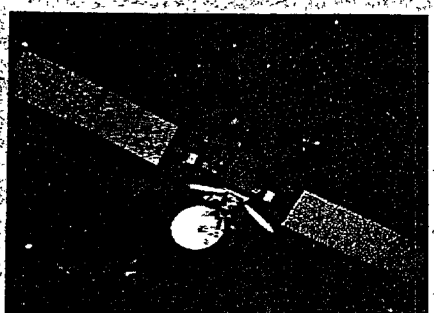
PHASE I REPORT



Congestion Management System/IVHS Program Study for Birmingham, Alabama

April 1995

submitted to

Alabama Department of Transportation

submitted by

Parsons Brinckerhoff Quade and Douglas, Inc.

CONGESTION MANAGEMENT/INTELLIGENT VEHICLE HIGHWAY SYSTEMS PROGRAM BIRMINGHAM, ALABAMA

EXECUTIVE SUMMARY

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) required states and metropolitan areas designated as transportation management areas develop congestion management systems. The Birmingham Planning Area is designated as a non-attainment area, and has been allocated Congestion Mitigation and Air Quality (CMAQ) funding and other federal funding from ISTEA that must be implemented through a Congestion Management program. The Intelligent Vehicle Highway System (IVHS) planning procedure is aimed at planning, development, alternative analysis, program management, and public involvement, which was the scope of this work program.

CONGESTION MANAGEMENT PROGRAM DEVELOPMENT

Guided by the oversight and steering committees, goals and objectives were developed. The goals of this program was:

> *Development of a Congestion Management System (CMS) for the Metropolitan Planning Area which, through a systematic and continuing process, provides information on transportation system performance to decision-makers for selecting and implementing cost-effective strategies to manage transportation facilities so that traffic congestion is reduced and mobility of persons and goods is enhanced.*

Based on research documentation and input from the oversight committee, steering committee, and executive interviews, performance measures and a congestion management procedure were developed for use in the Birmingham Planning Area. The primary performance measure is the ratio of traffic volume to the acceptable flow rate (AFR). The AFR is unique for the

Birmingham area based on the locally accepted definition of congestion. The AFR was factored to take into account the effect of incidents or accidents on roadway capacity. System performance was evaluated for each roadway in the study area that was identified to be part of the arterial system (interstate and major arterial). The system performance was documented in a database that can be utilized with a microcomputer based software program. System existing and future conditions can be determined by the operating agency as needed.

The general definition of congestion was agreed to be "the level at which the transportation system is no longer acceptable due to traffic interference." This level of system performance may vary by type of facility, geographic location, and/or time of day. Level of service "D" was selected as acceptable for the transportation system in Birmingham. Any facility with an existing or projected capacity of worse than "D" was considered to be congested.

The application of the Congestion Management Program and the database to the planning process was identified and recommendations for project decisions for project implementation were made. Additional data collection needs were identified and the existing and future baseline conditions procedure using the CMS database level of congestion index factor to identify severely congested locations were determined. The system performance criteria and analysis procedures were used to evaluate the system performance which could then be used by the implementing agency to develop project scopes for improvements.

USER SERVICE PLAN

After review and analysis of the results of the Public Involvement component of the Birmingham CMS\IVHS project, a User Service Plan was prepared that: defined the problem areas that caused congestion in the Birmingham Planning area; identified opportunities or solutions to the 13 identified problems; inventoried the existing transportation infrastructure and facilities; and matched these needs to 29 user services identified by the National Intelligent Transportation Systems (ITS) Committee. Ten user services were selected for further study and were identified by short, medium, and long range implementation categories. The problem areas were the foundation for determining strategies and projects for implementation and are listed below.

1. Congestion due to incidents
2. Congestion due to roadway construction
3. Air quality non-attainment
4. Under-used mass transportation facilities
5. Congestion due to motorist information and guidance
6. Congestion due to capacity deficiency on freeways, ramps, and interchanges
7. Congestion due to capacity deficiency on arterials and collectors (through multiple jurisdictions)
8. Adverse effect of institutional coordination and barriers
9. Congestion and accidents due to roadway planning, design, operations, and maintenance (land use controls, access management, traffic signal design, installation and operations, signage, and markings)
10. Congestion due to special events
11. Congestion due to truck traffic
12. Congestion due to major public, private and commercial developments
13. Congestion and accidents due to motorists education and traffic law enforcement

SYSTEM ARCHITECTURE PLAN

To insure that the investment of funds would result in feasible and viable projects that could be implemented and would solve identified problems in Birmingham, a System Architecture Plan was prepared. This plan mapped the ten user services to functions and supporting technologies such as surveillance communications, navigation/guidance functions, information management, traveler information, control strategies, and in-vehicle sensors, diagrams depicting the logical architecture, and diagrams depicting the physical architecture for each user service.

USER SERVICE SCREENING

The ten identified user services were screened using a "Macro-Level" and a detailed screening process. The preliminary screening was a subjective process that evaluated each user service based on whether it was feasible or not feasible for implementation. The criteria included financial viability, geometric feasibility, functional adequacy, public acceptability, and environmental constraints. No user services were identified as not feasible for further study. Projects with significant potential for solving the identified problems were recommended for early implementation (begin design). These user services recommended were Traffic Control, Incident Management, Ride Matching and Reservation, Van Pooling, and Public Transportation Management. The detailed screening procedure includes ranking factors, a rating formula, and a ranking procedure. User services were rated based on positive and negative impact on the system and measures of effectiveness. Based on the results of the rating formula, projects were ranked and assembled into short range (1-5 years), middle range (6-10 years), and long range (11-20 years) categories for implementation. Projects with a rating of greater than 2.00 were recommended for early implementation.

IMPLEMENTATION ISSUES

Major issues which would affect implementation of the previously identified user services were presented and discussed. These issues included agency coordination/responsibility, project funding, scheduling, implementation cost, procurement, and regulatory changes or laws needed for implementation. Project schedules were developed, initial cost estimates were made and implementing agencies and responsibilities were identified.

ENVIRONMENTAL REVIEW AND COST ESTIMATES/COST EFFECTIVENESS

An environmental review and cost estimates/cost effectiveness comparison for the user services were conducted. A detailed analysis using life cycle cost, unit of travel reduction in hours of

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delay, and cost per year per vehicle-mile traveled per hour of delay reduction was made for each user service. Projects with the most potential for delay reduction over the life of the project per dollar of funding were: Incident Management, Traffic Control, Ride Matching, Driver Information, and Route Guidance. All user services with low initial cost and a long service life that was directed at systems with severe existing traffic congestion showed better potential on a cost effective basis than were projects with high initial, maintenance and operational costs that were directed at solving system wide congestion problems.

PERFORMANCE MONITORING PLAN

A Performance Monitoring Plan was developed that identified performance measures based on identified goals and objectives of the Birmingham CMS/IVHS study. System wide planning elements and user service strategy elements were identified to monitoring the success of the implemented user services to determine whether the anticipated results of the user service were achieved. Performance monitoring criteria were developed for each performance monitoring elements and data needs were identified.

OPERATIONS PLAN

An Operations Plan was developed that outlined the Phase II work needed for implementation of the recommended user service projects. This plan identified the steps needed for implementation of the projects including incorporation in both the Birmingham Transportation planning process (TIP), and State Transportation Plan. A listing of the user services recommended for implementation is shown in priority order below.

1. Ridesharing Initiatives
2. Van Pooling
3. Traffic Control, ATMS
4. Incident Management
5. Public Transportation Management

6. Freeway Management and Control
7. Motorists Information/Education Systems, ATIS
8. Commercial Vehicle Policies and Control

A detailed listing of projects associated with each of the above user services including cost estimates and year of implementation was presented in Appendix Chapter X - Preliminary Operations Plan. Project implementation including funding, scheduling, project scope, method of design services and project responsibility was discussed for each of the projects recommended for implementation.

A public involvement video was also completed and will be used for public and civic presentations on the Birmingham CMS/IVHS Study results and recommendations and for other presentations on this study.

CHAPTER I

CONGESTION MANAGEMENT PROGRAM DEVELOPMENT

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INTRODUCTION

The Birmingham Congestion Management Project was initiated to assist in developing a Congestion Management System (CMS) for the Birmingham Metropolitan Planning Area. The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) provided criteria and guidelines for the Federal Department of Transportation's management of federal transportation funds and their oversight of the nation's ground transportation infrastructure. To this end, the Federal Highway Administration (FHWA) mandated the development of six transportation infrastructure oriented management system programs. These management systems included:

HIGHWAYS	Congestion Management System
BRIDGES	Bridge Management System
PAVEMENT	Pavement Management System
HIGHWAY SAFETY	Safety Management System
PUBLIC TRANSPORTATION	Public Transportation Management System
INTERMODAL	Intermodal Management System

All of these management systems are to be formalized at the state (Alabama Department of Transportation) and local planning levels (Birmingham Regional Planning Commission) for urbanized areas over 200,000 in population to assure that the decision-makers have viable information upon which to base their decisions. These management systems are intended to formalize a systematic process designed to assist decision-makers in selecting cost-effective strategies/actions to improve the efficiency and safety of, and protect the investment in, the nation's transportation infrastructure. This process includes decisions relating to the distribution of local, state and federal funds for transportation purposes.

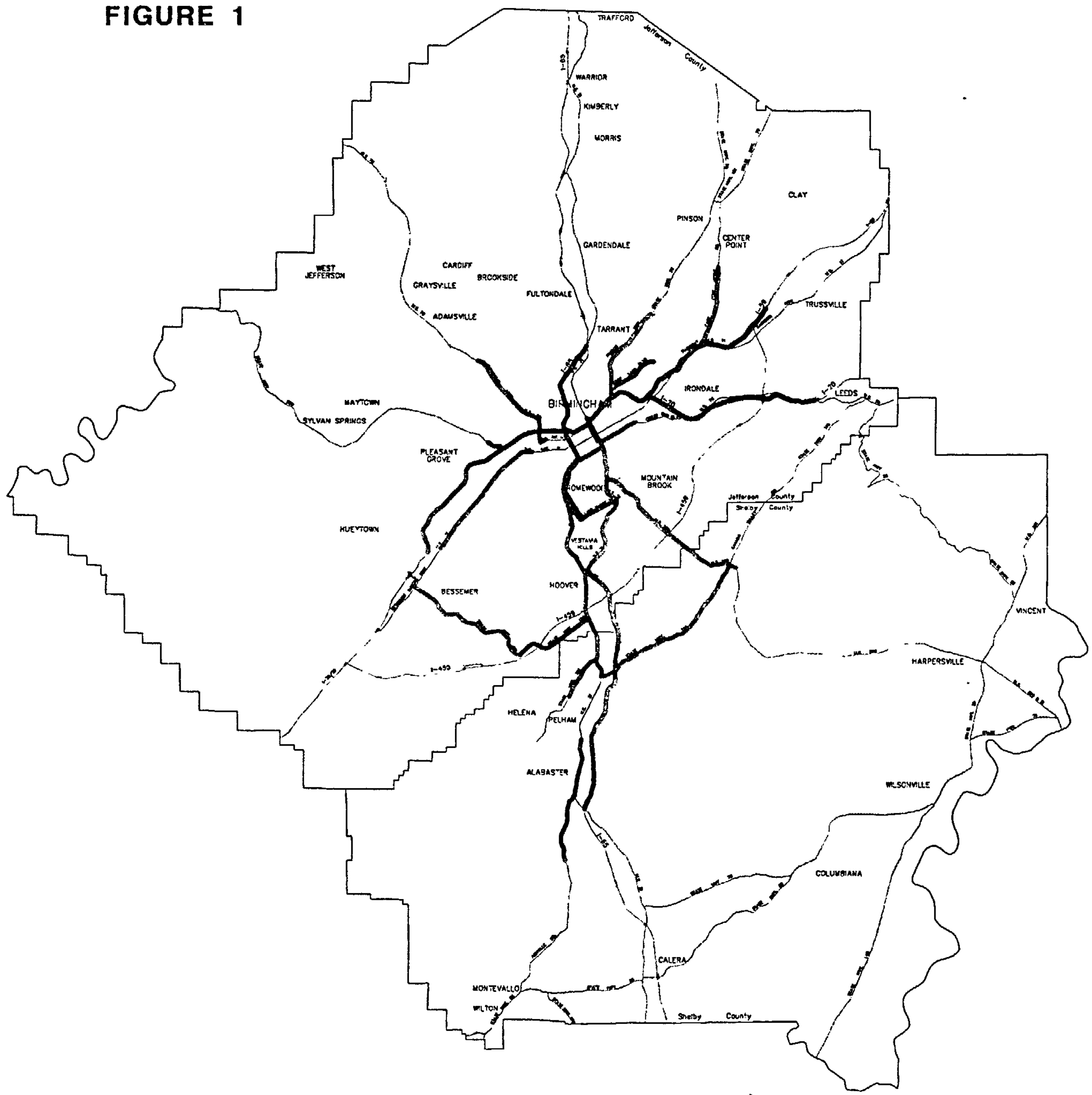
CMS STUDY PROCESS

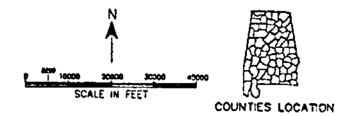
Committees were formed with representatives of the Alabama Department of Transportation (ALDOT), the Birmingham Regional Planning Commission (BRPC), local representatives from transportation related interests in the area, and local citizens selected through the BRPC were the sources of stakeholders input into the CMS development process. Public involvement in the CMS development and implementation processes are considered essential for a viable CMS program. A representative component of this group oversaw the development of the CMS. The first task was to formalize the goals and objectives of the CMS for the Birmingham area. Next, local perceptions of congestion were formalized and documented. This established a congestion threshold where those participating foresaw the need for transportation improvements. The public's qualitative assessment of congestion was transformed into a quantitative factor that could be used by the decision-makers in assessing need based on a cyclic process. The initial areas of congestion was formulated from survey data that were compiled and are shown on Figure 1. The process was further refined to describe a database management system for the roadway system and the base features that would be used to assess congestion. This database management system was found to be most appropriately managed by the BRPC. Basic data would be furnished by the state, BRPC and local governments. The CMS process was incorporated into the normal planning process of the BRPC and state.

CONGESTION MANAGEMENT SYSTEM GOALS AND OBJECTIVES

The goal of the CMS is that it is to be ***the basis of a continuing systemic process for managing transportation information on system performance to assist decision-makers in the selection and implementation of cost-effective strategies for managing the region's transportation infrastructure***. Ultimately, traffic congestion would be reduced with an enhancement of mobility for both goods and persons. A secondary goal of a CMS, as established by ISTEA, is to reduce the dependence on single occupant vehicles as the primary mode of transportation. This is done by providing input into the planning process which will lead to the implementation of strategies and actions to reduce congestion and enhance the mobility of persons and goods. The CMS is to provide an operational performance status of the area's transportation system. It will formalize the process of identifying and assessing effective and efficient strategies and actions to reduce traffic congestion. It will monitor the effectiveness of strategies and actions specifically implemented to reduce congestion and

FIGURE 1





LEGEND

- CONGESTION AREAS (From Problems, Needs, & Opportunities Survey)
- INTERSTATE HIGHWAYS
- U.S. AND STATE ROADS

ALABAMA DEPARTMENT OF TRANSPORTATION

BIRMINGHAM IVHS CMS PROJECT

INITIAL IDENTIFICATION OF CRITCAL CONGESTION AREAS

NOVEMBER 10, 1994

enhance the mobility of persons and goods. The CMS will protect, manage and enhance the transportation system. As with the normal transportation planning process, the implications on air quality relating to the Clean Air Act Amendments of 1990 (CAAA) must also be considered when assessing transportation needs and solutions. The CMS process is one integral facet of the BRPC's and state's normal planning process. The total planning process supports decisions made to develop the local Transportation Improvement Program (TIP), a region's spending plan for transportation improvements. A similar program would be applied at the state level in formulating the state TIP.

DATABASE DEVELOPMENT FOR ROADWAY SYSTEM ASSESSMENT

A major component of the CMS process is the transportation information component. This component is a database that facilitates assessing how well the transportation system is fulfilling the expectations of the public (need) and once actions are implemented, how well these perform at fulfilling their intended purpose (fulfillment). The database has been developed with physical features of the roadway system and existing documented standard traffic operations performance measures. A description of the roadway system studied in the development of the CMS is described in Chapter II, Existing and Future Baseline Conditions. The initial performance measures used may be modified with time as experience in managing the roadway system is gained. These performance measures must facilitate a procedure for documenting needs and selection of strategies/actions and a process for evaluating the effectiveness of implemented strategies/actions. Many different factors for quantifying system operational quality were reviewed and considered. Speeds and travel times were the predominate factors used by the public to describe congestion; however, there was not an on-going program to collect these data on any of the area's roadways. Because of the number of miles of congestion sensitive roadways in the Birmingham area, the availability of existing data was a primary factor. Due to constraints of time and funding, no local agency, or ALDOT, could initiate a broad new data collection program incorporating the entire roadway system in the Birmingham area. The primary traffic data available included traffic counts, on a one- to five-year cycle on most major routes, local traffic counts for special studies, crash records, and other local studies for development support aor highway improvement studies.

The process first involved the quantifying of the qualitative definition of congestion as defined by transportation aligned professionals and citizens from the Birmingham area (see Figure 1). This input defined a threshold of acceptable/unacceptable congestion by identifying congested roadway corridors and sections. A review of the traffic volumes for these areas revealed that many approximated an operating level of service (LOS) D. This is the same LOS used by the BRPC to program improvement needs in the region. Highway corridors and sections were identified that did not exhibit a level of service constraint. Since some 61 percent of an urban area's congestion is non-continual and some 80 percent of that congestion is of short duration, factors other than travelway capacity affect congestion. Congestion can be caused by incidents such as work zone activities, breakdowns, operational constraints, physical constraints, driver behavior, unforeseen conditions, crashes, debris in the travelway, and any other condition that necessitates an unforeseen response by the driver. An incident factor[1] to reflecxt the impact of external influences on traffic flow was applied to the LOS D service volume to develop a threshold volume of congestion. Dividing the directional hourly roadway volume by the adjusted LOS D volume would yield the congestion index for that roadway section. The resulting term is the level of congestion (LOC) factor. Any roadway section with an LOC factor equal to or greater than one is congested. Any roadway section or corridor with an LOC factor greater than one warrants further consideration for corrective action.

Future traffic count and crash data were incorporated into the CMS database on a routine basis as data becomes available. To facilitate this process, a data management system was established for use by the BRPC. The database roadway segment listing is shown in Appendix Chapter I, Sections B, C and D. The existing conditions are shown in Section B and future (2010) conditions with the implementation of the Birmingham Long Range Plan Program.

[1] In the limited studies done in this area, documented crashes have been identified as some 10 percent of the total number of factors adversely affecting the smooth flow of traffic. Based on these studies, incident rates and their impact on traffic flow based on a number of lanes were developed which were in turn corelated with reported crashes. Tables reflecting these factors is provided in Appendix Chapter I, Section A.

The data can be converted once a suitable system is established. This would facilitate upgrading the data base as updates are incorporated into the BRPC traffic modeling programs. A database documentation manual was developed that explains in detail the inputs, formats, tables, calculations and usage of the computer based data management system.

TRANSPORTATION SYSTEM ASSESSMENT

Once this quantification was complete, the process for assessing the roadway network[2] was reviewed by applying assessment techniques to a representative sample of roadway types and classes. This process will enable the staffs supporting the decision-makers to establish an order of need for the different categories of transportation projects. Chapter II addresses the additional data collection needs and process for further analysis of the roadway segments identified as congested based on the database roadway assessment explained previously. This further analysis uses the Highway Capacity Manual (HCM). The roadway sections, intersections and ramp/freeway sections needing improvements can be tested using the HCM.

The only continual data collection effort was to maintain traffic flow data. This is being done at the state and local level. Crash reports are also being managed at the state and local level. These factors were felt to be the most cost effective factors for identifying congestion, at least until a traffic management system might be implemented. Such a system would facilitate the automatic acquisition of data on operating speeds and travel times, which could be used as LOC factors to quantify future congestion.

To facilitate the process of identifying needs, an LOC factor was developed. LOC is based on a combination of peak hour lane volume and other factors that would influence the smooth flow of traffic. As decisions are made at the local and state level which impact the Birmingham area roadway system, the LOC performance measures, in conjunction with other standard

[2] For this first cycle of exercising the CMS process, only interstate, Federal, and numbered State routes would be assessed. Subsequent cycles will include these route and primary local routes, with the transportation road network being expanded with each subsequent review cycle.

traffic engineering performance measures, will be applied to identify needs and access benefits of previous actions. As this process continues, the thresholds for congestion may be adjusted to better address the public needs at that time.

CONGESTION MANAGEMENT SYSTEM PROCESS

The IVHS implementation process is discussed in Chapters III through VI of this Phase I report. Chapters VII through X discuss implementation issues, performance monitoring, and presents a CMS/IVHS operation plan for the Birmingham Planning Area.

