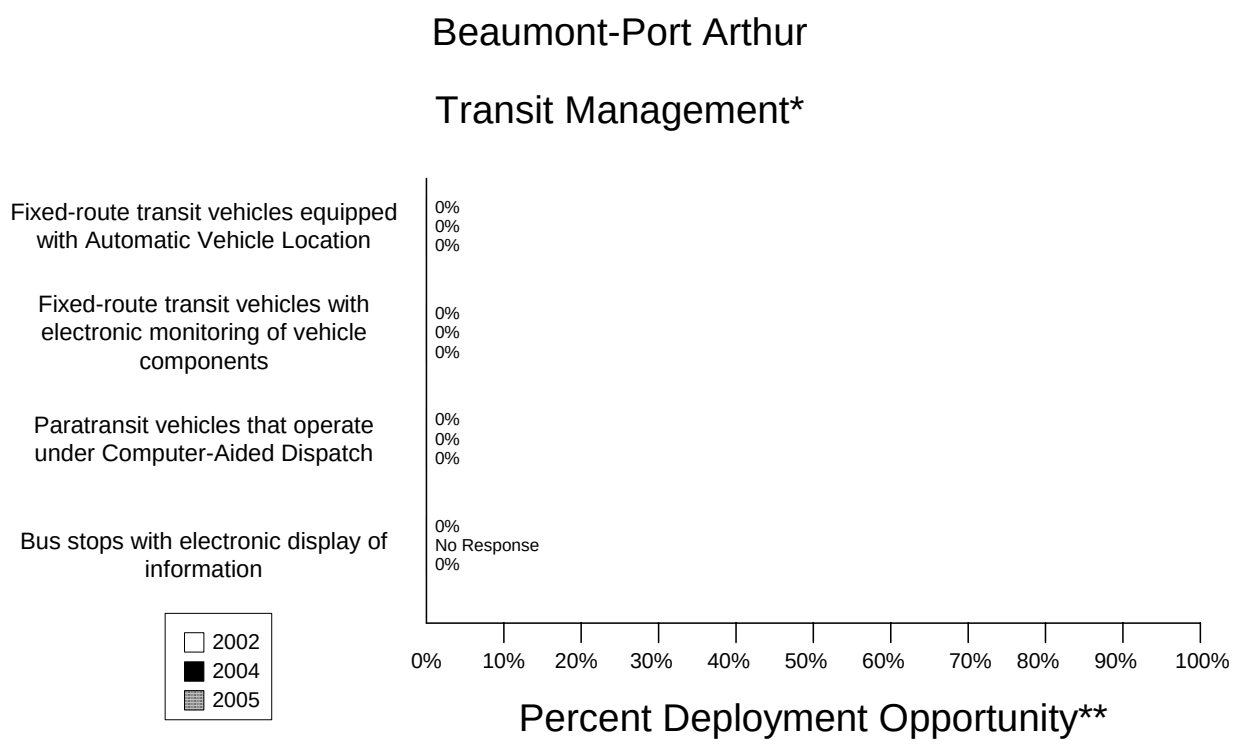
Transit Management Components



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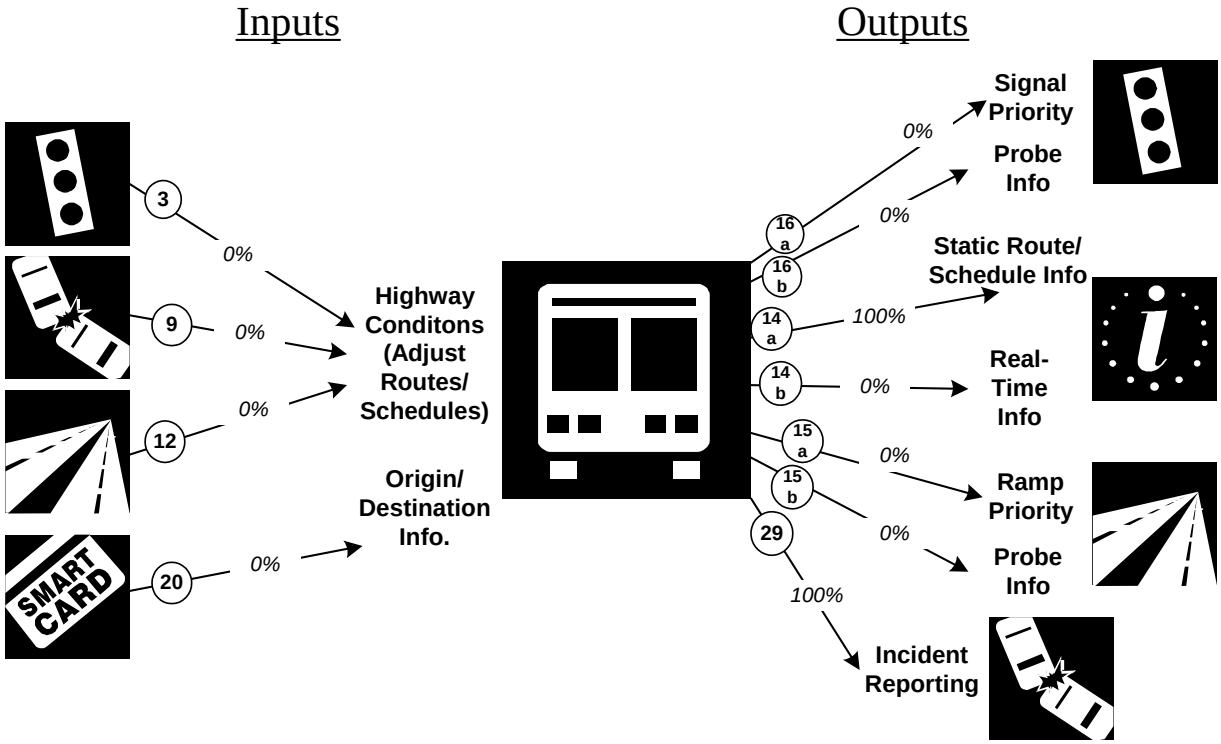
Transit Management Integration