The IVHS planning process was used to evaluate the feasibility of certain systemwide and specific roadway segment user services and roadway/intersection improvements. The system-wide projects would tend to alleviate traffic conditions on an entire system (i.e., interstates, major arterials and the site-specific projects such as traffic control systems) would solve congestion on a particular congested roadway segment. All of the recommended CMS/IVHS user services and projects are directed at solving the types of congestion identified in the Birmingham Planning Area and should be considered by the BRPC for implementation to address the congested segments derived from the database assessment.

Transportation improvement needs are addressed locally at the city and county levels. These needs are brought to the attention of the ALDOT and BRPC, where they are consolidated with regional and state needs. Based on projected resourcing, regardless of the source, the BRPC annually updates the TIP. This update involves prioritizing transportation needs, validating project requirements, reviewing feedback from completed actions, balancing impacts, benefits and funding, and assessing project support. This TIP then competes with the TIPs of other planning areas for the resources distributed throughout the state. The assessment of need for transportation related actions receives the scrutiny of the public and the professional planning officials. The framework of the CMS assists these decision-makers in prioritizing actions. Once actions have been completed, the same process is employed to assess the benefits gained. With each annual cycle of the review/feedback, the process is improved.

PUBLIC INVOLVEMENT

As part of this study, a video was developed that explains in simple terms what congestion measures are available to the public and what the federal, state and local agencies are planning to address. This video would be useful in presentations to civic, professional and interested groups. Public input would be solicited after the showing of the video.

CHAPTER II

EXISTING AND FUTURE BASELINE CONDITIONS

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INTRODUCTION

The purpose of this chapter is to present a summary and analysis of the existing and future conditions of the system-wide network and sample locations in the project study area. These sample locations were selected to illustrate how the program will operate and the procedures and data collection necessary to analyze the system as a whole. Data used in the preparation of this report was obtained through the Alabama Department of Transportation, City of Birmingham Traffic Engineering Department and two independent field survey teams.

LOCATION SELECTION

Sample locations were chosen to give a well represented cross section of the study area using the congestion index found in the data base inventory. These locations were presented to the Advisory Committee for discussion and 25 locations were selected to be used for additional analysis. Location descriptions and congestion indexes are shown in Table 1. See Figure 1 for the road system under study and 25 sample locations receiving further study.

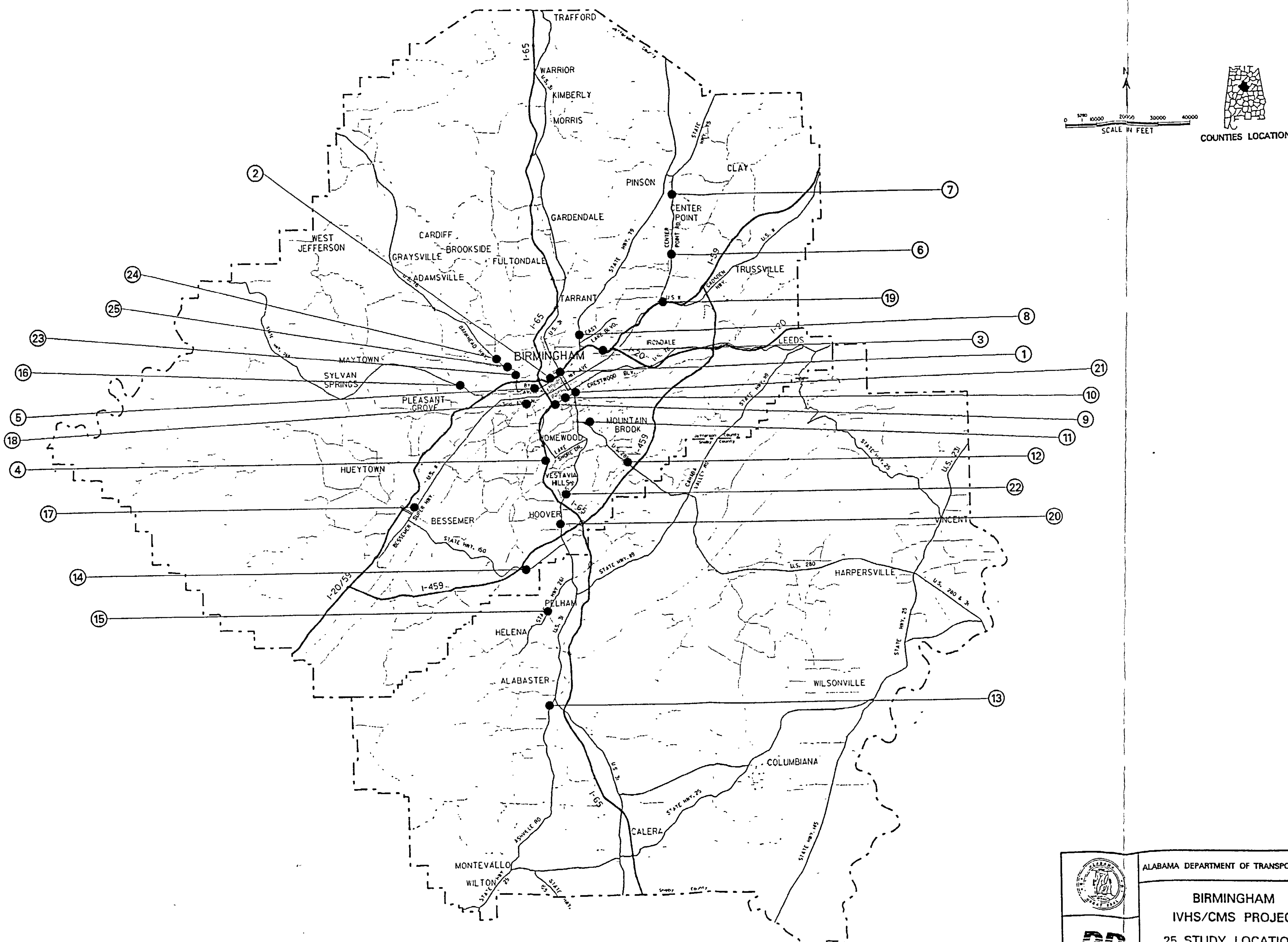
ADDITIONAL DATA COLLECTION AND METHODOLOGY

Additional data was collected as needed at the selected locations including turning movement counts, vehicle occupancy, speed and delay, signal phasing and roadway features. This data was used to evaluate selected locations using the analysis methodology outlined in this chapter. Table 2 identifies the location, time periods and type of data collected necessary to complete the performance measures. In addition to the data collected as part of this study, other features should be noted in order to develop a basis for which improvements are to be made. These include roadway constraints such as substandard design, terrain, routes which are heavily used during special events, and any other observed condition which would reduce roadway capacity.

TABLE 1

25 STUDY LOCATIONS

Location #	Node A	Node B	Milepost A	Milepost B	ROAD NAME (AND SEGMENT DESCRIPTION)	A-B Lanes	B-A Lanes	1994 Peak per Lane	Congestion Index (C.I.)	Volume/Flow Ratio	C.I. LOC
1	625	626	126.78	128.22	I-20/I-59 - Interchange #126B to #128	4.0	4.0	1,780	1.948	1.047	CONGESTED
2	622	623	124.97	125.91	I-20/I-59 - Interchange #125A to #125B	3.0	3.0	2,528	1.968	1.487	CONGESTED
3	627	609	129.55	130.25	I-20/I-59 - Interchange #129 to #130	3.0	3.0	1,979	1.403	1.164	CONGESTED
4	565	566	258.24	259.51	I-65 - Interchange #258 to #259	3.0	3.0	1,885	1.308	1.109	CONGESTED
5	569	570	260.44	261.23	I-65 - Interchange #260 to #261	4.0	3.0	1,821	1.233	1.071	CONGESTED
6	191	192	1.64	2.72	SR 75 (Center Point Pkwy.) - Huffman Rd. to 16th Ave. NW	2.0	2.0	990	1.758	1.524	CONGESTED
7	205	206	5.00	7.24	SR 75 (Center Point Rd.) - Westchester Rd. to Clayton St.	1.0	1.0	824	1.376	1.099	CONGESTED
8	161	162	1.96	2.06	SR 79 - I-20/59 WB/SB Exit Ramp (#128) to the Lane Addition (on SR 79)	2.0	2.0	1,692	2.603	2.603	CONGESTED
9	127	128	7.08	7.18	SR 149 (University Blvd.) - 13th St. S. to 14th St. S.	2.0	2.0	1,024	2.442	2.410	CONGESTED
10	133	134	7.83	7.88	SR 149 (University Blvd.) - 21st St. S. to 22nd St. S.	2.5	2.5	819	1.711	1.672	CONGESTED
11	644	643	2.03	2.31	US 280 - @ US 31 Interchange	1.0	1.0	2,633	3.534	3.511	CONGESTED
12	637	636	4.56	5.78	US 280 - Pumphouse Rd. to Dolly Ridge Rd.	2.0	2.0	1,029	1.727	1.584	CONGESTED
13	42	43	10.97	11.54	SR 119 - 11th Ave. SW to 6th Ave. SW	1.0	1.0	919	1.252	1.226	CONGESTED
14	75	650	8.87	9.41	SR 150 - Stadium Trace Pkwy. to Tree/Trace Crossings	1.5	1.5	441	0.718	0.715	UNCONGESTED
15	67	68	2.13	4.75	SR 261 - RR Crossing to N. Chandalar Dr.	1.0	1.0	952	1.300	1.271	CONGESTED
16	148	149	2.41	2.87	SR 269 - Ave. C. to Beginning of Divided Section	2.0	2.0	285	0.519	0.519	UNCONGESTED
17	355	356	124.73	125.03	US 11 - 19th St. to 22nd. St.	2.0	2.0	763	1.406	1.389	CONGESTED
18	390	391	135.02	135.27	US 11 - 3rd St. W. to Center St.	2.5	2.5	717	1.495	1.495	CONGESTED
19	448	449	145.62	145.77	US 11 - SR 75 to Roebuck Pkwy.	2.5	2.5	677	1.418	1.412	CONGESTED
20	257	258	265.97	266.32	US 31 - Hoover Commons Shopping Ctr. to Braddock Dr.	2.0	2.0	1,508	2.494	2.321	CONGESTED
21	284	285	272.85	276.71	US 31(Elton B. Stevens Expwy.) - US 280 Interchange to 6th Ave. N.	3.0	3.0	1,691	2.644	2.637	CONGESTED
22	261	262	267.02	267.78	US 31 - I-65 NB Return Ramp to Vestavia Pkwy.	2.0	2.0	1,281	1.984	1.972	CONGESTED
23	529	528	99.46	99.56	US 78 (Bankhead Hwy.) - Finley Blvd. to 12th Ave. W. (west of US 78)	2.0	2.0	1,048	1.627	1.613	CONGESTED
24	532	531	98.81	98.96	US 78 (Bankhead Hwy.) - Pratt Pkwy. to the Lane Drop on US 78	2.0	2.0	1,048	1.629	1.613	CONGESTED
25	528	527	99.56	99.57	US 78 (Bankhead Hwy.) - 12th Ave. W. (west of US 78) to 12th Ave. W. (east of U	2.0	2.0	1,048	1.615	1.613	CONGESTED



ALABAMA DEPARTMENT OF TRANSPORTATION

BIRMINGHAM
IVHS/CMS PROJECT
25 STUDY LOCATIONS

FIGURE 1

TABLE 2

ADDITIONAL DATA COLLECTION

Data to be Collected	Location	Time Period
Occupancy: Average persons in cars and in transit vehicles (if possible). If no transit vehicles are seen during time period, so state.	All arterials and freeways	AM or PM peak hour
Travel Time: Average (in seconds) through each arterial section. Count and record vehicles in queue for each run, then average (3 runs each direction).	All arterials and freeways	AM or PM peak hour
Delay: Total stopped time through system. Count vehicles in queue for each run, then average (3 runs each direction).	All arterials and freeways	AM or PM peak hour
Speed: Make three floating car runs in each direction, then average.	All arterials and freeways	AM or PM peak hour
Duration of delay: After average delay calculation, measure time period in minutes that the average delay occurs.	All arterials and freeways	AM or PM peak hour
Capacity: Collect geometric roadway features and adjustment factors.	All arterials and freeways	
Traffic volumes: Collect either 24 hour or peak hour counts including vehicle classification.	All arterials and freeways	AM or PM peak hour

SIGNALIZED INTERSECTION ANALYSIS

Table 3 summarizes the results of an operations analysis performed using the 1985 Highway Capacity Manual, Special Report 209, Transportation Research Board. A sampling of four signalized intersections were chosen from the 25 study locations to illustrate this process. Additional traffic volumes were obtained using machines which recorded volumes in 15-minute intervals. These volumes were used to determine the existing peak AM and PM travel times. The detailed operations analysis is shown in Appendix Chapter II Section A. Future volumes (2010) were determined based on the following growth rates supplied by the Alabama Department of Transportation.

Interstates	3.5% per year
All other roadways	2.75% per year

TABLE 3

OPERATIONS ANALYSIS SUMMARY

Loc. #	Intersection Location	Time	Volume (veh./hr.) Existing	Volume (veh./hr.) 2010	Level of Service Existing	Level of Service 2010
9	University Blvd. @ 13th Street	AM	3762	5650	E	F*
		PM	3707	5569	F	F+
16	Avenue C @ 20th Street	AM	2431	3651	F*	F+*
		PM	2192	3294	B	C
20	U.S. 31 @ Braddock Lane	AM	3594	5400	E	F*
		PM	3367	5059	C	F*
17	U.S. 11 @ 19th Street**	AM	1315	1976	B	B
		PM	3001	4507	B	F*

* Level of service F is due to one failed approach which may be rectified by improved signal timing.

** Actual phasing plans were not available for this location.

The following table provides a summary of the input information required to conduct an operational analysis.

TABLE 4

OPERATIONS ANALYSIS PARAMETERS

Type of Condition	Parameter
Geometric Conditions	Area Type Number of Lanes Lane Widths (ft.) Grades (%) Existence of Exclusive LT or RT Lanes Length of Storage Bay, LT or RT Lanes Parking Conditions
Traffic Conditions	Volumes by Movement (vph) Peak Hour Factor Percent Heavy Vehicles Conflicting Pedestrian Flow Rate (peds/hr.) Number of Local Buses Stopping in Intersection Parking Activity (parking maneuvers/hr.) Arrival Type
Signalization Conditions	Cycle Length (sec.) Green Times (sec.) Actuated vs. Pretimed Operation Pedestrian Push-Button ? Minimum Pedestrian Green Phase Plan

TRAVEL TIME AND DELAY STUDIES

The objectives of the travel time and delay studies are to evaluate the operating conditions along a route and to determine the extents of traffic delay. A travel time and delay study was conducted using the average car technique where the vehicle traveled according to the driver's judgment of the average speed of the traffic stream. Beginning and ending points were selected in the project study area with time readings taken at these locations. As the test car was forced to stop or travel slowly, these times and durations were measured and recorded. The duration of delay represents the period that delay occurs in minutes. This time period may occur within the duration of the peak hour period. As part of this study, oberservations noted an average vehicle occupancy of 1.1. Table 5, below, summarizes the existing conditions of the 25 selected locations.

TABLE 5

EXISTING CONDITIONS - 25 SELECTED LOCATIONS

LOCATION (SEE MAP)	SEGMENT LENGTH (MILES)	AVERAGE TRAVEL TIME/ VEHICLE (SEC)	AVERAGE SPEED (MPH)	POSTED SPEED LIMIT	STOPPED DELAY/VEH (SEC)	DURATION OF DELAY (MIN)	CONGESTION INDEX *
1	1.44	188	30	55	10	32	1.948
2	0.94	74	60	55	0	0	1.968
3	0.70	51	35	55	0	0	1.403
4	1.27	161	40	55	10	30	1.308
5	0.79	52	55	55	0	0	1.233
6	1.08	309	40	45	90	85	1.758
7	2.24	255	40	40	90	66	1.378
8	0.10	75	20	40	60	53	2.6
9	0.10	16	20	30	40	67	2.442
10	0.05	46	20	30	30	31	1.711
11	0.28	62	20	55	NA	NA	3.534
12	1.22	782	40	55	660	51	1.584
13	0.57	346	30	35	280	34	1.228
14	0.54	61	45	45	10	21	0.71
15	2.62	307	45	35	0	0	1.271
16	0.46	52	35	35	0	0	0.519
17	0.30	59	25	40	20	32	1.389
18	0.25	71	30	40	42	27	1.495
19	0.15	84	30	40	64	15	1.412
20	0.35	41	40	40	0	0	2.321
21	3.86	218	50	55	20	61	2.637
22	0.76	93	40	40	35	21	1.972
23	0.10	62	35	40	25	14	1.613
24	0.15	43	35	40	10	15	1.613
25	0.01	59	20	40	42	121	1.613

* Congestion index taken from database with uncongested <1.0 and congested $\geq$ 1.0.

RAMP/FREEWAY JUNCTION ANALYSIS

The procedure for determining the level of service for ramp/freeway junctions is dependent on the sum of the hourly flow rates, in equivalent passenger cars per hour (pcph), of the freeway lane and ramp lane.[1] The point at which vehicles enter a freeway mainline from an on-ramp or the point at which mainline traffic diverges to an off-ramp are termed ramp/freeway junctions. Table 6, below, summarizes the existing operating conditions and levels of service of selected ramp/freeway junctions. A detailed operations analysis is shown in Appendix Chapter II Section B.

TABLE 6

OPERATING CONDITIONS

Location #	Location	Ramp	# Lanes Ea. Dir. Freeway	# Ramp Lanes	Existing Volumes Freeway AM	Existing Volumes Freeway PM	Existing Volumes Analysis Ramp AM	Existing Volumes Analysis Ramp PM	2010 Volumes Freeway AM	2010 Volumes Freeway PM	2010 Volumes Analysis Ramp AM	2010 Volumes Analysis Ramp PM
1	I-20/I-59 EB/NB @ Exit 126B	Off	4	1	4719	6753	812	457	7089	10,144	1220	687
		On	4	1	4719	6753	346	553	7089	10,144	520	8310
1	I-20/I-59 WB/SB @ Exit 126B	Off	4	1	7897	7543	558	2957	11,863	11,331	838	443
		On	4	1	7897	7543	516	865	11,863	11,331	775	1299
8	I-20/I-59 EB/NB @ Exit 128	Off	3	1	4307	6254	649	968	6470	9395	975	1454
		On	3	2	4307	6254	495	884	6470	9395	744	1328
8	I-20/I-59 WB/SB @ Exit 128	Off	3	1	6256	6315	1043	1685	9398	9486	1567	2531
		On	3	2	6256	6315	2029	1432	9398	9486	3048	2151

LEVELS OF SERVICE

Location #	Location	Ramp	Existing LOS Freeway AM	Existing LOS Freeway PM	Existing LOS Diverge/Merge AM	Existing LOS Diverge/Merge PM	2010 LOS Freeway AM	2010 LOS Freeway PM	2010 LOS Diverge/Merge AM	2010 LOS Diverge/Merge PM
1	I-20/I-59 EB/NB @ Exit 126B	Off	C	D	F	F	F	F	F	F
		On	C	F	C	E	F	F	F	F
1	I-20/I-59 WB/SB @ Exit 126B	Off	F	F	D	C	F	F	F	F
		On	D	E	F	F	F	F	F	F
8	I-20/I-59 EB/NB @ Exit 128	Off	C	F	C	F	F	F	F	F
		On	D	F	C	F	F	F+	F	F+
8	I-20/I-59 WB/SB @ Exit 128	Off	F	F	F	F	F	F	F	F
		On	F	F	F	F	F+	F+	F+	F+

[1] Traffic Engineering Handbook, ITE, 1992.

Table 7, below, gives the merge and diverge level of service criteria.

TABLE 7

LEVEL OF SERVICE CRITERIA FOR CHECKPOINT FLOW RATES AT RAMP/FREEWAY TERMINALS

Level of Service	Merge Flow Rate (PCPH)[a] v_m	Diverge Flow Rate (PCPH)[b] v_d	Freeway Flow Rates (PCPH)[c], v_f								
			70 mph Design Speed			60 mph Design Speed			50 mph Design Speed		
			4-Lane	6-Lane	8-Lane	4-Lane	6-Lane	8-Lane	4-Lane	6-Lane	8-Lane
A	≤ 600	≤ 650	≤1,400	≤2,100	≤2,800	d	d	d	d	d	d
B	≤1,000	≤1,050	≤2,200	≤3,300	≤4,400	≤2,000	≤3,000	≤4,000	d	d	d
C	≤1,450	≤1,500	≤3,100	≤4,650	≤6,200	≤2,800	≤4,200	≤5,600	≤2,600	≤3,900	≤5,200
D	≤1,750	≤1,800	≤3,700	≤5,550	≤7,400	≤3,400	≤5,100	≤6,800	≤3,200	≤4,800	≤6,400
E	≤2,000	≤2,000	≤4,000	≤6,000	≤8,000	≤4,000	≤6,000	≤8,000	≤3,800	≤5,700	≤7,600
F	WIDELY VARIABLE										

[a] Lane 1 flow rate plus ramp flow rate for one-lane, right-side on-ramps.
[b] Lane 1 flow rate immediately upstream of off-ramp for one-lane, right side on-ramps.
[c] Total freeway flow rate in one direction upstream of off-ramp and/or downstream of on-ramp.
[d] Level of service not attainable due to design speed restrictions.

Source: *Highway Capacity Manual*, 1985, Special Report 209 (Washington, D.C.: Transportation Research Board), pp. 5-6, 5-15.

SUMMARY

The main objectives of the database and the analysis outlined in this chapter are to identify problem areas and monitor improvements. Problem areas are identified on a system wide basis based on the congestion index of each segment found in the database (see Appendix Chapter I). A more detailed analysis is performed on selected areas using the methodology as shown in this chapter. The monitoring criteria used to continue this analysis and develop a congestion management system is described in Chapter IX - performance monitoring plan of this Phase I report. This process clearly indicates which improvements are eliminating congestion and identifies areas requiring further study by comparing the existing analysis made after improvements are implemented.

CHAPTER III

USER SERVICES PLAN

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INTRODUCTION

This document is the focus for identification and implementation of "User Services." These "User Services" are the Intelligent Vehicle Highway Systems (IVHS)* tools used by transportation providers and users. The users are defined as travelers of any mode, operators of transportation management centers, transit operators, MPO's, commercial vehicle operators and owners, state and local governments, and many others who utilize transportation services or technologies. Although each user service is unique, they share several common characteristics. User services are:

- Composed of Multiple Technological Elements
  A single user service will usually depend upon several technologies such as advanced communications, mapping, and surveillance.
- Building Blocks
  Once the basic technological functions, such as communications or surveillance, have been deployed for one or more service, the additional functions needed by one or more related services may require only a small additional incremental cost, while producing additional benefits. User services can be combined for deployment in a variety of ways depending on local priorities, needs, and market forces.
- Adaptable to Rural, Urban, and Suburban Settings
  ITS user services are not specific to a particular location. Rather, the function of the service can be adapted to meet local needs and conditions.

"User Services" are composed of many technologies or strategies. Once the basic technology or function is implemented, other strategies can be added with small incremental costs, i.e., communications and surveillance technologies are used in many of the "User Services." By virtue of this characteristic, several like user services can be bundled together for ease of development and implementation. These "bundles" are cited on Table 1, shown on page 2.

**The replacement title for IVHS is Intelligent Transportation Systems (ITS)*

TABLE 1

USER SERVICE BUNDLES

BUNDLE	*USER SERVICES*
1. Travel and Transportation Management and Operations	1. Enroute Travel Information 2. Route Guidance 3. Traveler Services Information 4. Traffic Control 5. Incident Management
2. Travel Demand Management	1. Pre-trip Travel Information 2. Ride Matching and Reservation 3. Demand Management
3. Public Transportation Management and Operations	1. Public Transportation Management 2. En-route Transit Information 3. Personalized Public Transit 4. Public Travel Security
4. Electronic Payment	1. Electronic Payment Services
5. Commercial Vehicles Management and Operations	1. Commercial Vehicle Electronic Clearance 2. Automated Roadside Safety Inspection 3. On-board Safety Monitoring 4. Commercial Vehicle Administrative Processes 5. Hazardous Material Incident Response 6. Commercial Fleet Management
6. Emergency Management	1. Emergency Notification and Personal Security 2. Emergency Vehicle Management
7. Advanced Vehicle Control and Safety Systems	1. Longitudinal Collision Avoidance 2. Lateral Collision Avoidance 3. Intersection Collision Avoidance 4. Vision Enhancement 5. Safety Readiness 6. Pre-Crash Restraint Deployment 7. Automated Highway Systems

USER SERVICES

A complete description of the User Services which may be applicable to the Birmingham, Alabama, planning area was assembled based on FHWA and National ITS Program documents (see Reference Nos. 3, 12, 13 and 15). A detailed discussion and presentation of user services and user service bundles is provided in Appendix Chapter III Section A.

PROBLEM DEFINITION

The first step was to define the problems that cause or contribute to congestion in the Birmingham planning area. These problem areas should not be solutions to the problem, but actual causes of congestion. A list of 13 problems are shown on Table 2, below. These problems are the foundation for determining strategies and projects for implementation.

TABLE 2

PROBLEM AREAS

1. Congestion due to incidents.
2. Congestion due to roadway construction.
3. Air quality non-attainment.
4. Under used mass transportation facilities.
5. Congestion due to motorist information and guidance.
6. Congestion due to capacity on freeways, ramps and interchanges.
7. Congestion due to capacity on arterials and collectors (through multiple jurisdictions).
8. Adverse effect of institutional coordination and barriers.
9. Congestion and accidents due to roadway planning, design, operations, and maintenance (land use controls, access management, traffic signal design installation and operations, signage, marking).
10. Congestion due to special events.
11. Congestion due to for truck traffic.
12. Congestion due to major public, private and commercial developments.
13. Congestion and accidents due to motorists education and traffic law enforcement.

OPPORTUNITIES

Surveys of Birmingham transportation officials and citizens were conducted by PB which indicated the perceived problem areas and opportunities. Some of the opportunities that were based on the results of this study are shown in Table 3. The complete results of these surveys are shown in Appendix Chapter III Section B. As indicated, there were many opportunities in the Birmingham planning area for implementation of IVHS "User Services," especially strateies described previously as "travel and transportation management and operations," "travel demand management," and "public transportation management and operations." These type projects are similar to the projects already planned for implementation through the MPO planning process. These and other user services were analyzed in detail as will be presented in the USER SERVICES IDENTIFICATION SECTION of this "User Services" plan.

TABLE 3

SOLUTIONS TO CONGESTION

• Timely removal of debris in roadway	• Improve transit service
• Safer merging conditions	• Improve signal timing, control and placement of traffic signals
• Improve incident management	• Better manage traffic
• Transit / carpool park-and-ride lots	• Safer existing conditions ("exit only" lanes, etc.)
• Reserve lanes for HOV's	• Improve roadway striping/marking/signs
• Improve roadway signing	• Remove unwarranted signals
• Telecommuting	• Congestion pricing (Some/higher parking costs)
• Consolidation of driveway accesses	• Variable work schedules
• More roadway capacity (additional lanes, roadways)	• Ridesharing (carpool / vanpool) program
• Revising Truck Traffic Policies	• Additional lanes
• Enforce Speed Limints	• Provide Alternate Available Routes
• Implement Access Control	• Educate Drivers on Traffic Laws

EXISTING SYSTEMS

Before the "User Services" were selected, the existing transportation infrastructure and facilities were inventoried. These systems are composed of organizational agencies, physical components, studies and plans. The organizational components are described below:

ORGANIZATION	RESPONSIBILITY
City of Birmingham	
Traffic Engineering Department	Traffic engineering, administration, traffic operations, and maintenance.
Birmingham Police Department	Law enforcement and accident investigation
Engineering and Planning	City engineering, transportation planning, land use planning, and master planning.
Fire Department	Hazardous material cleanups.
Metropolitan Planning Organization	Long range transportation planning, transportation improvement plans, transportation funding,
Technical Coordinating Committee (TCC)	Technical review of transportation documents, development of the transportation improvement program, support to the MPO.
Birmingham Regional Planning Commission (BRPC)	Staff agency to the MPO, transportation planning, transportaion modeling, air quality, transportation funding, development of long range transportation plan.
Alabama Department of Transportation	
Multimodal Bureau	Transportation management systems.
Transportation Planning Bureau	Statewide planning, project scheduling, transportation funding.
Design Bureau	Environmental assessment and air quality.
Division Engineer (3rd Division)	Project design, maintenance, and funding.
District Engineer (3rd Division)	Transportation Maintenance.
Alabama State Troopers	Traffic law enforcement and accident investigation. Motorist assistance.
Jefferson County	
County Engineer and Traffic Engineer	Traffic engineering administration, traffic operations and mainteance, transportation funding, project development.
Public Health Department	Environmental impact and air quality.
Sheriffs Department	Traffic law enforcement and accident investigation.
Alabama Department of Environmental Management (ADEM)	Environmental assessment and air quality.
Federal Highway Administration (FHWA)	Transportation planning, transportation systems, project review, IVHS (ITS), environmental review and air quality.
Birmingham - Jefferson County Transit Authority (MAX)	Manages and operates the transit system including rideshare/ vanpool activities.

An inventory of existing studies in the Birmingham planning area that affects the transportation system network and outlines past studies of the operation of the transportation system were researched and are listed below:

1. Post, Buckley, Schuh and Jernigan, Inc., Congestion Mitigation and Air Quality Improvement Program Study for the Birmingham Non-attainment Area, Alabama DOT and Birmingham Air Quality Task Force, October 1994.
2. Birmingham Metropolitan Planning Area, 2010 Long-Range Transportation Plan Update - Phase III, Regional Planning Commission, January 1994.
3. Magic Program for Birmingham Area, Alabama Department of Transportation, October 1992.
4. Birmingham Regional Transportation Study/Plan Report, Birmingham - Jefferson County Transit Authority, Gannett Fleming, Inc., October 19, 1993.
5. Transportation Improvement Program, FY 1994 - 1998, Birmingham MPO, Birmingham Regional Planning Commission, October 1993.
6. 2010 Highway Plan Update - Phase I - 1990 - 2010 Volume/Capacity Analysis for Existing Roadways, Birmingham Regional Planning Commission, September 1991.
7. 1993 Traffic Accident Summary, Jefferson County Traffic Engineering Department, June 1994.
8. U.S. 280 Closed Loop Traffic Signal System, Before and After Evaluation Study, Jefferson and Shelby Counties, Alabama, SASCO, Watt and Estes, Inc.
9. I-65 and I-59, Analysis and Evaluation of Existing Facility, State of Alabama Highway Department, Miller, Watt and Estes, March 1985.
10. Transportation Control Measures: State Implementation Plan Guidance, U.S. Environmental Protection Agency (EPA), Pacific Environmental Services, Inc., September 1990.
11. Intelligent Vehicle Highway System (IVHS) Planning and Functional Requirements, an Overview, USDOT Federal Highway Administration, JHK and Associates, July 1994.
12. IVHS User Services Requirements, USDOT, October 13, 1993.
13. IVHS - The State of the Art, Massachusetts Department of Highways, JHK and Associates, March 1993.
14. IVHS Planning and Project Deployment Process, USDOT, FHWA, April 1, 1993.
15. Long Range Transportation Plan, Highway and Transit Element, Birmingham Planning Commission, BRPC, April 1994.
16. Transit Vision 2000, Center for Urban Affairs, the University of Alabama at Birmingham, September 1993.

The physical components of the system were inventoried and are discussed in detail in Appendix Chapter III Sections C and D. Section C shows the existing signal systems and transportation control centers that exist and are planned for the Birmingham planning area, which includes the city of Birmingham, outlying communities, Jefferson County and Shelby County. The existing transit system is operated by the Birmingham - Jefferson County Transit Authority (MAX). An inventory of the existing transit facilities and routes are shown in detail Section D of Appendix Chapter III.

The existing roadway network in the study area is shown on a network map included in Appendix Chapter III Section E. Due to project scope and schedule limitations, the initial network did not include any off-system, non-federal or non-state numbered roads, other than one defense access road.

An inventory of the existing traffic volumes for the study roadways was obtained from ALDOT. An analysis of this data was made using the travel forecasting capacities provided by the BRPC, Appendix Chapter III Section F. The current volume/capacity ratios were calculated by the BRPC for all roadways in the Birmingham Planning area. The results for the current and future build and no-build alternatives are shown in Appendix Chapter III Section G. Volume capacity ratios and congestion indices were calculated by PB for the freeways and arterials on the state system. They are a part of this study and are shown in Appendix Chapter I. The methodology used for the development of these congestion indices was discussed in Chapter I - CMS Development, along with input traffic data, capacities and accident data that were used and are shown in Appendix Chapter I.

Other data was obtained from various sources such as: accident information from ALDOT and Jefferson County; copies of studies showing the transit network and service by MAX, long range transportation plans, and studies from the BRPC.

INSTITUTIONAL FRAMEWORK

At the beginning of this study an advisory and oversight committee was established. These committees were formed to include representatives from all transportation agencies in the Birmingham planning area. A listing of these agencies is shown in Appendix Chapter III Section I. A list of committee members is provided in Appendix Chapter III Section J. Several meetings were held with these committees and a listing of these meetings is also shown in Section J. Several other agencies will need to be added to these committees before implementation of the user servive projects such as the media, utilities, private transportation providers, commercial vehicle operators, chamber of commerce, etc.

USER SERVICES IDENTIFICATION

Based on the problems listed previously, the needs of the Birmingham area were matched with the 29 user services identified by the National Intelligent Transportation Systems (ITS) Committee. A listing of these "User Services" and their implementation strategies are presented in Appendix Chapter III Section A. These services were analyzed based on development of system and User Service objectives and performance criteria for each problem area. A summary of the results of this analysis is shown in Table 4. The detailed analysis that was used to develop this information is shown in Appendix Chapter III Section K. These "user services" were also identified based on short-, medium-, and long-term implementation requirements.

Based on a subjective analysis of the "User Services" ability to solve the problems defined, meet system and user service objectives, and the goals and objectives of this study, projects were characterized as applicable, somewhat applicable or not applicable. The detailed results of this analysis, by problem area, is contained in Section K of Appendix Chapter III.

This data was summarized and is shown on Table 4. The "User Services" with the highest "Very Applicable" score were prioritized as shown on Table 4. The "User Services" showing the best opportunity for solving congestion problems in the Birmingham area based on the above analysis, were ranked in priority order and are shown on Table 5.

TABLE 4

SUMMARY*1 AND PRIORITY RANKING*2 OF USER SERVICES

USER SERVICE	VERY APPLICABLE	SOMEWHAT APPLICABLE	NOT APPLICABLE	PRIORITY RANKING
Pre-Trip Travel Information	9	3	1	4*3
Enroute Travel Information	6	7	0	8
Route Guidance	10	3	0	2
Ride Matching and Reservation	5	7	1	9
Traveler Services Information	7	6	0	7
Traffic Control	9	4	0	3
Incident Management	11	2	0	1
Travel Demand Management	9	3	1	4*3
Public Transportation Management	8	4	1	6
Enroute Transit Information	3	9	1	12
Personalized Public Transit	1	11	1	22
Public Travel Security	1	10	2	23
Electronic Payment Services	2	8	3	19
Commercial Vehicle Electronic Clearance	1	9	3	24
Automated Roadside Safety Inspection	0	9	4	28
On-board Safety Monitoring	0	10	3	27
Commercial Vehicle Administrative Processes	3	7	3	13
Hazardous Material Incident Management	2	10	1	17*3
Commercial Fleet Management	5	6	2	10
Emergency Notification and Personal Security	3	10	0	11
Emergency Vehicle Management	2	10	1	17*3
Longitudinal Collision Avoidance	2	11	0	14*3
Lateral Collision Avoidance	2	11	0	14*3
Intersection Collision Avoidance	1	12	0	20*3
Vision Enhancement for Crash Avoidance	1	12	0	20*3
Safety Readiness	2	11	0	14*3
Pre-Crash Restraint Deployment	0	13	0	25*3
Automated Vehicle Operation	0	13	0	25*3

*1 *The number of ratings by "User Services" from the work sheets in Appendix Chapter III Section K were totaled by column.*

*2 *"User Services" were ranked by the highest total number of ratings in the very applicable category in priority order.*

*3 *Denotes tied ranking.*

TABLE 5

SELECTED USER SERVICES

	SHORT	MEDIUM	LONG
1. Incident Management	X	X	
2. Route Guidance		X	X
3. Traffic Control	X	X	
4. Pre-trip travel information	X	X	X
5. Travel Demand Management	X	X	X
6. Public Transportation Management	X	X	X
7. Travelers Service Information	X	X	X
8. En-route Travel Information	X	X	X
9. Ride Matching and Reservation	X	X	
10. Commercial Fleet Management		X	X

These ten user services are recommended for further study and analysis. Based on this "User Service" plan, alternate congestion management strategies and a system architecture plan will be developed as part of this study and summarized in a project summary report.

REFERENCES

1. Post, Buckley, Schuh and Jernigan, Inc., Congestion Mitigation and Air Quality Improvement Program Study for the Birmingham Non-attainment Area, Alabama DOT and Birmingham Air Quality Task Force, October 1994.
2. Birmingham Metropolitan Planning Area, 2010 Long-Range Transportation Plan Update - Phase III, Regional Planning Commission, January 1994.
3. National ITS Program Plan, USDOT, November 1994.
4. Magic Program for Birmingham Area, Alabama Department of Transportation, October 1992.
5. Birmingham Regional Transportation Study/Plan Report, Birmingham - Jefferson County Transit Authority, Gannett Fleming, Inc., October 19, 1993.
6. Transportation Improvement Program, FY 1994 - 1998, Birmingham MPO, Birmingham Regional Planning Commission, October 1993.
7. 2010 Highway Plan Update - Phase I - 1990 - 2010 Volume/Capacity Analysis for Existing Roadways, Birmingham Regional Planning Commission, September 1991.
8. 1993 Traffic Accident Summary, Jefferson County Traffic Engineering Department, June 1994.
9. US 280 Closed Loop Traffic Signal System, Before and After Evaluation Study, Jefferson and Shelby Counties, Alabama, SASCO, Watt and Estes, Inc.
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14. IVHS - The State of the Art, Massachusetts Department of Highways, JHK and Associates, March 1993.
15. IVHS Planning and Project Deployment Process, USDOT, FHWA, April 1, 1993.
16. Long Range Transportation Plan, Highway and Transit Element, Birmingham Planning Commission, BRPC, April 1994.
17. Transit Vision 2000, Center for Urban Affairs, the University of Alabama at Birmingham, September 1993.

CHAPTER IV

SYSTEM ARCHITECTURE PLAN

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INTRODUCTION

Stakeholders in Intelligent Vehicle/Highway System (IVHS)* User Services, i.e., State DOT, MPO, City of Birmingham, Jefferson County, police and fire departments, have to be assured that investment of transportation funds will result in projects that function as designed, will not become obsolete and are applicable to solve the problems that have been identified to cause congestion in the Birmingham planning area. The framework for this process is called System Architecture. The System Architecture describes, by use of narrative description and charts, the operation and exchange of information of the System.

Defining what the system does and how it does it is accomplished by identifying User Service requirements (as developed by USDOT, FHWA). Allocation of these User Services to sub-systems, and defining information exchange and interfaces between subsystems is then accomplished. Flow charts are used to depict the framework of the system elements.

The objective of this exercise is to develop an administration plan that supports the user services identified in the User Service Plan; that is compatible with the existing Birmingham infrastructure (as identified in the User Service Plan); that provides flexibility for non-proprietary procurement; can be implemented (public, local or combination of funding); and maintained by the operating agencies.

FUNCTIONAL AREAS

As explained in the User Service Plan, the User Services that have the most potential for solving the identified problems in the Birmingham Area were prioritized and ranked. In the User Service Plan, these User Services were bundled into major areas for implementation. Identified User Services by major function were mapped with the appropriate functional areas as shown in Table 1.

* *Now titled Intelligent Transportation System (ITS)*

These functional areas will be needed to support the previously selected USER SERVICES. These functional areas are defined as:

- Surveillance:
  Collection of speed, volume, density, travel, time, queue length, position, classification, weather, hazardous material, and information for use in providing user services.
- Communication:
  Transmission of voice, data and video information among vehicles and system infrastructure (dependent on national architecture).
- Navigation / Guidance Functions:
  Systems to assist traveler in route planning, position identification, and route following.
- Information Management Functions:
  Management integration and quality control of all data algorithms pertaining to IVHS
- Traveler Interface:
  Means by which a traveler receives information
- Control Strategies:
  Strategies implemented by system to help regulate traffic flow and ensure traveler safety
- In-Vehicle Sensors:
  Monitoring of vehicles, driver and external driving environment pertaining to vehicle operations

USER SERVICE FUNCTIONS

The user service functions that are applicable to support or implement each technology were identified as shown on Table 2. The user service applicable functions are shown by bundled user service. These applicable functions are then grouped as shown in Table 1 by functional area.