Beaumont-Port Arthur
Transit Management Integration*



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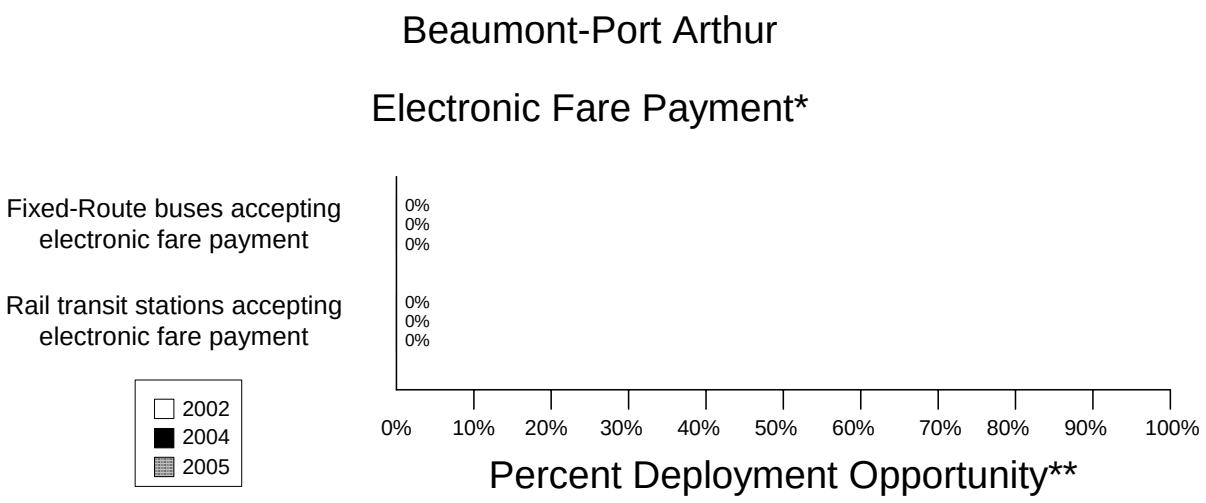
Electronic Fare Payment Components



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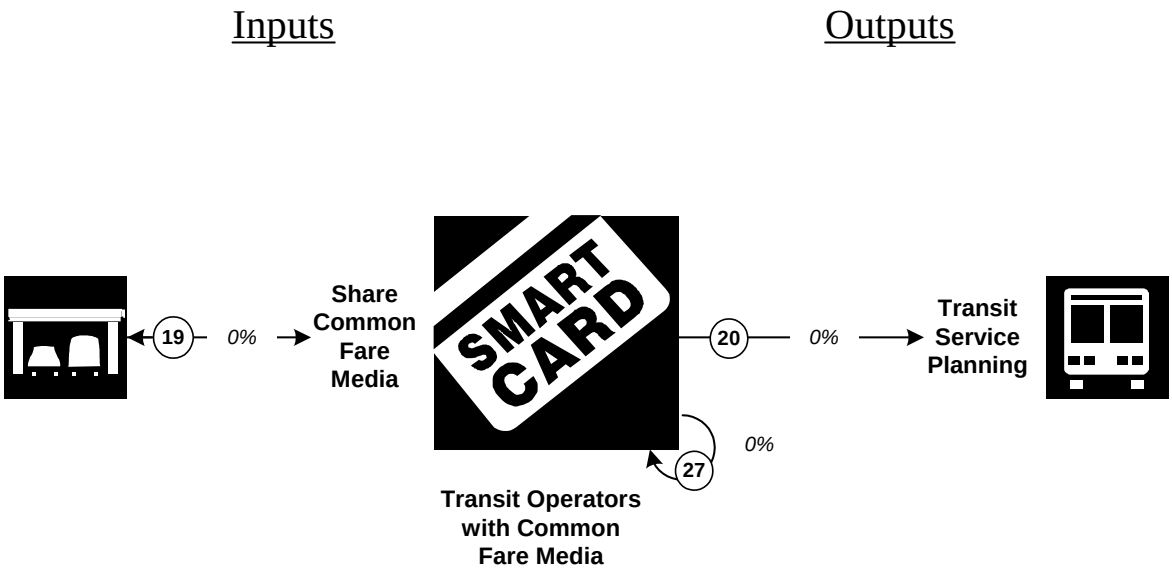
Electronic Fare Payment Integration

Beaumont-Port Arthur
Electronic Fare Payment Integration*



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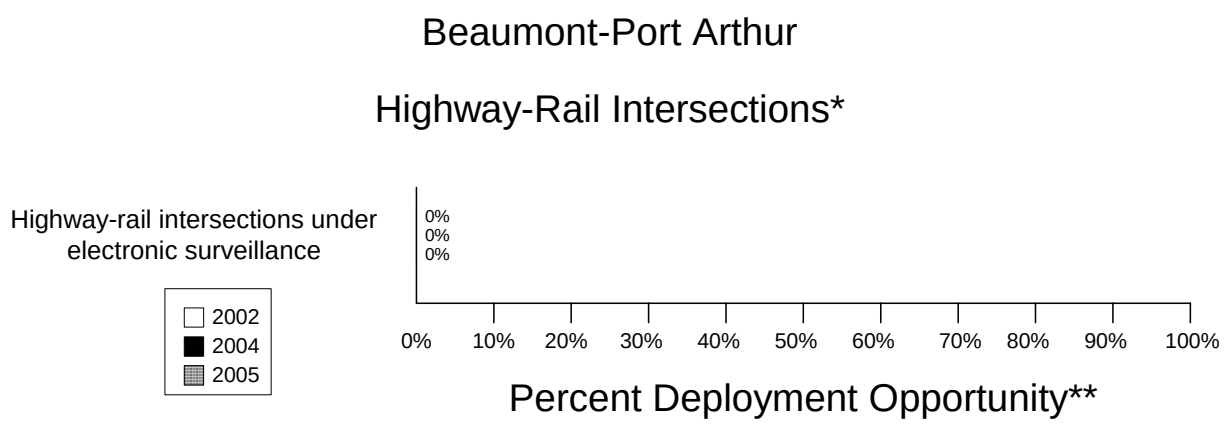
Highway-Rail Intersections Components



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Highway-Rail Intersections Integration