IVHS ARCHITECTURE ISSUES

The IVHS architecture system must be described in terms of what it does and how it does it. The functions are further outlined by User Service Requirements, detailed in Appendix Chapter IV Section A. The User Service Requirements for each user Service and problem area are outlined in hierachial order, as an iterative process shown in Section A. These user service requirements are used to identify the technologies by functional area (Table 1) needed to support the user service, allocate user service requirements to subsystems, and define information

Table 1

Mapping Functional Area to Function

Functional Area	Traffic Surveillance	Vehicle Surveillance	Inter-Agency Coordination	1-Way Mobile Communications	2-Way Mobile Communications	Stationary Communications	Individual Traveler Interface	Payment Systems	Variable Message Displays	Signal Traffic Control	Restrictions Traffic Control	Navigation	Database Processing	Traffic Prediction Data Processing	Traffic Control Data Processing	Routing Data Processing	In-Vehicle Sensors / Devices
Surveillance	■	■						■									
Information Management			■					■					■	■	■	■	
Control Strategies										■	■						
Traveler Interface							■		■								
Navigation / Guidance				■	■		■					■					
Communications				■	■	■											
In-Vehicle Sensors																	■

(Functions)

flows and interfaces between subsystems. How the IVHS architecture system will operate was identified by mapping the user services to the IVHS technologies by the functional area. This is shown on the table in Appendix Chapter IV Section B - Mapping of User Services to IVHS Technologies.

The architecture technologies identified in Section B were then used to develop the architecture design. Figure 1 - IVHS Supporting Technologies - identified the technologies that have been developed and are supported by existing technologies. The USDOT FHWA has developed logical architecture and physical architecture for User Services that are compiled of these functional areas shown on Figure 1.

Another issue is the level of risk associated with the identified functions. These risks are presented in Appendix Chapter IV Section C - Architecture Risk of Mapped Functions. As discussed and presented in Section C, the architecture risk is minimal to moderate for the functions that support the user services that were recommended for Birmingham, Alabama. CMS/IVHS system architecture plans.

Other issues related to the IVHS architecture system are: 1) Compatibility with institutional framework; 2) Will the architecture system be "open", with "open" defined as incorporation standard, non-proprietary technologies, devices and systems; and 3) Allow for public/private responsibilities in funding and operating the sub-systems i.e., use of public right of way for private communications, resale of surveillance information or communications cable capacity to private concerns such as the media to recoup cost of IVHS technology, and the sale of advertising space on traveler information components such CMS and VMS. All of the technologies that were developed for implementation as part of this study for Birmingham, Alabama have been evaluated based on these issues, as well as other issues, and decisions were made in the design of architecture systems based on these concerns. Along with funding availability, the availability of existing technology was the primary concern, in designing the system architecture for Birmingham, Alabama.

SYSTEM ARCHITECTURE

The system architecture design was based on diagrams of the logical architecture and physical architecture for the recommended user services that are directed at solving identified problems in Birmingham, Alabama The logical architecture identifies information flows between functions (See Tables 1 and 2). The physical architecture, groups the functions into subsystems (See Appendix B - IVHS Technologies).

The system architecture is shown on the following Figures 2-9. The logical architecture and corresponding physical architecture was designed for each of the grouped or associated user services. These architecture designs will solve several problem areas as shown on the figures.

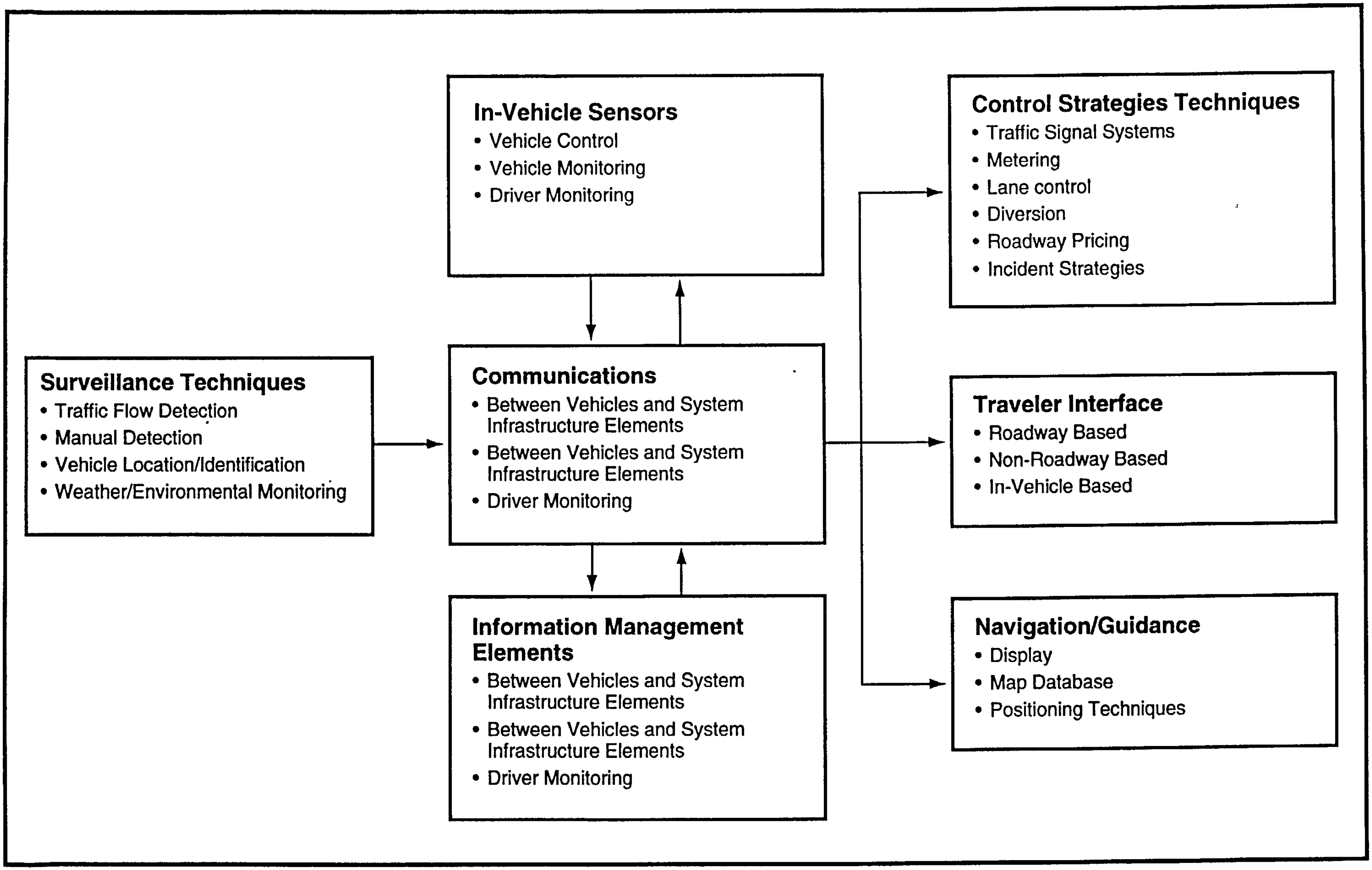

Figure 1 **IVHS Supporting Technologies**

TABLE 2

USER SERVICE FUNCTIONS

Payment Systems	Traffic Control	Data Base Processing	Stationary Communications	Traffic Surveillance	2-Way Mobile Communications	Individual Traveler Interface	Variable Message Displays	Navigation	1-Way Mobile Communications	Traffic Prediction Data Processing	Inter-Agency Coordination	Routing Data Processing	Signalized Traffic Control	Traffic Control Data Processing	Vehicle Surveillance	In-Vehicle Sensors/Devices	Provide Deployment Basis for these User Services
Travel and Transportation Management																	
		●	●	●	●	●	●	●	●	●	●	●					En-Route Driver Information
		●	●	●	●	●		●	●	●		●					Route Guidance
		●			●	●		●									Traveler Services Information
		●	●	●			●			●	●		●	●			Traffic Control
		●	●	●	●	●	●	●	●	●	●	●	●	●			Incident Management
Travel Demand Management																	
	●	●	●	●	●	●	●	●		●	●	●					Pre-Trip Travel Information
●		●	●		●	●	●	●	●		●	●			●		Ride Matching & Reservation
●	●	●	●			●	●	●	●				●		●		Travel Demand Management
Public Transportation Operations																	
●		●	●	●	●	●	●	●	●	●	●	●	●		●	●	Public Transportation Management
Commercial Vehicle Operations																	
		●	●		●	●		●	●			●			●		Commercial Fleet Management

Source: National ITS Program

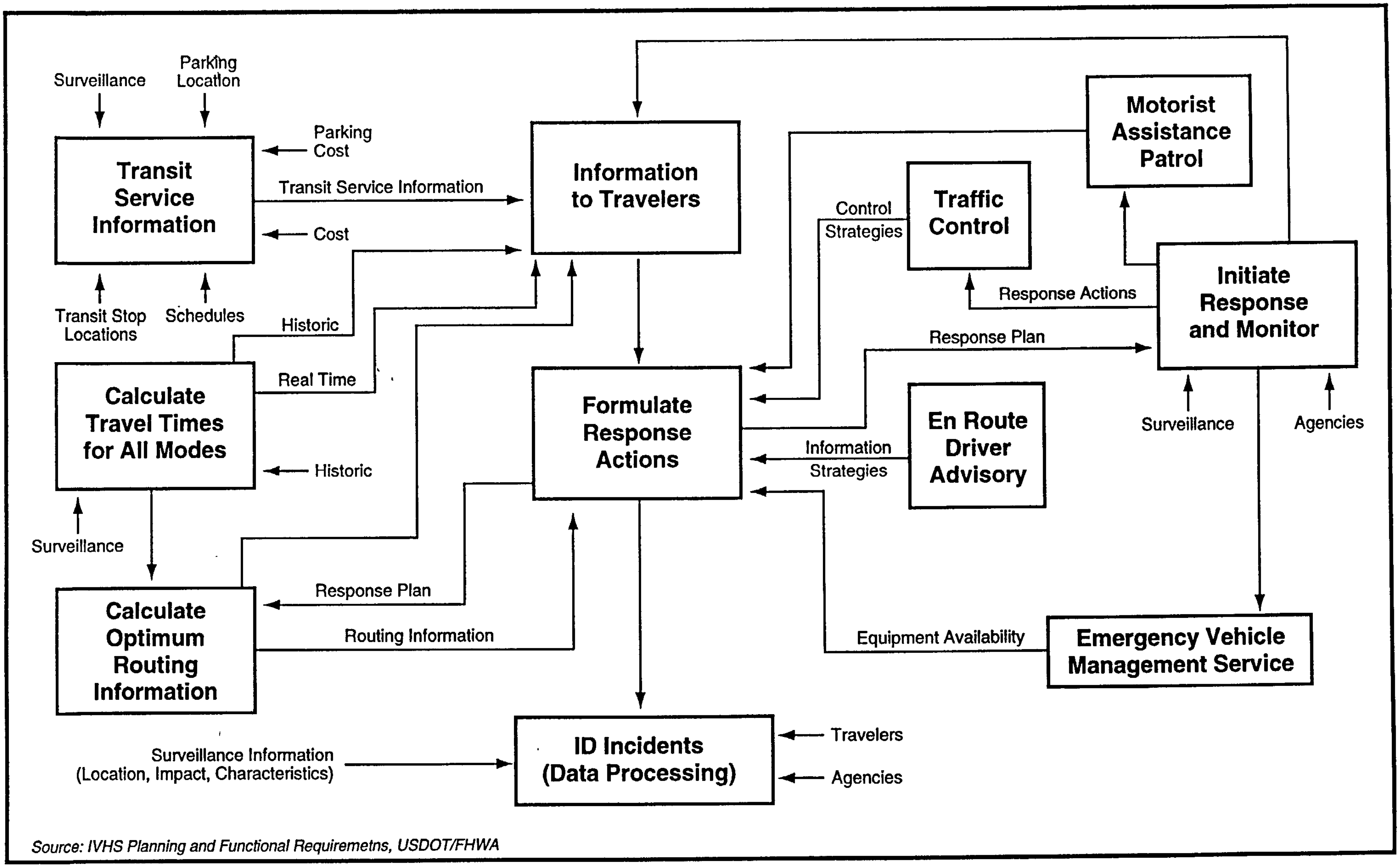

Figure 2 **Logical Architecture**

Problem: Congestion due to accidents / Roadway construction / air quality / motorist information and guidance / capacity on freeways and arterials / special events

User Sevices: Incident management and pre-trip travel information

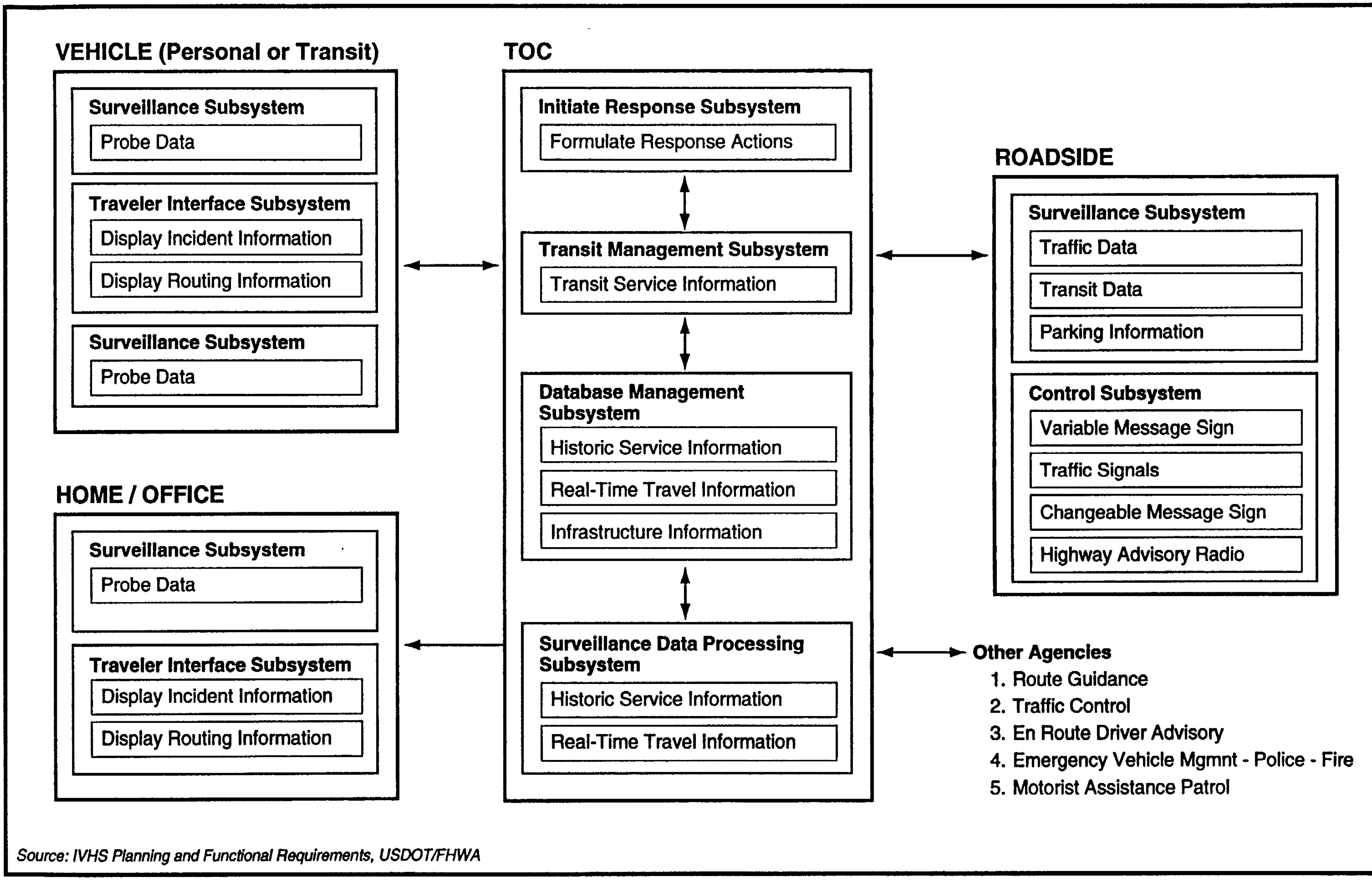

Figure 3 **Physical Architecture**

Problem: Congestion due to accidents / roadway construction / air quality / motorist information and guidance / capacity on freeways and arterials / special events
User Services: Incident management and pre-trip travel information

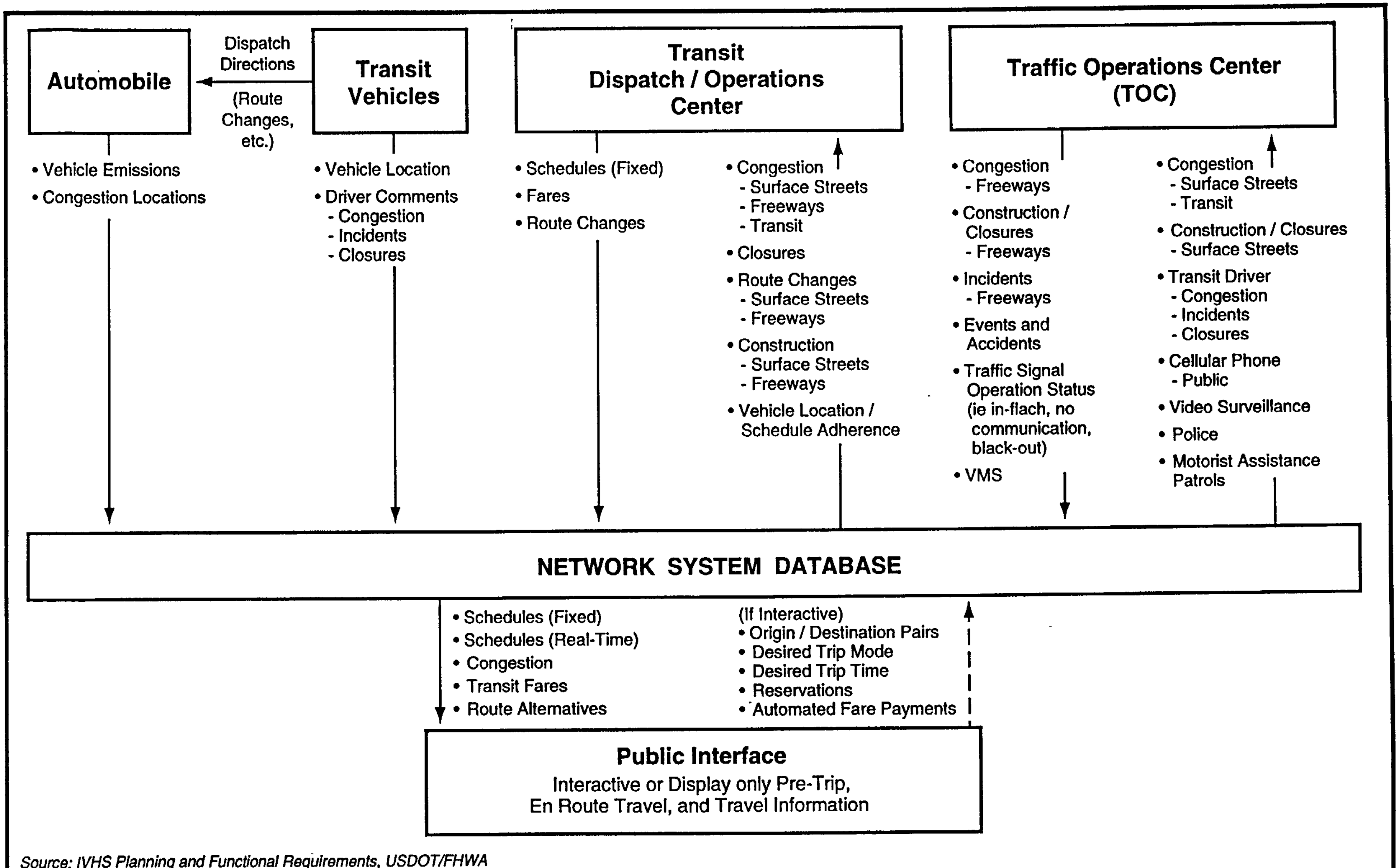

Figure 4 **Logical Architecture**

Problem: Congestion due to lack of capacity on freeways and arterials / roadway construction / air quality / motorist information and guidance / special events under used mass transit / roadway planning

User Services: Traffic control / transit management / en route driver information / route guidance