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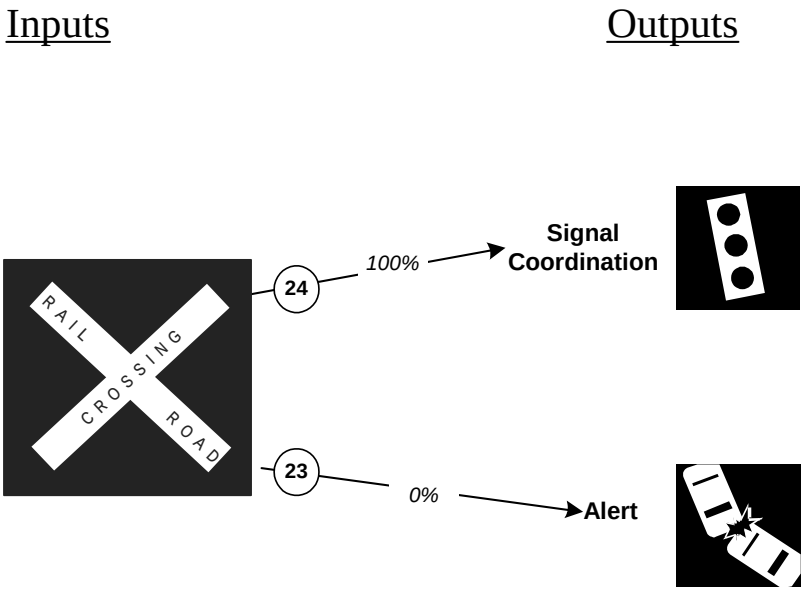
Highway-Rail Intersections Integration*



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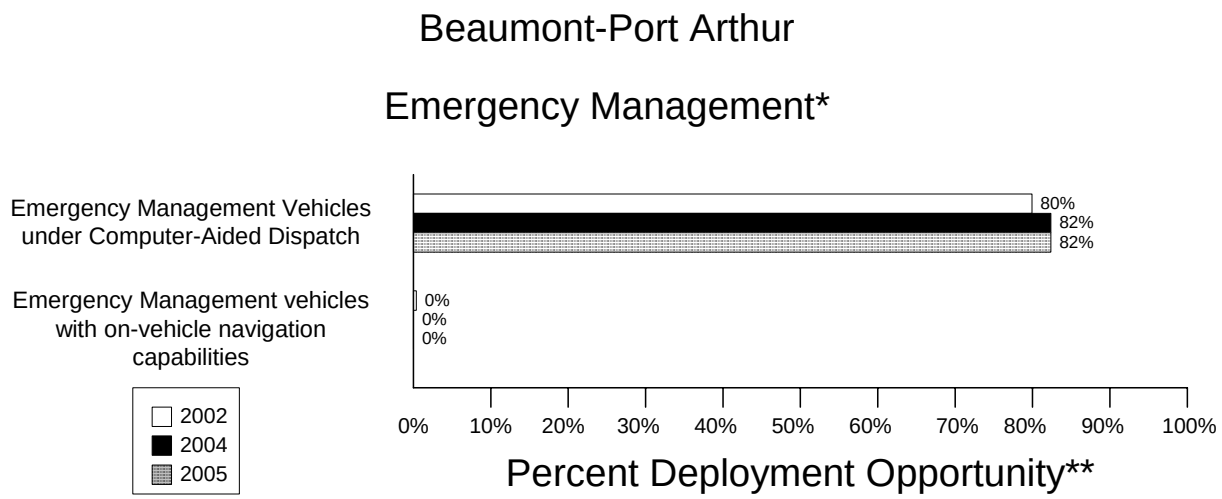
Emergency Management Components



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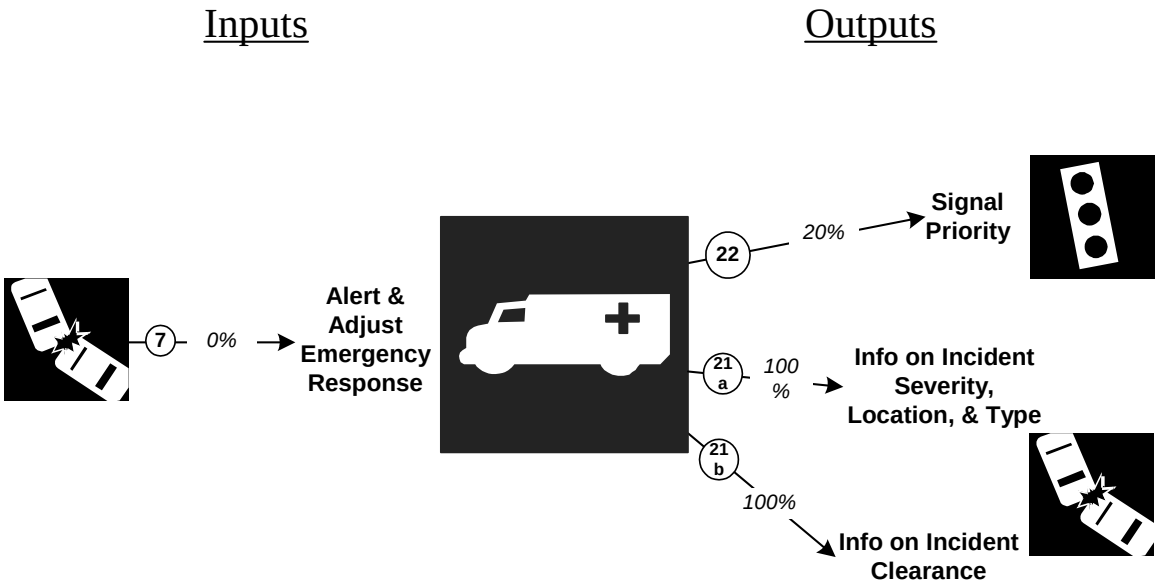
Emergency Management Integration

Beaumont-Port Arthur

Emergency Management Integration*



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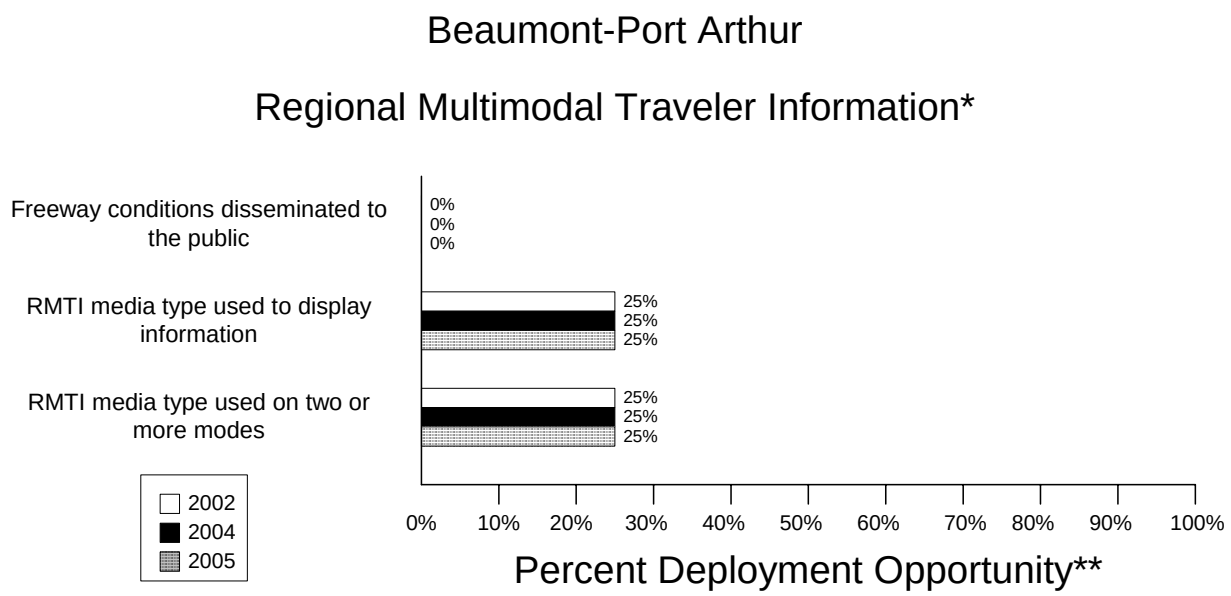
Regional Multimodal Traveler Information Components