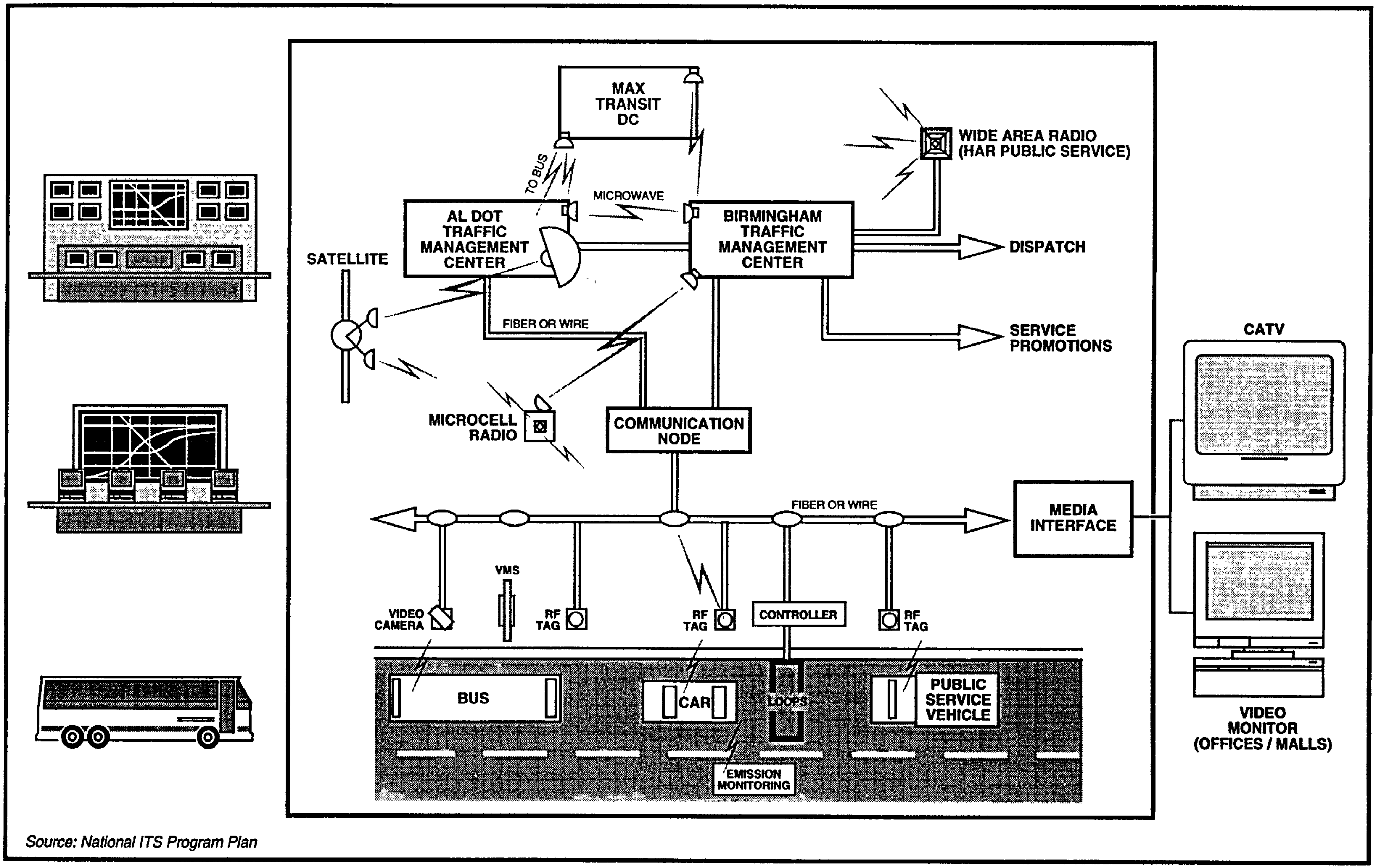

Figure 5 **Physical Architecture**

Problem: Congestion due to accidents / roadway construction / air quality / motorist information and guidance / capacity on freeways and arterials / special events

User Services: Traffic control / transit management / en route driver information / route guidance

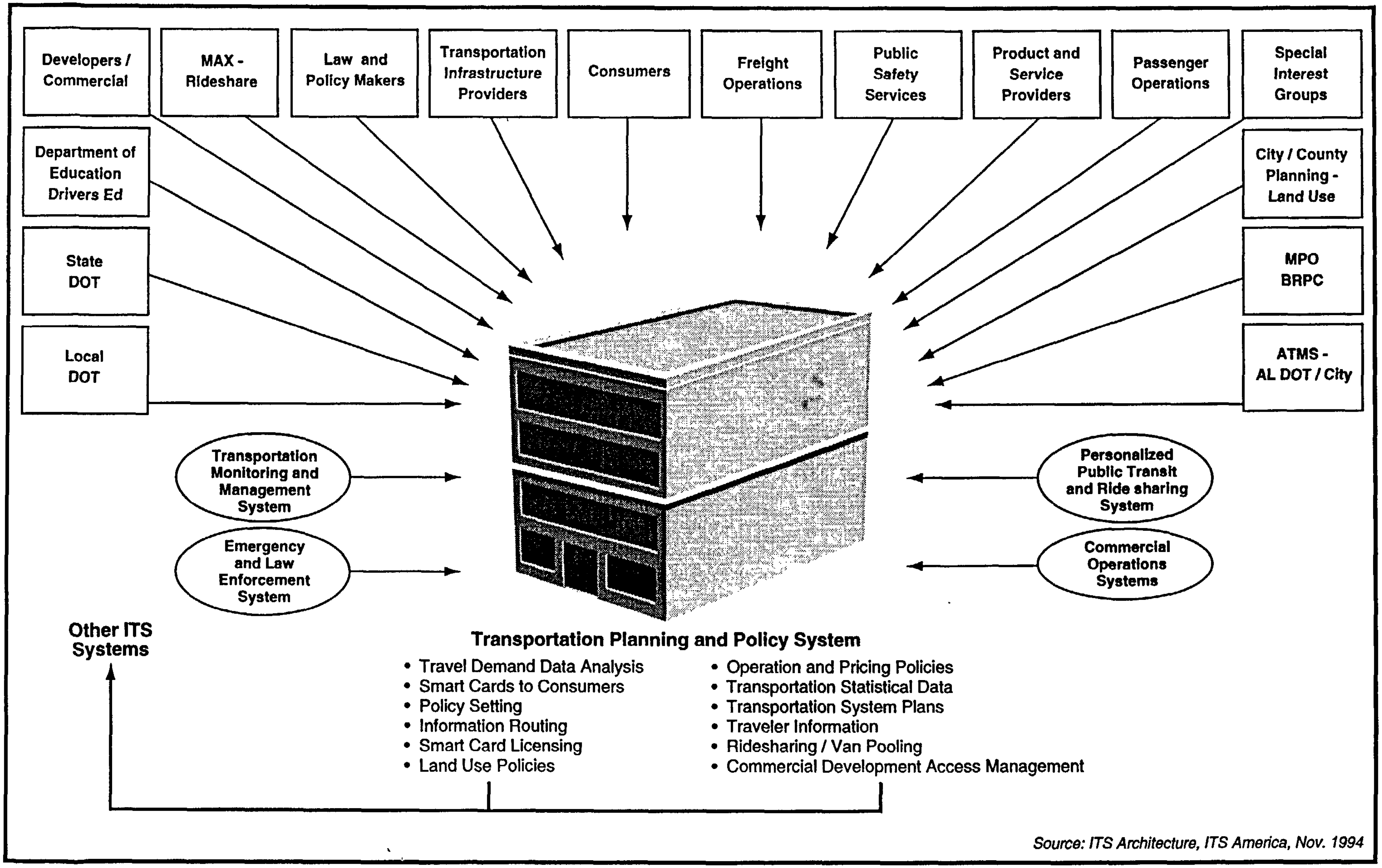

Figure 6 **Logical Architecture**

Problem: Congestion and accidents due to planning, design, operation, maintenance / access to commercial development / motorist information, education, and law enforcement

User Services: Travel services information, travel demand management, ride matching and reservation

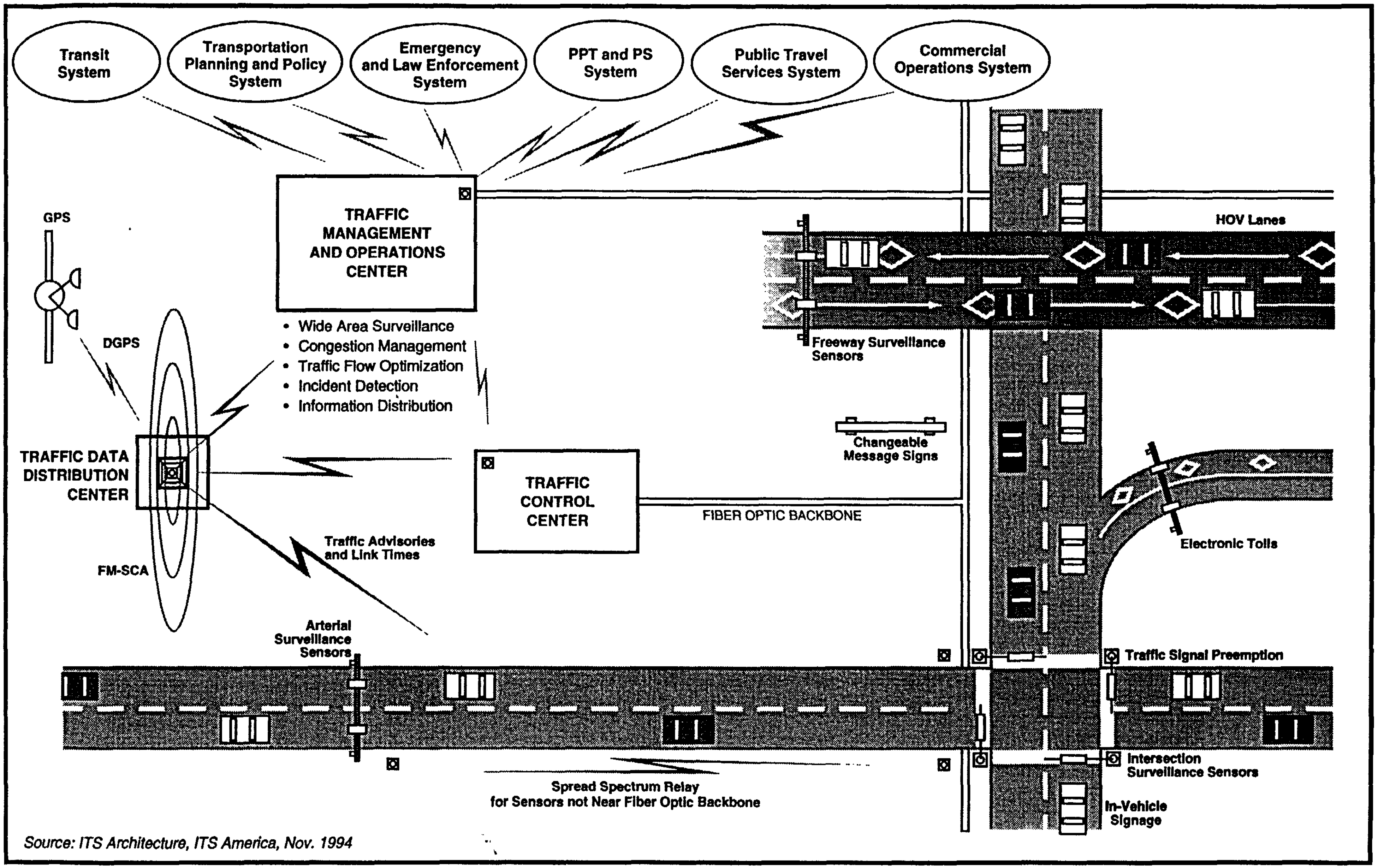

Figure 7 **Physical Architecture**

Problem: Congestion and accidents due to planning, design, operation, maintenance / access to commercial development / motorist information, education law enforcement

User Services: Traveler service information, travel demand management, ride matching and reservation

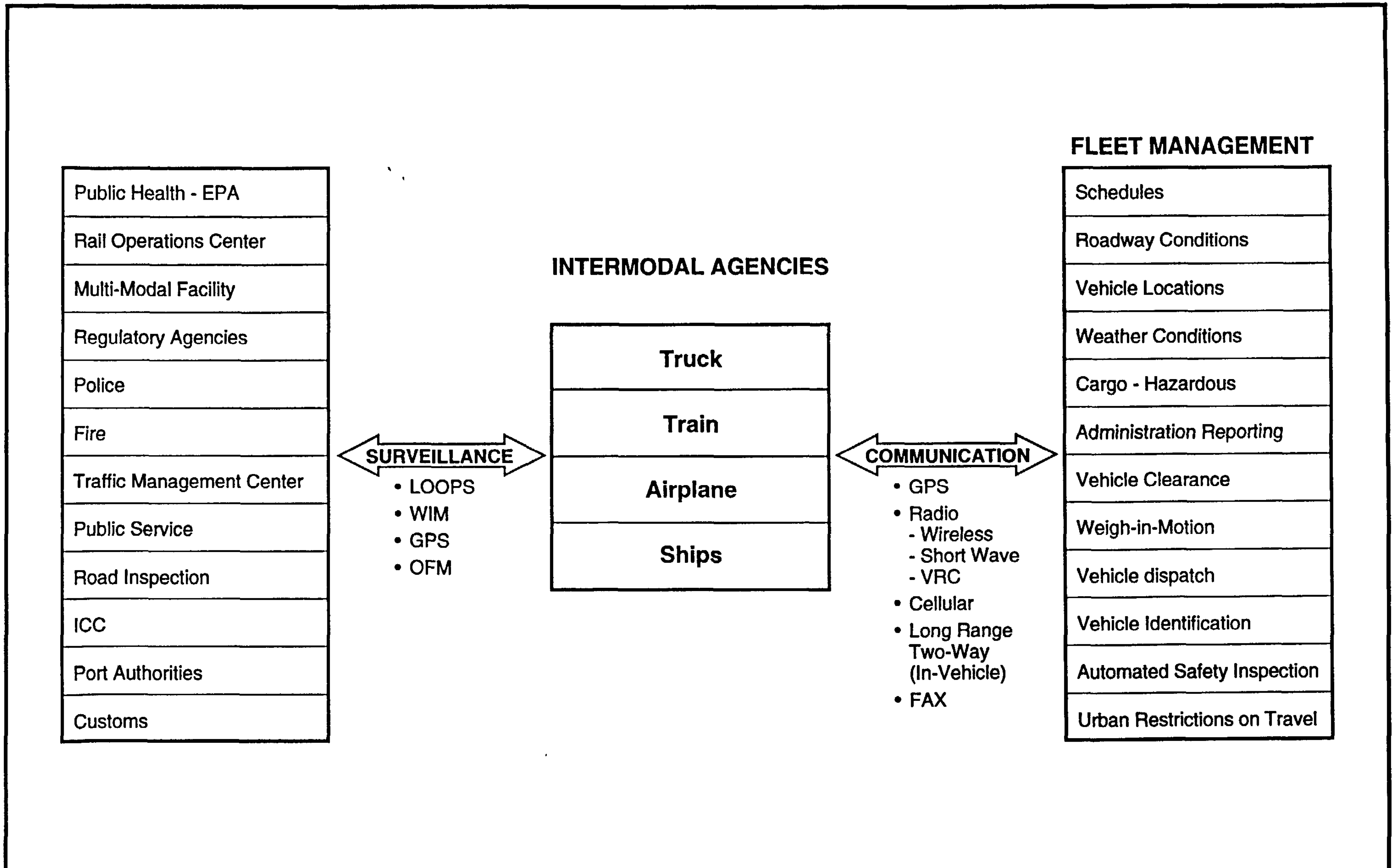

Figure 8 **Logical Architecture**

Problem: Congestion due to lack of policies, planning for truck traffic
User Services: Fleet management / air quality

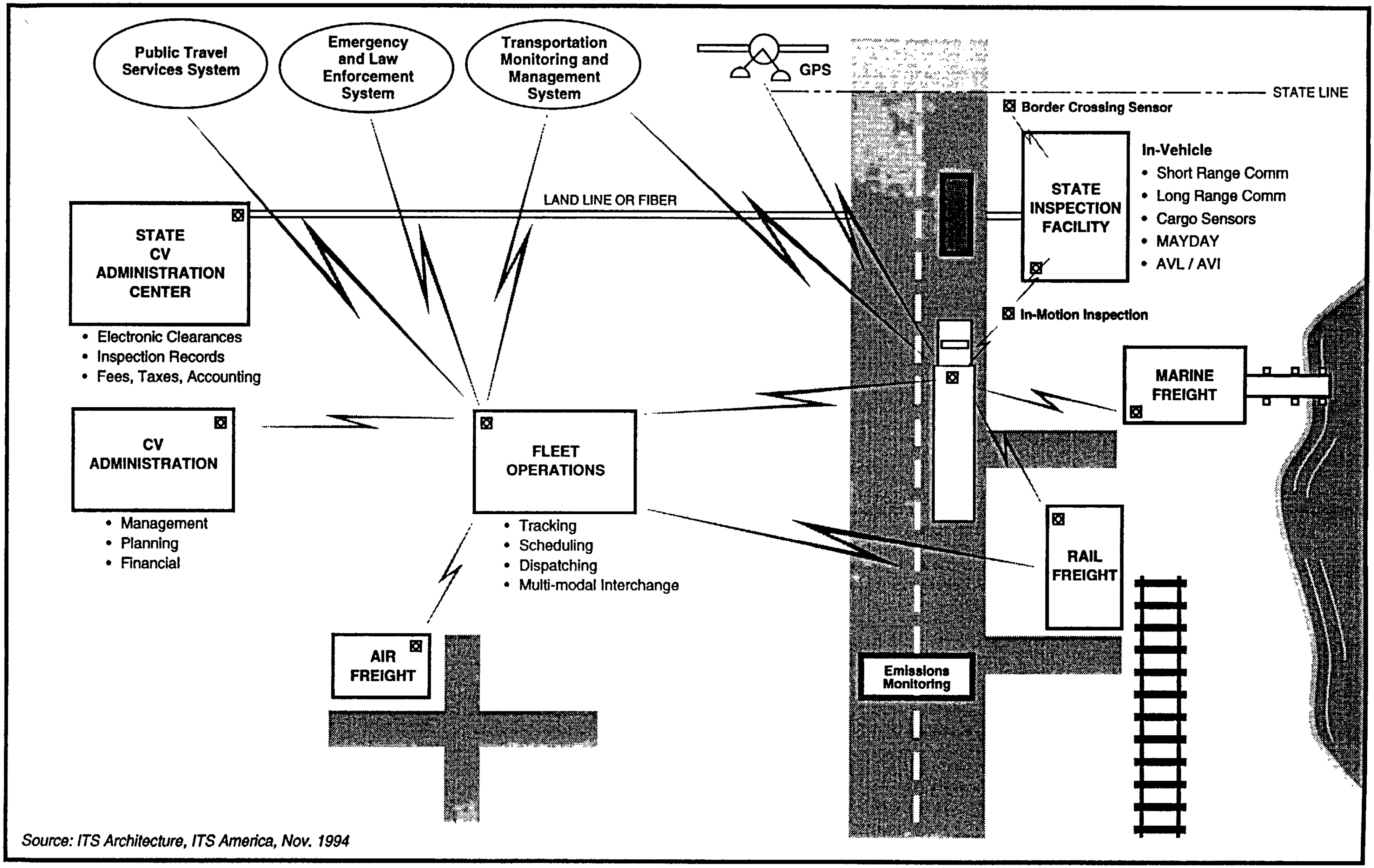

Figure 9 **Physical Architecture**

Problem: Congestion due to lack of policies and planning for truck traffic

User Services: Commercial fleet management / incident management / air quality

CHAPTER V

MACRO-LEVEL SCREENING OF ALTERNATIVES

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INTRODUCTION

Based on the User Services Plan and the System Architecture Plan, the range of alternatives were identified. A "macro-level" screening criteria process was developed that was based on performance criteria. Surviving alternatives would be recommended for detailed analysis. Technologies having significant and immediate benefits to the Birmingham Planning Area were recommended for early implementation.

"MACRO-LEVEL" SCREENING PROCESS

Based on input from the user surveys and from meetings and conversations with the Alabama DOT, FHWA, BRPC, the City of Birmingham and the oversight committee, a subjective analysis criteria was developed. The purpose of this process was to screen out those alternatives that were not feasible to consider for implementation in the Birmingham area.

The screening criteria were: financial viability, geometric feasibility, functional adequacy, public acceptability, and environmental feasibility. Technologies or user services by major area that were recommended for further study in the user services plan were evaluated and listed as being completely feasible, moderately feasible, or not feasible.

This was a subjective analysis procedure based on the following considerations:

Financial Viability:	Cost which can be funded based on available funding. See preliminary cost estimate in Technical Report - Environmental/Cost Estimates.
Geometric Feasibility:	Identification of physical elements compatible with the geometric characteristics of the transportation facilities for which they were proposed. See user service plan and architecture plan.
Functional Adequacy:	The ability of an alternative to achieve the objective of alleviating congestion in the Birmingham Planning Area. See User Service Plan and System Architecture Plan.
Public Acceptability:	Identification of user services which are likely to provoke a negative public response which would render the strategy not feasible. See user survey results.
Environmental Constraints:	Alternatives that had obvious environmental fatal flaws were screened out. See Post Buckley CMAQ Report referenced in report.

Each user service strategy was evaluated based on the above screening criteria as shown in Table 2 - Preliminary Screening of Alternatives. The legend and rating criteria for Table 2 is shown in Table 1 - Subjective Analysis Criteria.