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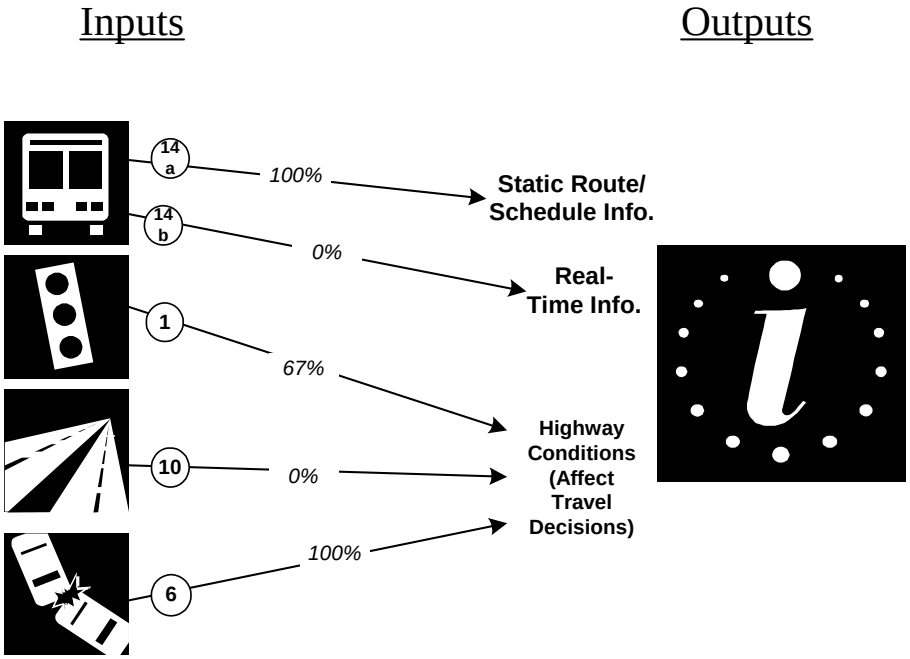
Regional Multimodal Traveler Information Integration

Beaumont-Port Arthur

Regional Multimodal Traveler Information Integration*



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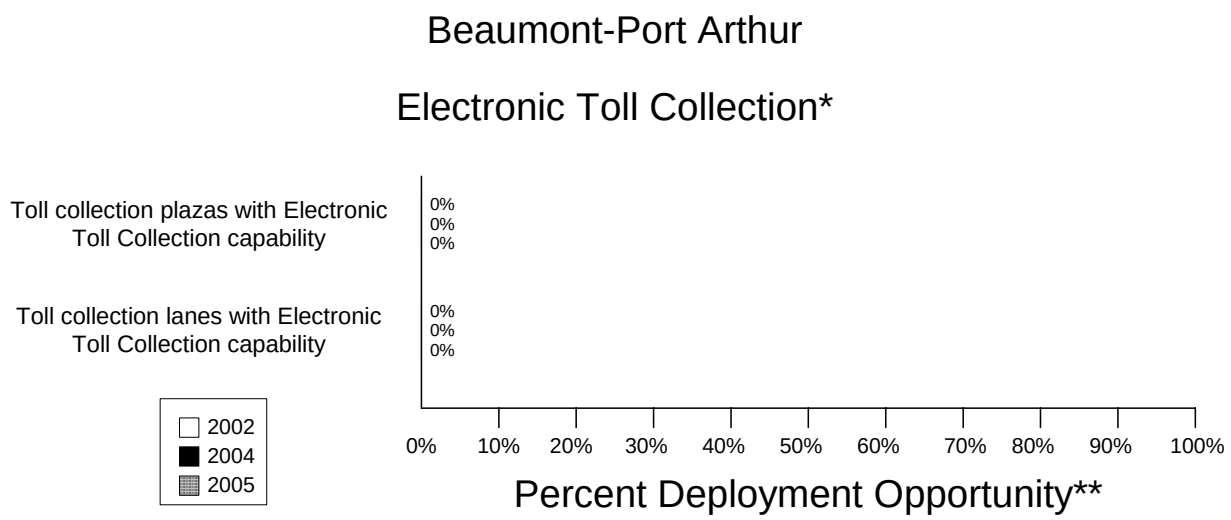
Electronic Toll Collection Components



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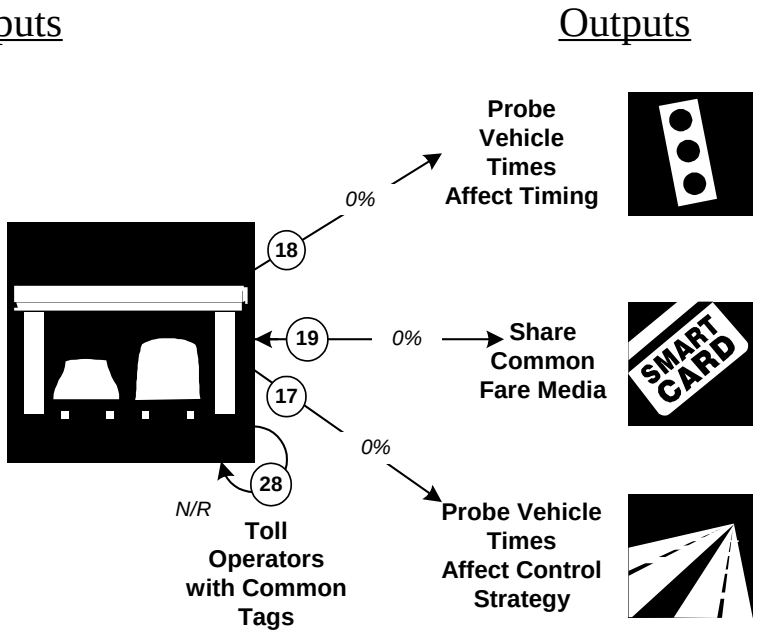
** Deployment opportunity reflects potential totals that do not necessarily reflect actual need.

Electronic Toll Collection Integration

Beaumont-Port Arthur
Electronic Toll Collection Integration*



* Indicators are single surrogates that do not necessarily reflect the full breadth of ITS deployment activity.

Appendix A. Component Indicators

Freeway Management Component Indicators

Description	2002	2004	2005
Freeway centerline miles are under electronic surveillance for monitoring traffic flow	0%	0%	0%
Freeway entrance ramps are controlled by ramp meters		NR	NR
Freeway centerline miles will be controlled by lane control	0%	NR	NR
Freeway miles are covered by VMS	25%	25%	25%
Freeway miles are covered by HAR	34%	34%	34%

Incident Management Component Indicators

Description	2002	2004	2005
Freeway miles covered by incident detection algorithms	0%	0%	0%
Freeway miles covered by free cellular phone calls to a dedicated number	NR	NR	NR
Freeway miles covered by surveillance cameras	0%	0%	0%
Freeway miles covered by on-call publicly sponsored service patrol or towing services	0%	NR	NR
Arterial miles covered by incident detection algorithms	0%	0%	0%
Arterial miles covered by free cellular phone calls to a dedicated number	NR	NR	NR
Arterial miles covered by surveillance cameras	0%	0%	0%
Arterial miles covered by on-call publicly-sponsored service patrol or towing services	0%	0%	0%

Arterial Management Component Indicators

Description	2002	2004	2005
Signalized intersections are covered by electronic surveillance for monitoring traffic flow	43%	42%	42%
Signalized intersections are under centralized or closed loop control	18%	18%	20%
Arterial miles are covered by VMS	0%	9%	9%
Arterial miles are covered by HAR	0%	8%	8%

Electronic Toll Collection Component Indicators

Description	2002	2004	2005
Toll collection plazas with ETC capability	NR	NR	NR
Toll collection lanes with ETC capability	NR	NR	NR

Transit Management Component Indicators

Description	2002	2004	2005
Fixed-route transit vehicles are equipped with Automatic Vehicle Location (AVL)	0%	0%	0%
Fixed-route transit vehicles are equipped with electronic monitoring of vehicle component	0%	0%	0%
Paratransit vehicles operate under computer-aided dispatch	0%	0%	0%
Bus stops display information to the public	0%	0%	0%

Electronic Fare Payment Component Indicators

Description	2002	2004	2005
Fixed-route transit vehicles that accept electronic payment	0%	0%	0%
Rail transit stations that accept electronic payment	NR	0%	0%

Highway Rail Intersection Component Indicators

Description	2002	2004	2005
Highway-rail intersections are under electronic surveillance	0%	0%	0%

Emergency Management Component Indicators

Description	2002	2004	2005
Public sector emergency vehicles that operate under computer-aided dispatch	80%	82%	82%
Public sector emergency vehicles that have in-vehicle route guidance capability	0%	0%	0%

Regional Multimodal Traveler Information (RMTI) Component Indicators

Description	2002	2004	2005
Freeway conditions disseminated to travelers	0%	0%	0%
Possible RMTI media types are used to display information to travelers	25%	25%	25%

Description	**2002**	**2004**	**2005**
Possible RMTI media are used to display information on *two or more modes* to travelers	25%	25%	25%