PRELIMINARY SCREENING OF ALTERNATIVES

The criteria for evaluating the user service strategies for recommendation for further study elimination or early implementation is shown in Table 1. This criteria was used as shown in Table 2 to identify user services that were **not feasible** (i.e. - one occurrence of a not feasible rating, or greater than three moderately feasible ratings), **feasible for implementation** (i.e. - three or less moderately feasible ratings), **recommended for early implementation** (i.e. three or more significantly positive impact rating).

PRELIMINARY SCREENING RESULTS AND RECOMMENDATIONS

The results of this preliminary screening process is as follows:

USER SERVICES NOT FEASIBLE

NONE

USER SERVICES FEASIBLE

ROUTE GUIDANCE
EN-ROUTE DRIVER INFORMATION
PRE-TRIP TRAVEL INFORMATION
COMMERCIAL FLEET MANAGEMENT

EARLY IMPLEMENTATION STRATEGIES

TRAFFIC CONTROL
INCIDENT MANAGEMENT
TRAVELER SERVICES INFORMATION
RIDE MATCHING AND RESERVATION
VANPOOLING
PUBLIC TRANSPORTATION MANAGEMENT

It is recommended that preliminary engineering be included in the Birmingham Transportation Improvement Program (TIP) and State Transportation Improvement Program (STIP) for fiscal year 1995 for:

- Develop a Strategic Plan and Design for an Incident Management Advanced Traveler Information System (ATIS)
- Develop a Public Transportation Enhancement and Management Program
- Develop and implement an Aggressive Van Pool Program; and rideshare program (with park and ride lots)
- Plan and design an Advanced Transportation Management System (ATMS)
- Implementation of Closed Loop Signal Systems and a Comprehensive Signal System Retiming Program

After planning and design of these projects, which should include detailed cost estimates by phased implementation, these projects should be included in the fiscal year 1996 TIP and STIP for implementation.

TABLE 1
SUBJECTIVE ANALYSIS CRITERIA

LEGEND

O - Completely Feasible/Acceptable/Adequate

◑ - Moderately Feasible/Acceptable/Adequate

● - Not Feasible/Unacceptable/Not Adequate

CRITERIA

● ≥ 1- Significant Adverse Impact - Not Feasible

◑ > 3 - Significant Adverse Impact - Not Feasible

◑ < 3 - Feasible for Implementation

O ≥ 3 - Significant Positive Impact = > Early Implementation

TABLE 2 - PRELIMINARY SCREENING OF ALTERNATIVES

USER SERVICES	SCREENING CRITERIA				
	FINANCIAL VIABILITY	GEOMETERIC FEASIBILITY	FUNCTIONAL ADEQUACY	PUBLIC ACCEPTABILITY	ENVIRONMENTAL FEASIBILITY
TRAVEL AND TRANSPORTATION MANAGEMENT					
Traffic Control	O	O	O	O	◐
Incident Management	O	O	O	◐	◐
Route Guidance	O	O	◐	◐	◐
En-Route Driver Information	O	O	◐	◐	◐
Traveler Services Information	O	O	O	◐	◐
TRAVEL DEMAND MANAGEMENT					
Pre-Trip Travel Information	O	◐	◐	◐	O
Ride Matching And Reservation	O	O	◐	◐	O
Van Pooling	O	O	◐	◐	O
PUBLIC TRANSPORTATION					
Public Transportation Management	O	O	◐	O	O
COMMERCIAL VEHICLE OPERATIONS					
Commercial Fleet Management	O	◐	◐	O	O

CHAPTER VI

DETAILED SCREENING OF ALTERNATIVES

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INTRODUCTION

The surviving user service technologies from the preliminary screening criteria process were evaluated based on several considerations which included the impact on Architecture, Configuration, Performance, Reliability, Compatibility, Expandability, Maintenance Requirements, Life Cycle Cost (Preliminary Estimate from Magic Program developed by ALDOT), Travel Patterns, Land Use Impacts, Future Growth, Traffic Conditions, and Measures of Effectiveness, shown in Table 2 - Detailed Analysis of IVHS/CMS Alternatives.

DETAILED ANALYSIS PROCEDURE

The detailed analysis procedure including ranking factors, rating formula and ranking procedure is shown in Table 1 - Detailed Analysis of Technologies. User Services were rated based on positive and negative impact on the system and measures of effectiveness as shown in Table 2. Based on the rating formula, strategies were given an overall rating and assembled into short range (1-5 years), middle range (6-10 years), and long range (11-20 years) implementation categories, as shown in Table 3. Projects with a rating less than one were deleted from further study. Projects were then listed by category based on overall rating, as shown in Table 3. Projects with an overall rating of 2.0 or higher were recommended for early implementation.

DETAILED ANALYSIS RESULTS

The matrix in Table 2 shows results of the analysis. The quantifiable rating procedure and for project ranking is shown in Table 3. Projects shown in Table 3 with a rating of 2.0 or higher are recommended for early implementation by implementing phase as shown in Table 3. Projects with a rating of less than one are deleted from further consideration i.e. - ramp metering, emergency lanes, priority lanes/preemption, additional roadway lanes, light rail systems. All other projects should be advanced on a typical schedule for implementation.

TABLE 1

DETAILED ANALYSIS OF TECHNOLOGIES
Project Ranking Procedure

Ranking Factors

- "+" Positive Impact = One Point
- "-" Negative Impact = Three Points
- System Ratings Factor = > 1.0
- Measures of Effectiveness Ratings Factor = > 1.5

Rating Formula

(Positive System Points X 1.0) - (Negative System Points X 3.00 / Number of Ratings + (Positive Moe Points X 1.5) - (Negative Moe Points X 3.0 / Number of Ratings = Overall Points

Ranking Procedure

- Projects Ranking By Overall Points
- Projects Assembled into Implementation Categories - Short - (1-5 years), Middle - (6-10 years) and Long Range (11-20 years).
- All Projects with an Overall Rating of less than one are deleted from Further Consideration.
- Projects Listed by Category Based on Overall Rating.
- Projects with an Overall Rating of 2.0 or Higher Recommended for Early Implementation.

TABLE 2
DETAILED ANALYSIS OF CMS/IVHS TECHNOLOGIES

	Applies to				Implementation			Impact On											Traffic Conditions		*Measures of Effectiveness*												
Project Type	Freeway	Arterial	Transit	Commercial	Short	Medium	Long	Architecture	Configuration	Performance	Reliability	Compatibility	Expandability	Maintenance	Life Cycle Cost	Travel Patterns	Land Use	Future Growth	Peak	Off Peak	Travel Time	Accident Rate	Congestion Index	Public Political Acceptance	Cost Benefit	Acceptable Flow	Arterial *	Intersection **	Freeway ***	Public Transit (****)	Transportation Demand *V	Air Quality (*VI)	Overall Rating
TRAVEL AND TRANSPORTATION MGMT.																																	
TRAFFIC CONTROL																																	
Intersection Improvements		O			O					+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		-	-	+	1.68
Signal Systems		O			O				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		-	-	+	1.68
TOC/ATMS	O	O	O	O		O	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	1.75
Interchange Improvements	O					O			+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	-		+	-	-	+	1.27
Additional Lanes	O	O				O				+				-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	0.88
Emergency Vehicle Pre-emptions		O			O					-				-					-		-	+	-	+	+	-	-	-		-		-	-4.65
Ramp Metering	O				O			+	+	+				-	+	+	+	+	+		+	+	+	-	+	+			+	-	-	+	0.71
INCIDENT MANAGEMENT																																	
Motorist Assistance Patrols	O	O		O	O				+	+			+	+	+	+			+		+	+	+	+	+	+	+		+			+	2.5
Push Bumpers	O	O			O					+	+			+	+	+			+		+	+	+	+	+	+	+		+			+	2.5
Major Incident Emergency Response	O	O	O	O	O					+									+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Traffic Control Diversion and Routing	O	O	O	O	O					+						+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Wrecker Contract	O	O			O					+	+			+	+				+		+	+	+	+	+	+	+		+			+	2.5
Incident Clearance/Clean-up/Training	O	O	O	O	O					+						+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Accident Investigation Sites	O	O	O	O	O					+					+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Route Planning and Roadway Milepost System	O	O	O	O	O				+	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Communications Center	O	O	O	O		O	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Emergency Call Boxes	O				O				+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+			+			+	2.5
ROUTE GUIDANCE																																	
Freeway Surveilance/CMS/VMS/Control/Mgmt.	O					O	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			+	-	-	+	1.60
Arterial Surveilance/CMS/HAR/VMS/Control		O				O	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		-	-	+	1.68
Construction Traffic Control Plans (Freeway Management Teams)	O	O			O					+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	1.75

(+) Pos. Impact (*) Avg Speed of Avg though Vehc. (**) Stopped Delay Reduc. (***) Avg Speed Incr./Accd. Rate Decr.
(-) Neg. Impact (*IV) Avg % Transit Vehc. Occup. (*V) Auto Occup. Incr./Incr. in Van Pool Usage (*VI) VMT Decr.

TABLE 2
DETAILED ANALYSIS OF CMS/IVHS TECHNOLOGIES

Project Type	Applies to				Implementation			Impact On											Traffic Conditions		*Measures of Effectiveness*												
	Freeway	Arterial	Transit	Commercial	Short	Medium	Long	Architecture	Configuration	Performance	Reliability	Compatibility	Expandability	Maintenance	Life Cycle Cost	Travel Patterns	Land Use	Future Growth	Peak	Off Peak	Travel Time	Accident Rate	Congestion Index	Public Political Acceptance	Cost Benefit	Acceptable Flow	Arterial *	Intersection **	Freeway ***	Public Transit (****)	Transportation Demand *V	Air Quality (*VI)	Overall Rating
ENROUTE DRIVER INFORMATION																																	
HAR	O	O	O	O		O	O		+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	1.75
Cellular Phone/CB Monitoring	O	O	O	O	O				+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
CCTV/Monitoring	O	O				O			+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Automated Media Access/Information	O	O	O			O	O	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
VMS	O	O			O	O		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Automated Construction Information	O	O	O	O		O	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	2.5
TRAVELER SERVICES INFORMATION																																	
Gas/Food/Entertainment Information	O			O	O				+		+	+	+	+	+						+	+	+	+	+	+			+			+	2.0
Special Events	O	O	O	O	O				+	+						+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Automated Parking Information	O	O				O	O	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+		+	-	-	-	1.27
Bike/Pedestrian Planning Routes/Signing		O			O					+				+		+	+	+		+		+		+	+		+	-		+	+	+	1.94
TRAVEL DEMAND MANAGEMENT																																	
PRE-TRIP TRAVEL INFORMATION																																	
Public Service Announcements	O	O	O		O					+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Driver Training/Education	O	O		O	O				+	+	+								+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Automated Transit Information			O			O	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+				+	+	+	2.5
CCTV/Malls/Offices	O	O	O			O	O	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
RIDE MATCHING AND RESERVATION																																	
Ride Sharing	O	O	O		O	O	O		+	+	+		+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Van Pooling/VIP Service	O	O	O		O	O	O		+	+	+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
HOV Lanes	O	O	O			O	O		+	+			+	+	-	+	+	+	+		+	+	+	-	-	+	-	-	-	+	+	+	0.13

(+) Pos. Impact (*) Avg Speed of Avg though Vehc. (**) Stopped Delay Reduc. (***) Avg Speed Incr./Accd. Rate Decr.
(-) N... Impa... (*V) A... % Tran... Vehc. ... p. (*... to O... Inc... in V... Pool U... (*V... ...T De

TABLE 2
DETAILED ANALYSIS OF CMS/IVHS TECHNOLOGIES

	Applies to				Imple-mentation			Impact On											Traffic Condi-tions		*Measures of Effectiveness*												
Project Type	Freeway	Arterial	Transit	Commercial	Short	Medium	Long	Architecture	Configuration	Performance	Reliability	Compatibility	Expandability	Maintenance	Life Cycle Cost	Travel Patterns	Land Use	Future Growth	Peak	Off Peak	Travel Time	Accident Rate	Congestion Index	Public Political Acceptance	Cost Benefit	Acceptable Flow	Arterial *	Intersection **	Freeway ***	Public Transit (****)	Transportation Demand *V	Air Quality (*VI)	Overall Rating
PUBLIC TRANSPORTATION OPERATIONS																																	
PUBLIC TRANSPORTATION MANAGEMENT																																	
Park and Ride Lots	O	O	O		O	O	O		+	+			+		+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	2.5
Priority Lanes/Pre-emption	O	O	O			O			+	+					+	+	+	+	+		-	+	-	-	-		-	-	-	+	+	+	0.36
Alternative Fuels			O	O	O	O					+	+	+											+	+					+		+	2.5
Headway Reduction			O			O	O		+	+	+		+		+	+	+	+	+	+	+	+	+	+	+	+				+	+	+	2.5
Route Planning			O		O				+	+	+		+			+	+	+	+	+		+		+	+	+				+	+	+	2.5
Transit Operations Center			O			O	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	2.5
Light Rail System Planning	O		O			O	O	+	+	+	+	+	+	-	-	+	+	+	+	+		+		+	-	+			-	+	+	+	0.76
COMMERCIAL VEHICLE OPERATIONS																																	
COMMERCIAL FLEET MANAGEMENT																																	
Truck Lane Restrictions	O			O	O				+	+			+			+		+	+	+	+	+	+	-	+	+			+	+	+	+	2.05
Truck Routing	O	O		O	O				+	+						+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	2.05
Delivery Vehicle/Tracking/Policies				O		O	O	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+						+	2.5
WIM/Automatic Payment	O			O		O			+	+	+	+	+	+	+				+	+	+	+	+	+	+	+			+			+	2.5

(+) Pos. Impact (*) Avg Speed of Avg though Vehc. (**) Stopped Delay Reduc. (***) Avg Speed Incr./Accd. Rate Decr.
(-) Neg. Impact (*IV) Avg % Transit Vehc. Occup. (*V) Auto Occup. Incr./Incr. in Van Pool Usage (*VI) VMT Decr.

TABLE 3

RANKING OF CMS/IVHS PROJECTS

Short Range - (1-5 years)

Freeway

Project	Score
1. Motorist assistance Patrols	2.5
2. Push Bumpers	2.5
3. Wrecker Contract	2.5
4. Cellular Phone/CB Monitoring	2.5
5. Traffic Control Plans/Diversion and Routing	2.5
6. Driver Training Education	2.5
7. Incident Clearance/Clean Up/Training	2.5
8. Accident Investigation	2.5
9. Public Service Announcements	2.5
10. Special Events Planning/Control	2.5
11. Route Planning/Roadway Mile Post System	2.5
12. Minor/Major Incident Emergency Response	2.5
13. Ride Sharing	2.5
14. Van Pooling/VIP Service	2.5
15. Variable Message Signs (VMS)	2.5
16. Emergency Call Boxes	2.5
17. Truck Lane Restriction	2.05
18. Truck Routing	2.05
19. Gas/Food/Entertainment Information	2.0
20. Innovative Traffic Control Plans/Freeway Management Terms	1.75
21. Ramp Metering	0.71

Arterial

Project	Score
1. Motorist Assistance Patrols	2.5
2. Push Bumpers	2.5
3. Wrecker Contract	2.5
4. Cellular Phone/CB Monitoring	2.5
5. TCP/Traffic Diversion And Routing	2.5
6. Driver Training Education	2.5
7. Incident Clearance/Clean-Up/Training	2.5
8. Public Service Announcements	2.5
9. Special Events Planning	2.5
10. Route Planning/Roadway Mile Post System	2.5
11. Minor/Major Incident Emergency Response	2.5
12. Ridesharing	2.5
13. Van Pooling / VIP Service	2.5
14. Variable Message Signs/VMS	2.5
15. Truck Routing	2.5
16. Bike/Pedestrian Planning Routes/Signing	1.94
17. Traffic Control Plans Alternatives	1.75
18. Intersection Improvements	1.68
19. Signal Systems And Maintenance	1.68
20. Emergency Vehicle Preemption	-4.68

Transit

Project	Score
1. Alternative Fuels	2.5
2. Route Planning	2.5
3. Cellular Phone/CB Monitoring	2.5

4. Traffic Control Diversion	2.5
5. Incident Clearance/Clean-Up/Training	2.5
6. Route Planning and Roadway Mile Post System	2.5
7. Minor/Major Incident Emergency	2.5

Commercial Vehicles

Project	Score
1. Alternative Fuels	2.5
2. Motorist Assistance Patrols	2.5
3. Cellular Phone/CB Monitoring	2.5
4. Traffic Control Diversion and Routing	2.5
5. Route Planning and Roadway Mile Post Systems	2.5
6. Incident Clearance/Clean-Up/Training	2.5
7. Truck Routing	2.05
8. Truck Lane Restrictions	2.05

Medium Range (6-10 years)

Freeway

Project	Score
1. Communications Center	2.5
2. CCTV/Monitoring	2.5
3. Automated Media Access/Information	2.5
4. Information	2.5
5. CCTV/Malls/Offices-Information	2.5
6. Park and Ride Lots	2.5
7. Automatic Payment/WIM	2.5
8. Highway Advisory Radio (HAR)	1.75
9. Traffic Operations Center (TOC) ATMS	1.75

10. Freeway Surveillance CMS/VMS/Control Mgmt.	1.60
11. Interchange Improvements	1.27
12. Automated Parking Information	1.27
13. Additional Lanes	0.88
14. Light Rail System Planning	0.76
15. Priority Lanes/Preemption	0.36
16. HOV Lanes	0.13

Arterial

Project	Score
1. Communications Center	2.5
2. CCTV/Monitoring	2.5
3. Automated Media Access/Information	2.5
4. Automated Construction Information	2.5
5. CCTV/Malls/Offices Information	2.5
6. Park and Ride Lots	2.5
7. Highway Advisory Radio (HAR)	1.75
8. Traffic Operations Center (TOC)/ATMS	1.75
9. Arterial Surveillance VAR/CMS/Mgmt.	1.60
10. Automated Parking Information	1.27
11. Additional Lanes	0.88
12. Priority Lanes/Preemption	0.36
13. HOV Lanes	0.13

Transit

Project	Score
1. Communications Center	2.5
2. Automated Media Access/Information	2.5

3. Automated Construction/Information	2.5
4. Automated Transit Information	2.5
5. CCTV/Malls/Offices-Information	2.5
6. Park and Ride Lots	2.5
7. Transit Vehicle (Bus) Headway Reduction	2.5
8. Transit Operations Center	2.5
9. Highway Advisory Radio (HAR)	1.75
10. TOC/ATMS	1.75
11. Light Rail System Planning	0.76
12. Priority Lanes/Preemption	0.36
13. HOV Lanes	0.13

<u>Commercial</u>

Project	Score
1. Communications Center	2.5
2. Automated Construction Information	2.5
3. Automated Delivery Vehicle	2.5
4. Training/Policies	2.5
5. WIM/Automatic Payment	2.5
6. Highway Advisory Radio	1.75
7. TOC/ATMS	1.75

CHAPTER VII

IMPLEMENTATION ISSUES

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INTRODUCTION

Major issues which would affect implementation of the User Service projects, especially projects recommended for early implementation, were identified. These issues include agency coordination/responsibility, project funding, scheduling, implementation, cost, procurement, and regulatory changes or laws needed for implementation.

Implementation requirements are shown on Table 1 - Project Schedule, along with the schedule of activities/projects. Implementation by short range, medium range and long range phases, including initial cost and annual cost estimates for IVHS/CMS projects, is shown on Table 2 - Recommended IVHS/CMS Projects. Other issues, such as detailed cost estimates and environmental concerns, are discussed in Chapter VIII - Environmental Process Requirements and Cost Estimates/Effectiveness. A user service strategy for a Birmingham Incident Management Program outlining the implementation issues that must be addressed in the Birmingham planning area is presented as an "example" of the planning process required to implement the recommended user strategies in Birmingham.

Other user service strategies that are Early Implementation Projects and are affected by the Incident Management Project are included in this technical report. Sample programs, plans, specifications and agreements are contained in Appendix Chapter VIII. User Service Funding sources, and amounts will be presented and discussed as part of Chapter X - Operations Plan - of this Strategic Deployment Plan Report.

PURPOSE

The purpose of this task of the CMS/IVHS study was to identify implementation issues by developing a management and operations plan for the user services previously identified in the study for the Birmingham Planning area. This is accomplished by the identification of the operating area, agency involvement, coordination requirements, responsibilities, organization, agreements, funding, and schedules.

TABLE 1
SCHEDULE OF IVHS / CMS ACTIVITIES / PROJECTS

	1995			1996													1997		
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
* SUBMIT EARLY IMPLEMENTATION PROJECTS AND CONSULTANT SERVICES STUDIES TO MPO FOR INCLUSION TO LRTP AND TIP, AND INCLUDE IN TIP FOR SUBMITTAL TO FHWA.		1ST																
* BEGIN PUBLIC INFORMATION PROGRAM (PSA's) FOR ALL PROJECTS.								1ST										
* REVIEW STATE LAWS AND DRAFT LEGISLATION FOR MOVING VEHICLES FROM ROADWAY, CARGO RELOCATION AND TRAFFIC CONTROL.								1ST										
* DEVELOP AND NEGOTIATE "WRECKER CONTRACT".									15TH									
* IMPLEMENT "PUSH BUMPER PROGRAM".									15TH									
* NEGOTIATE CONTRACT, PURCHASE VEHICLES AND IMPLEMENT "SERVICE PATROLS".											15TH							
* DEVELOP ATMS PROGRAM.														1ST				
* DEVELOP PLANS AND SPECIFICATIONS, PURCHASE EQUIPMENT FOR "COMMUNICATION CENTER", "TRAFFIC OPERATIONS CENTER" AND "TRANSIT OPERATIONS CENTER."																		1ST
* DEVELOP PLANS AND SPECIFICATIONS, AND PURCHASE INCIDENT MANAGEMENT VEHICLES, EQUIPMENT, COMMUNICATIONS, TRAFFIC CONTROL DEVICES, WRECKERS, MOTORCYCLES, AND ASSIGN TO RESPONSIBLE AGENCY.										1ST								
* DEVELOP, REVIEW AND TEST TRAFFIC CONTROL/ DIVERSION ROUTES FOR INCIDENT PROGRAMS.												15TH						
* DEVELOP ROADWAY MILEPOST SYSTEM AND PRINT ROUTE DIVERSION SHEETS AND PAMPHLETS.												1ST						
* CONDUCT RESPONSE TEAM TRAINING PROGRAM.												1ST						
* FIELD TEST INCIDENT MANAGEMENT COMMAND STRUCTURE (MINOR AND MAJOR INCIDENTS).													15TH					
* COORDINATE PROJECTS WITH MPO LOCAL AGENCIES (TIP).													22ND					

TABLE 1 (CONT'D)
SCHEDULE OF IVHS / CMS ACTIVITIES / PROJECTS

Timeline: 1995 OCT, NOV, DEC; 1996 JAN, FEB, MAR, APR, MAY, JUNE, JULY, AUG, SEP, OCT, NOV, DEC; 1997 JAN, FEB, MAR

Activity	Bar starts	Bar ends	End label
* CONDUCT PUBLIC INFORMATION/MEDIA COORDINATION PLAN AND IMPLEMENT TRAFFIC CONGESTION/INCIDENT REPORTING PROGRAM.	OCT 1995	OCT 1996	1ST
* IMPLEMENT INCIDENT MANAGEMENT PROGRAM.	OCT 1995	OCT 1996	15TH
* CONDUCT AFTER INCIDENT REVIEW AND RESPONSE TEAM TRAINING ACTIVITIES.	OCT 1995	NOV 1996	1ST
* CONDUCT TRAFFIC ENGINEERING STUDIES, DEVELOP PLANS AND SPECIFICATIONS FOR ARTERIAL SIGNAL SYSTEMS, SIGNAL UPGRADES, TRAFFIC CONTROL SYSTEMS, AND INTERSECTION IMPROVEMENTS AND IMPLEMENT PROJECTS.	OCT 1995	NOV 1996	15TH
* IMPLEMENT SIGNAL RE-TIMING PROGRAM.	OCT 1995	DEC 1996	1ST
* DEVELOP PROGRAM POLICIES AND IMPLEMENT FOR TRUCK LANE RESTRICTIONS AND ROUTING, SPECIAL EVENTS, ALTERNATIVE FUELS, TRANSIT ROUTE PLANNING, EXPRESS BUS SERVICE, FREE-WAY MANAGEMENT, BIKE/PEDESTRIAN PLANNING, HOV LANES, CONSTRUCTION TRAFFIC CONTROL ALTERNATIVES, CONSTRUCTION/TRANSIT/CON-GESTION AUTOMATED INFORMATION SYSTEM, AUTOMATIC TRUCK PAYMENT, MEDIA ACCESS SYSTEM, AUTOMATED DELIVERY VEHICLE TRACK-ING POLICIES, AUTOMATED PARKING INFORMATION SYSTEM.	OCT 1995	SEP 1996	1ST
* DEVELOP PLANS, SPECIFICATIONS AND LET TO CONTRACT PRIORITY (25) PROJECTS, DEVELOP PLANS AND SPECIFICATIONS FOR THOSE FREEWAY WAY SURVEILLANCE/CONTROL/TRAFFIC MONI-TORING PROJECTS (I.E. CCTV, TRAFFIC VOLUME/ DENSITY LOOPS, VMS, EMERGENCY CALL BOXES, HAR, PRIORITY LANES, PARKING INFORMATION AND GUIDANCE, CB MONITORS, PARK AND RIDE LOTS, RIDE SHARE, VAN POOL, MOTORIST INFORMATION.	OCT 1995	JAN 1997	1ST
* COORDINATE IVHS/CMS PROJECTS WITH MPO/ LOCAL AGENCIES (PUT IN TIP).	OCT 1995	FEB 1997	1ST

TABLE 1 (CONT'D)
SCHEDULE OF IVHS / CMS ACTIVITIES / PROJECTS

* IDENTIFY FUTURE PROJECTS FOR IVHS CONGESTION MANAGEMENT, DEVELOP PLANS, SPECIFICATIONS AND IMPLEMENT.

* COORDINATE PROJECTS AND CONGESTION MANAGEMENT PROGRAM WITH OTHER MANAGEMENT SYSTEMS.

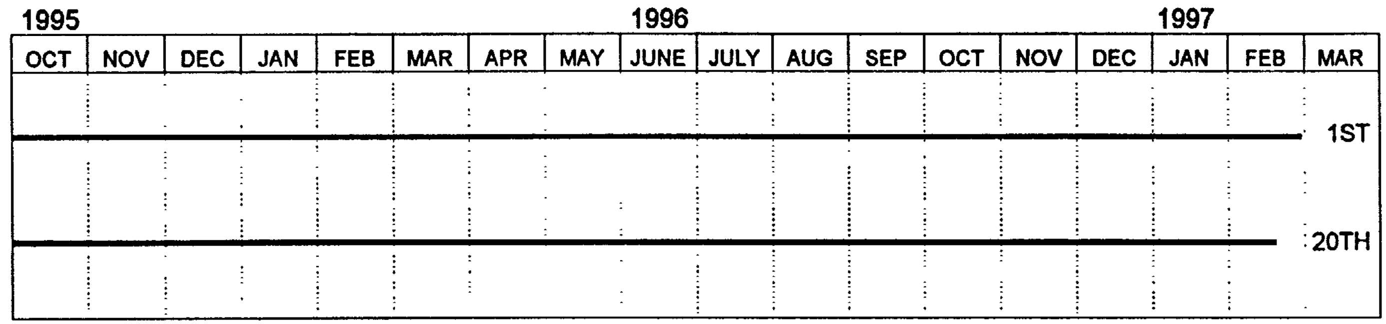


TABLE 2

RECOMMENDED IVHS/CMS PROJECTS

SHORT RANGE (1-5 YEARS) PROJECTS - EARLY IMPLEMENTATION	INITIAL COST	ANNUAL COST
1. MOTORIST ASSISTANCE PATROLS	$1,222,400	$670,560
2. PUSH BUMPERS	$124,800	$16,200
3. WRECKER CONTRACTS	$104,500	$54,000
4. CELLULAR PHONE/CB MONITORING	$35,000	$10,000
5. TRAFFIC CONTROL PLANS/DIVERSION/ROUTING	$617,000	$275,400
6. INCIDENT CLEARANCE/CLEANUP/TRAINING	$869,600	$351,540
7. DRIVER TRAINING AND EDUCATION	$147,000	N/A
8. ACCIDENT INVESTIGATION SITE PLANNING, DESIGN	$200,000	N/A
9. MOTORIST INFORMATION/PUBLIC SERVICE ANNOUNCEMENTS/MOTORIST SERVICES/ATIS STUDY PLAN	$841,200	$168,480
10. ROUTE PLANNING/ROADWAY MILEPOST SYSTEM. SPECIAL EVENTS PLANNING AND OPERATIONS, FREEWAY MANAGEMENT STUDY PLAN	$339,000	$188,200
11. MAJOR INCIDENT EMERGENCY RESPONSE	$1,797,760	$1,204,720
12. PARK AND RIDE LOT PLANNING DESIGN	$4,200,000	$400,000
13. RIDESHARING DESIGN	$280,000	$102,600
14 VANPOOLING	$1,190,000	$308,000
15. ALTERNATIVE FUELS (TRANSIT VEHICLES)	$150,000	$150,000
16 TRANSIT ROUTE PLANNING	$290,000	$40,000
17. TRUCK OPERATING POLICIES/LANE RESTRICTIONS/ROUTING	$150,000	N/A
18. INNOVATIVE TRAFFIC CONTROL PLAN MEASURES (CONSTRUCTION ZONES)/FREEWAY MANAGEMENT TEAMS (FMT)	$1,264,980	$754,380
19. PLANNING INITIATIVES/BICYCLE AND PEDESTRIAN PLANNING/ROUTES/ SIGNING/HOV FEASIBILITY STUDY/RAPID RAIL TRANSIT STUDY AND DESIGN/PARKING STUDY/CIRCULATION STUDY	$2,990,000	$55,000
20. ARTERIAL TRAFFIC CONTROL SYSTEMS/SIGNAL OPERATIONS AND ATMS STUDY PLAN	$15,918,200	$1,812,660
21. INTERCHANGE/INTERSECTION IMPROVEMENTS (TOPICS TYPE)	$16,002,000	$15,000,000
22. ACCIDENT INVESTIGATION SITES/EQUIPMENT/DESIGN	$250,000	N/A
MEDIUM RANGE (6-10 YEARS) PROJECTS	**INITIAL COST**	**ANNUAL COST**
1. TRAFFIC SURVEILLANCE/AND COMMUNICATIONS/HAR/VMS/CMS/CCTV/CB/ CELLULAR PHONE/DETECTORS/EMERGENCY CALL BOXES (FREEWAY AND ARTERIAL)/FIBER OPTIC CABLE TO TOC AND COMMUNICATIONS CENTER (CC)/ATIS IMPLEMENTATION	$7,042,200	$1,235,200
2. COMMUNICATIONS CENTER/AUTOMATED MEDIA ACCESS, AUTOMATED CONSTRUCTION INFORMATION, AUTOMATED HIGHWAY/TRANSIT INFORMATION (FROM TROC)	$4,555,800	$323,800
3. PARK AND RIDE LOTS DESIGN AND CONSTRUCTION	$4,500,000	$400,000
4. TRANSIT VEHICLE (BUS) HEADWAY REDUCTION/EXPRESS BUS SERVICE, REPLACEMENT, MAINTENANCE, OPERATIONS	$46,070,000	$7,806,000
5. COMMERCIAL VEHICLE AUTOMATED DELIVERY/VEHICLE TRACKING/POLICIES/PAYMENT/WIM	$10,150,000	$100,000
6 TRAFFIC OPERATIONS CENTER (TOC)/COMMUNICATIONS/AUTOMATED TRANSIT, HIGHWAY CONSTRUCTION AND PARKING INFORMATION, ATMS IMPLEMENTATION, FREEWAY MGMT. SYSTEM IMPLEMENTATION	$4,606,000	$955,340
7. TRANSIT OPERATIONS CENTER (TROC)/AUTOMATED TRANSIT INFORMATION/COMMUNICATIONS/2-WAY RADIO AND FIBER OPTIC TO TOC/CC	$2,200,000	$343,667
8 INTERCHANGE/INTERSECTION IMPROVEMENTS	$15,000,000	$15,000,000
9. ACCIDENT INVESTIGATION SITES - CONSTRUCTION	$4,000,000	$200,000
LONG RANGE (10-20 YEARS) PROJECTS	**INITIAL COST**	**ANNUAL COST**
1. PARK AND RIDE LOT/DESIGN AND CONSTRUCTION	$7,200,000	$1,280,000
2 EXPRESS BUS SERVICE/HEADWAY REDUCTION	$20,751,000	$4,212,000
3 HOV LANE/DESIGN AND CONSTRUCTION (NOT RECOMMENDED FOR IMPLEMENTATION	$34,500,000	$41,200

CMS/IVHS IMPLEMENTATION ISSUES

A suggested thought process for planning to implement some of the recommended CMS projects are presented in the following sections. Similar issues would need to be resolved in order to implement the recommended IVHS/IVHS projects shown in Table 2.

OPERATING AREA

The operating area for freeway control and guidance, traffic control and response to incidents, and service patrols is shown on the map shown on Figure 1. The routes for operation are highlighted on this map. They include 120 miles of interstate and over 150 miles of major arterials inside the urbanized area boundaries.

LEAD AGENCY

Alabama Department of Transportation (ALDOT) Multimodal Bureau.

IMPLEMENTING AGENCIES

Suggested implementing agencies are identified below with the suggested primary agency underlined. These agencies should be tasked by a coordinated effort through a steering committee made up of all local planning and operating agencies.

User Service Responsibility	Implementing Agencies (Primary Responsible Agency underlined)
Service Patrol:	ALDOT - Implementation responsibility, coordination with Alabama State Troopers Birmingham District Office as operating agency under contract with State
Communication Center:	Alabama State Troopers Birmingham District Office in cooperation with Jefferson Co. Sheriff Dept. Communications Center
Traffic Operations Center (TOC):	State DOT Division Office - City of Birmingham Traffic Engineering Dept., Jefferson Co. Traffic Engineering Dept.
Push Bumper Program:	Alabama State Trooper Office: City of Birmingham Police, State DOT
Planning & Roadway Milepost System:	ALDOT (consultant services)
Wrecker Contract:	ALDOT Division Office, Private Wrecker Agreements by ALDOT Multi-modal Bureau
Motorist Education Program:	Birmingham MPO Staff Agency (BRPC) and ALDOT Multimodal Bureau
Major Incident Response:	State Troopers, City of Birmingham Police, Traffic & Fire, Jefferson Co. Sheriff Dept., ALDOT Division/District Office

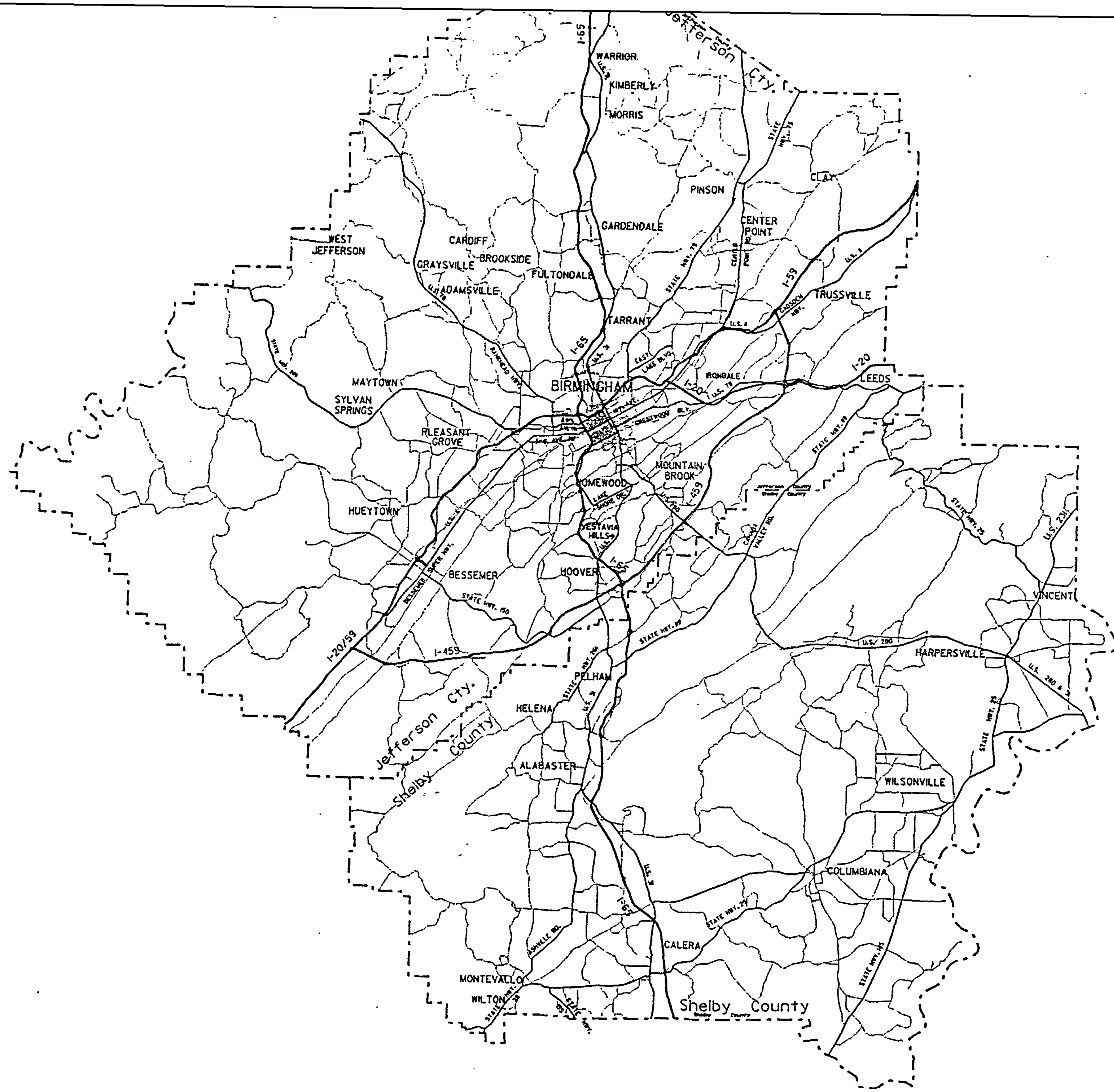
User Service Responsibility	Implementing Agencies (Primary Responsible Agency underlined)
Minor Incident Response:	City of Birmingham, Fire, Traffic and Police Depts., State Troopers, Jefferson Co., ALDOT
Transit Operations Center:	Max, ALDOT,
Incident Hazmat Clearance:	Birmingham Fire Dept., Civil Defense
Incident Traffic Control:	Birmingham Police and Traffic Depts., State Troopers, ALDOT Division/ District Office
Incident Clearance & Clean-up:	ALDOT Division/District Office, City of Birmingham Maintenance Dept.
Traffic Diversion:	ALDOT Div. Office (through TOC), City of Birmingham Traffic Engineering
Motorist Information:	Local Radio, TV Stations, ALDOT Div. Office (through TOC), City of Birmingham Traffic Engineering Dept. and Police Dept.
Training:	Hazmat - Birmingham Fire Dept.; Traffic Control - ALDOT Division Traffic Engineer; Command Operations - Birmingham Civil Defense

IMPLEMENTING AGENCY RESPONSIBILITIES

The agencies tasked with implementing the user service projects should be identified based on the Architecture Plan presented in Chapter IV of this Phase 1 report. Suggested implementing agency responsibilities for the previously identified early implementation user services and related user service projects are shown below.

ALABAMA DOT

- Operate the Birmingham Traffic Operations Center (TOC).
- Establish Service Patrols and purchase vehicles, prepare agreements and contracts for all actions.
- Apply for FCC license for radio frequencies.
- Review and approve plans for Communications Center and Traffic Operations Center.
- Purchase wreckers.
- Secure, train and manage personnel for Traffic Operations Center, and crews for wreckers, clean-up, traffic control and management.
- Provide vehicle maintenance facilities for service patrols, wreckers, trucks and cars used in program.
- Conduct traffic studies and route planning for establishing diversion plans.
- Plan, design and install surveillance and communications equipment (HAR, VMS, CMS, Detectors, CCTV, CB Receivers) on freeways and arterials.
- Conduct motorist information activities.
- Maintain traffic detection, verification and Motorist Information Systems.



LEGEND

- INTERSTATE HIGHWAYS
- U.S. AND STATE ROADS
- NON IVHS/CMS NETWORK ROADS
- OPERATING AREA

ALABAMA DEPARTMENT OF TRANSPORTATION

BIRMINGHAM
IVHS/CMS PROJECT

IVHS/CMS NETWORK MAP

FIGURE 1

- By contract through RTAP program, develop Traffic Control Training Program.
- Develop Motorist Information Program and implement projects.
- Maintain radio equipped command post for incident response/clearance/traffic control and surveillance equipment on freeway and public places (TV monitors and traffic loop volume detectors).
- Operate vehicles for incident clean-ups.
- Set up traffic control plan to route traffic around incidents.
- Coordinates incident management activities including legal and liability issues.
- Assist in Motorist Education Program.
- Develop program for traffic signal system projects and signal maintenance.
- Operate freeway surveillance, operations and traffic signal systems.
- Develop freeway management teams for construction and maintenance traffic control.
- Develop and execute contracts for private wrecker service during peak hours.
- Plan, design and construct park and ride lots, security systems, and lighting.