Appendix B. Integration Indicators

IndicatorsLink Description	2002	2004
1. Arterial Management agencies disseminate arterial travel times, speeds, and conditions to the public	0%	67%
2. Arterial Management agencies sending information to Freeway Management	0%	0%
3. Arterial Management agencies transfer arterial travel times, speeds, and conditions to Transit Management	0%	0%
4. Arterial Management agencies sending arterial conditions to Incident Management	0%	0%
5. Incident Management agencies transfer information describing incident severity, location, and type to Arterial Management agencies	0%	0%
6. Incident Management agencies disseminate information describing incident severity, location, and type to the public	100%	100%
7. Incident management agencies transfer information describing incident severity, location, and type to Emergency Management agencies	0%	0%
8. Incident Management agencies sending information describing incident severity, location, and type to Freeway Management agencies	0%	0%
9. Incident Management agencies transfer information describing incident severity, location, and type to Transit Management agencies	0%	0%
10. Freeway Management agencies disseminating freeway conditions to the public	0%	0%
11. Freeway Management agencies sending information to Arterial Management	0%	0%
12. Freeway Management agencies sending freeway conditions to Transit Management	0%	0%
13. Freeway Management agencies sending freeway conditions to Incident Management	0%	0%
14a. Transit Management agencies disseminate information describing transit routes, schedules, and fares to travelers	100%	100%
14b. Transit Management agencies disseminate information describing schedule/route adherence to travelers	0%	0%
15a. Transit management agencies with vehicles equipped with ramp meter priority	0%	0%
15b. Transit Management agencies with vehicles equipped as probes	0%	0%
16a. Transit management agencies with vehicles equipped with traffic signal priority	0%	0%
16b. Transit Management agencies have vehicles equipped as probes on arterials	0%	0%

IndicatorsLink Description	2002	2004
17. Freeway Management agencies receiving freeway conditions from vehicle probes	0%	0%
18. Number of Arterial Management agencies receiving information from vehicle probes	0%	0%
19. Transit agencies that accept electronic payment through the use of electronic toll collection media	0%	0%
20. Transit Management agencies using Electronic Fare Payment data in transit service planning	0%	0%
21a. Incident management agencies receiving incident severity from Emergency Management	100%	100%
21b. Incident management agencies receiving incident clearance activities from Emergency Management	100%	100%
22. Emergency Management agencies have vehicles equipped with traffic signal preemption capability	40%	20%
23. Arterial Management agencies receive information on highway-rail intersection crossing blockages for the purpose of managing incident response	0%	0%
24. Arterial Management agencies have traffic signals within 200 feet of a highway-rail intersection with the capability of having their signal timing adjusted in response to a train crossing	100%	100%
25. Police, fire, and EMS agencies participating in a formal incident management plan/team	20%	40%
26. Arterial Management agencies under cooperative agreement to share traffic signal timing for coordinated response	0%	0%
27. Transit Management agencies that use the same electronic payment system	0%	0%
28. Toll operators using common toll tag technology		
29. Transit Management agencies report traffic incidents as part of an organized regional incident management program	100%	100%
30. Freeway Management agencies sending information to another Freeway Management agency	0%	0%

Appendix C. Surveyed Agencies

Beaumont-Port Arthur

	2002		2004	
	Date Out	Date In	Date Out	Date In
Arterial Management				
Beaumont City Public Works	7/24/2002	8/29/2002	6/16/2004	9/2/2004
Port Arthur City Public Works	7/24/2002	9/18/2002	6/14/2004	7/30/2004
Texas Department of Transportation	7/23/2002	8/6/2002	7/7/2004	7/23/2004
Emergency Management				
Beaumont Fire Department	7/24/2002	7/30/2002	5/17/2004	8/3/2004
Beaumont Police Department	7/24/2002	8/27/2002	5/17/2004	8/26/2004
Jefferson County Sheriff Department	7/25/2002	8/28/2002	5/17/2004	10/27/2004
Port Arthur City Fire Department	7/24/2002	9/18/2002	5/17/2004	7/12/2004
Port Arthur City Police Department	7/24/2002	8/30/2002	5/17/2004	8/4/2004
Freeway Management				
Texas Department of Transportation	7/23/2002	8/6/2002	7/7/2004	7/23/2004
MPO				
South East Texas Regional Planning Commission	Not Surveyed in 2002		6/1/2004	9/23/2004

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