CITY OF BIRMINGHAM

- Birmingham Civil Defense to develop training program for command post practices and conduct training exercises as required by coordinating committee.
- Birmingham Fire Dept. to develop Hazmat training program and sessions.
- Assist State in manning Traffic Operations Center (TOC) for entire operating area.
- Maintain traffic operations, control and surveillance equipment on city streets.
- Police Dept. to operate Push Bumper Program on local roadways.
- Assist Motorist Information Program by providing traffic congestion data to radio, TV, print media, conduct press conferences.
- Police Dept. to operate command post and direct activities at minor incidents.
- Fire Dept. to provide Hazmat clearance and command actions.
- Police Dept. to provide traffic control during minor incidents.
- Traffic Engineering to operate traffic signal systems with special timing plan for local streets due to diverted traffic during incidents.
- Maintain vehicles and equipment used in programs.
- Train personnel as required.

- By contract with the State, Civil Defense to operate service patrol on local streets to manage and direct actions for minor incident first response and major incident detection and verification.
- Manage and direct actions of motorcycle police in incident detection, verification, and traffic control and diversions for entire operating area.
- Maintain command post for Police and Fire Dept. response and clearance actions during minor incidents, and provide personnel to assist in operation of central command post during major incidents.

JEFFERSON COUNTY

- Assist state troopers in operating the communications center.
- Assist State and City in manning TOC (Jefferson County Traffic Engineer).
- Assist in public motorist information activities and public awareness actions.
- Assist in traffic control and diversion actions.
- Assist in central command post actions (provide personnel).
- Assist in major incident response.
- Maintain command post for response and clearance during major incidents.
- Provide public information offices during major incidents.

STATE TROOPERS

- Operate Communication Center, including providing office space, personnel training, communication repair and maintenance for all incident management actions and monitoring, as well as routing cellular phone calls, call boxes, 911, and police, fire, traffic engineering, ALDOT and service vehicles communication during incidents or service patrol periods.
- Operate central command post and train personnel as required. Provide coordination with Birmingham Police, Fire, Traffic Engineering Depts.
- Repair and maintenance of communication equipment.
- Participate in Push Bumper Program.
- Assist in public awareness actions and Motorist Information Program.
- Participate in incident response actions.
- Provide traffic control during major incidents.
- Participate in traffic diversion routing around incidents.
- Manage and direct action of motorcycle troopers in incident detection, verification and traffic control for the entire operating area.
- Use accident investigation site, incorporating accident collection measures.

LOCAL EMERGENCY PLANNING COMMITTEE

- Schedule, manage and administer coordinating committee meetings for event planning and for review of actions after an incident to fine tune response/clearances actions.

MAX - BIRMINGHAM/JEFFERSON COUNTY TRANSIT AUTHORITY

- Operate transit operations center.
- Maintain radio (2-way) communications with bus vehicle drivers.
- Relay traffic/incident information to TOC/CC.
- Maintain transit schedule/fare/route information for dissemination to media and public via media/motorist information system.
- Develop bus headway reduction program and implement express bus service.
- Plan, maintain, and operate rideshare/vanpool/VIP service.
- Plan, develop, implement transit initiatives/alternative fuels/route planning.
- Plan/design, operate (security) for park and ride lots.

AGREEMENTS

All participating agencies will be required to pass resolutions with their governing body authorizing the chief elected official to enter into an agreement with the State and Federal Departments of Transportation to be a party to and carry out the actions of this program.

All agencies will accept liability, if any, for their actions as a partner in this program. The program will be developed based on existing legal rights of the governments to move vehicles from the roadway travel lane only. The appendix shows a sample agreement which will be needed to be enacted in Alabama to allow removal of cargo and trucks from the roadway. Fast removal is a very important element of this program.

All agencies agree to provide office space, personnel, administration and other overhead costs to match federal funds provided to implement this program.

All agencies will agree to cooperate in all actions of this program regardless of their agency's policies and procedures for operation on public roadways, i.e. traffic control, cargo removal, traffic diversion. See Appendix for sample agreements to be entered into by all parties.

INCIDENT MANAGEMENT ORGANIZATION FOR BIRMINGHAM PLANNING AREA

As an example of the organization and information flow needed to implement a typical user service project, the Birmingham Incident Management project was selected. Each user service project should follow a similar process. Typical organizations, information flows, program design criteria, and equipment required for the remaining early implementation projects are shown in the Appendix Chapter VII Sections A through Z.

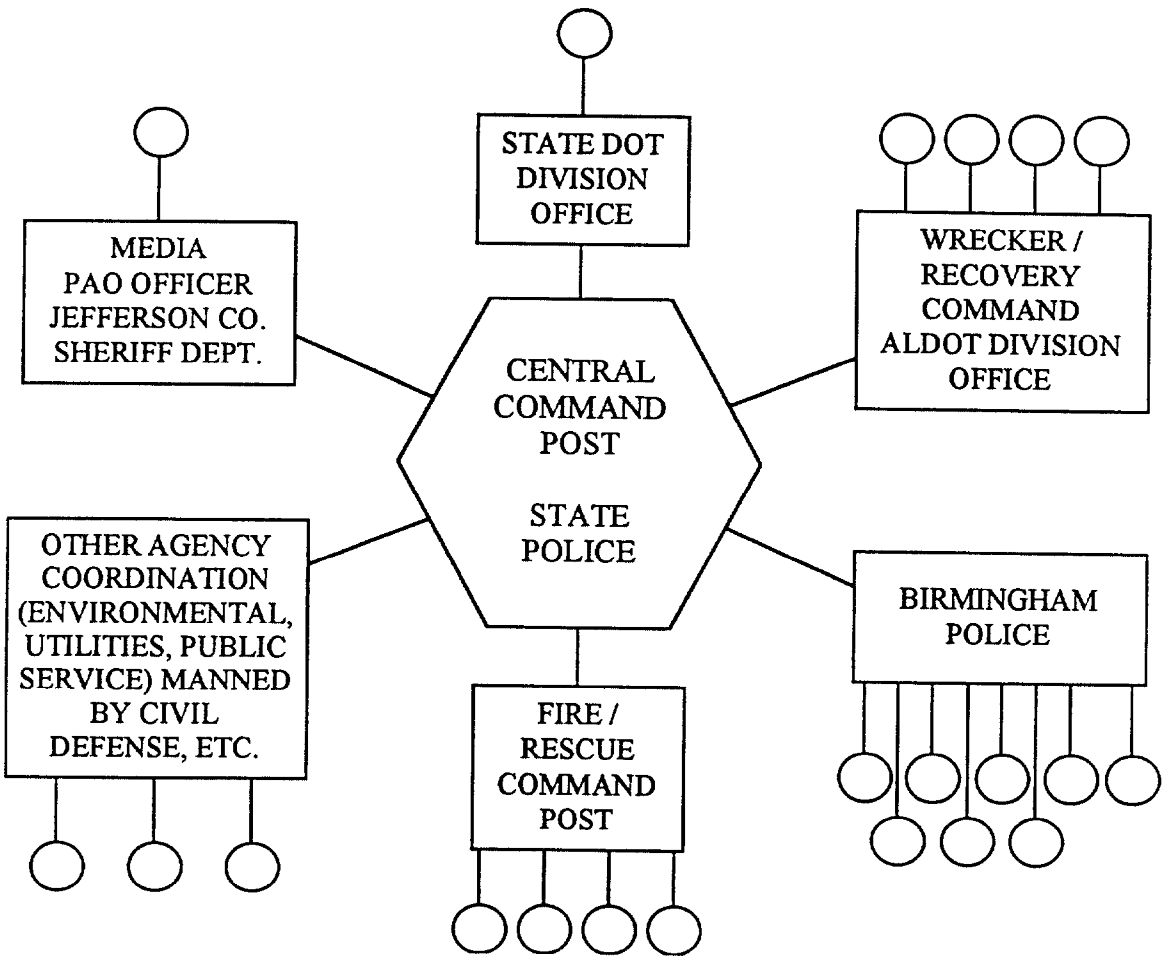
COMMAND POSTS

A command post is the central point of control at the incident and is usually in a mobile vehicle equipped with all needed communications and personnel representing and having administrative control over their activities and responding personnel. All media contact will be through the Command Post Captain.

This command post will be used - one for minor incidents, another for major incidents. A minor incident is defined as a blockage of only one lane on a multi-lane roadway, or when on a two-lane roadway, traffic can easily be routed around the incident (using the median or shoulder). A major incident would require blockage of at least one lane in either or both directions of traffic flow, or one that involves hazardous materials or serious injuries. That decision will be made by the first responders (State, City or County Police). This decision will be communicated to the central communication center (State Trooper Central Communication Center) and all needed responders will be notified of required action. Each responder shall maintain adequate vehicles, personnel and supplies to respond as required (herein explained).

For an incident the command post will be housed in a small van. The command post van will be provided by the City of Birmingham Police Department. The groups involved are shown on the diagram on Figure 2. The State Trooper Central Communication Center will provide the link shown on the diagram between major responders. The responding agencies' interaction with the command post are shown on the diagram on Figure 2.

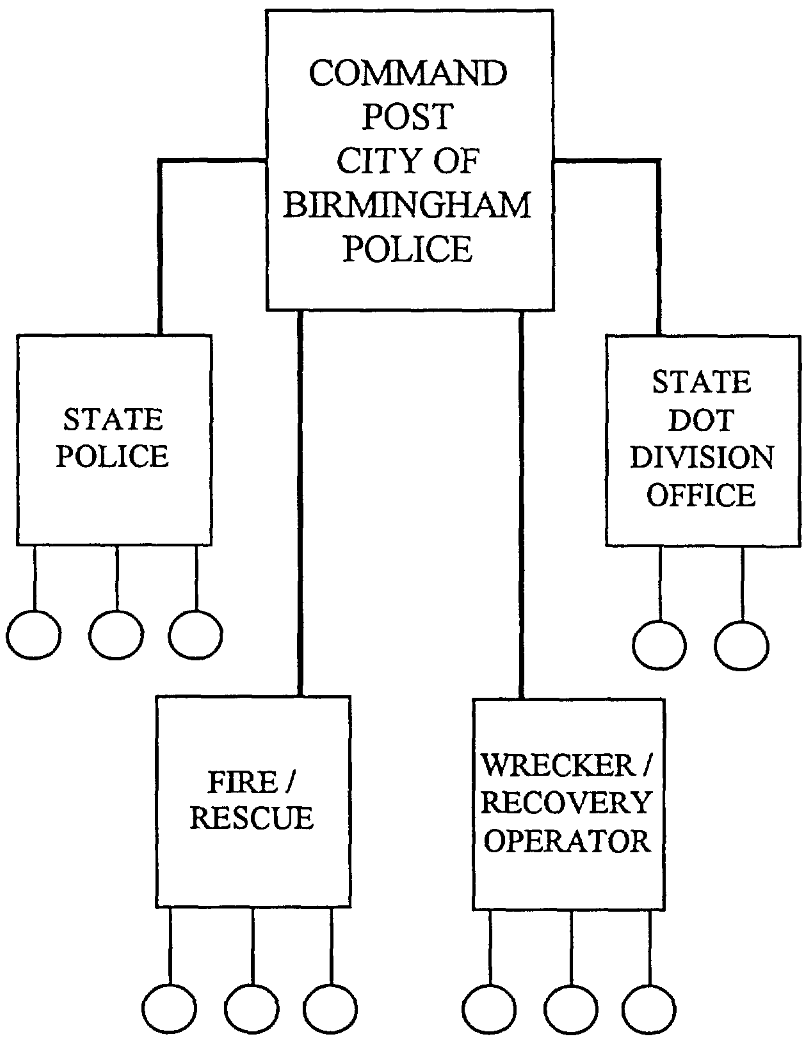
FIGURE 2
BIRMINGHAM INCIDENT MANAGEMENT ORGANIZATION



For a major incident, the State Trooper Birmingham Office will provide the central command center. The central command post will be a well equipped mobile RV-type vehicle. The communication link shown on the command post organization is provided by the Central Communication Center. Each responding activity will have a command post in a small vehicle or van. The major responders' command posts and link with the central command post are shown on the diagram on the Figure 3.

FIGURE 3

BIRMINGHAM INCIDENT MANAGEMENT STRUCTURE



CHAPTER VIII

ENVIRONMENTAL PROCESS REQUIREMENTS AND COST ESTIMATES/EFFECTIVENESS

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INTRODUCTION

As presented in previous Chapter V of this Phase 1 Report, user services were screened for environmental constraints to eliminate strategies that have obvious fatal flaws using "macro-level" screening criteria. Strategies surviving this initial screening were evaluated again based on environmental impacts in the detailed screening process. This was done using an analysis procedure and ranking formula. As a result of the "macro-level" screening process and the detailed analysis procedure, user services were ranked and recommended for implementation. Projects with significant impact on the system were recommended for early implementation.

User services were also evaluated based on preliminary lifecycle cost (annual cost and maintenance cost over the expected life of the project), funding considerations and initial cost as part of the detailed analysis of technologies. Detailed cost estimates, lifecycle cost and cost effectiveness were developed and evaluated for each user service as are contained in this chapter.

This chapter consists of the results of detailed cost estimates, building on the preliminary cost estimates presented in the Implementation Issues technical report. Funding sources and funding availability will be presented and discussed as part of the Operations Plan in Chapter V of this Phase 1 Report.

The environmental review conducted by Post Buckley Schuh & Jernigan, Inc. for Birmingham made a thorough review of the IVHS/CMS alternatives recommended for implementation as part of this study. The results of this review were used as the technical basis for the environmental analysis conducted and presented in this technical report.

ENVIRONMENTAL REVIEW

A detailed evaluation of traffic control measures (TCM's), and congestion management air quality projects, including environmental impacts and cost effectiveness, was conducted for the

Birmingham Planning Area by Post Buckley Schuh and Jernigan, Inc. and was documented in a report titled Congestion Mitigation and Air Quality Improvement Program Study for the Birmingham Non-Attainment Area dated October 1994. The projects evaluated as part of this report are similar to the user service strategies recommended in the IVHS/CMS study.

Projects were evaluated based on potential for reduction of emissions in grams per mile of hydrocarbons (HC) and nitrogen oxides (NO), and an overall review of travel patterns, trip reduction and growth projections were included in the CMAQ study. The study of zone formation and mobile source emissions is a very complex subject, which was well presented and discussed in the Post Buckley report. Mobile sources (automobile, buses, trucks) account for about 50% of the HC emissions and only a small amount of NO emissions in Birmingham. Most of the HC emissions occur when the vehicle is started with small HC amounts during operations. Emission reduction opportunities or impacts from these recommended alternatives may be minimal when evaluated on a singular basis, but could have moderate impact when implemented together. Operation of the vehicle affects HC only when speeds are less than 5 mph, therefore incident management, traffic control and other user services directed at congestion reduction occurring with these low speeds can have significant impact on air quality. Public transportation, demand management (ridesharing and van pooling user services) would have the most potential for air quality impact because their user services reduce single occupant vehicle (SOV) travel. While incident management, traffic control, motorist travel information, and guidance user services may encourage SOV travel, they will reduce the impact on air quality by reducing traffic congestion and low speed vehicle operations. Based on the user surveys, past trip making trends, and land use growth patterns in the Birmingham area, demand management and public transportation user services will not have the potential for significant air quality reduction in the Birmingham planning area.

Based on 1990 Journey to Work census data, 83% of commuters in Jefferson County and 86% of commuters in Shelby County commute alone in the Birmingham area. This trend is not expected to change unless economic, social opinions, and, more importantly, commute times change. Most of these commuters (90% in Jefferson County, 83% in Shelby County) have a commute time less than 40 minutes.

In the CMAQ study, the user services were evaluated based on the potential travel impact of the recommended strategies. The total emissions reduction for each project was analyzed by the expected change in emissions (E_T) before and after the projects are implemented. Emissions were calculated based on the following formula:

$$\mathbf{E_T = T \times L \times E_R}$$

Where: E_T = Total Emissions, grams
T = Number of Trips
L = Average Trip Length (Miles)
E_R = Emission Rate at Average Operating Speed grams/mile

Source: Post Buckley, Oct. 1994

Based on this methodology and the analysis conducted in the Post Buckley Report, Table 1 - IVHS/CMS User Service Comparison of Environmental Impacts for the Birmingham Planning Area was developed which shows the expected impact of the recommended user service improvements, where data was available. Traffic control, incident management and rideshare/ van pool user services showed the highest emission reduction potential. As Table 1 indicates, the entire TCM program does not result in significant air quality reductions. According to Chris Fleet and Pat DeCorla-Souza in a paper titled "VMT for Air Quality Purposes" presented during the Third Conference on Air Quality and Transportation Planning held in 1991 in Santa Barbara, California, "even a stringent TCM package would result in less than 7 percent reduction in DVMT (DVMT is the primary EPA/FHWA variable for measure of congestion reduction) and congestion levels of reduction and do not effect a reduction in DVMT but as congestion increased so did travel demand." Fleet and DeCorla-Souza make a convincing argument that TCM's will not have enough impact on emission reduction to warrant the emphasis placed on them by EPA and FHWA in the Air Quality Regulations and Non-Attainment measures for attainment. The TCM's may reduce delay, but they have the same effect on travel as lane additions or new roadways. The demand for travel by SOV will only continue to increase as has occurred in Los Angeles, Atlanta and Chicago.

The Post Buckley CMAQ report recommended that certain projects be implemented on a priority basis. The IVHS/CMS study projects recommended for implementation were included in the Post Buckley CMAQ priority listing in the highest and medium categories.

TABLE 1

COMPARISON OF IVHS/CMS USER SERVICE ENVIRONMENTAL IMPACTS FOR BIRMINGHAM PLANNING AREA

USER SERVICE (Bundled)	POTENTIAL FOR IMPACT ON	HC EMISSIONS*	NO EMISSIONS*
Travel and Transportation Management		Reduced / Year Tons	Reduced / Year Tons
Traffic Control	Delay Reduction / Speed Increase / VMT Reduction	30.33	3.41
Incident Management	Delay / Speed / VMT Reduction	35.4	10.2
Route Guidance	Delay / Speed / VMT Reduction	N/A	N/A
Enroute Driver Information	Delay / Speed / VMT Reduction	N/A	N/A
Traveler Services Information	VMT Reduction	N/A	N/A
Travel Demand Management			
Pre-Trip Travel Information	Trip / Delay Reduction	N/A	N/A
Ride Matching and Reservations	Trip / Delay Reduction	25.0	30.3
(Commercial Vehicle Operations)			
Commercial Fleet Management	Delay / VMT / Speed Reduction	N/A	N/A
Public Transportation Operations			
Public Transportation Management	Trip / VMT Reduction	2.0	9.0

Source: Post Buckley Schuh & Jernigan, Inc., CMAQ Improvement Program, Oct. 1994.
*** For Programmed Projects**

COST COMPARISON / EFFECTIVENESS

The conceptual costs for each user service that was prepared as part of the Implementation Issues chapter was refined and detail cost estimates prepared for each element of each user service. Appendix Chapter X - IVHS/CMS Project Cost Estimates - contains detailed costs, including equipment, construction, personnel, supplies, communication, buildings, capital cost, maintenance cost and annual cost based on the life of each project.

A detailed analysis of IVHS/CMS user services cost effectiveness and comparison is shown on Table 2. The rideshare and van pool projects show the greatest culminative air quality improvement with traffic control, public transportation management and incident management projects, respectively, predicted to reduce emissions in substantial amounts. Based on life cycle cost, ridesharing and van pooling is the best value for reducing emissions but incident management is the best value based on cost per hour of delay reduction. The amount of delay reduction is greatest with traffic control and public transportation management user services, but the cost per hour of delay reduction is higher for these two user services. This is primarily due to the high initial cost of traffic control and public transportation management projects.

TABLE 2

IVHS/CMS USER SERVICES COST EFFECTIVENESS AND COMPARISON FOR BIRMINGHAM PLANNING AREA

USER SERVICE	HC + No_x Grams/Yr./ Dollar	Initial and Annual Cost	Life Cycle Cost (Life / Cost)	Unit of Travel Reduction - Hours of Delay (*2) per VMT	Cost per Year per VMT per Hour of Delay Reduction
Travel and Transportation Management					
Traffic Control	99.34	$86,186,600	35 yrs/$2,462,474	1,114,667 Hrs	$2.21
Incident Management	16.68	$10,816,330	15 yrs/$721,089	539,583 Hrs	$1.34
Route Guidance	N/A	$2,546,560	5 yrs/$509,312	269,792 Hrs	$1.89
Enroute Drive Information	N/A	$1,054,680	5 yrs/$210,936	134,896 Hrs	$1.56
Traveler Services Information		$8,424,200	10 yrs/$842,420	202,334 Hrs	$4.16
Travel Demand Management					
Pre Trip Travel Information	N/A	$4,045,000	5 yrs/$809,000	202,334 Hrs	$4.00
Ride Matching and Reservations	247.62	$19,860,600	15 yrs/$1,324,040	612,500 Hrs	$2.16
Commercial Vehicle Operations					
Commercial Fleet Management	N/A	$11,400,000	10 yrs/$1,140,000	539,583 Hrs	$2.11
Public Transportation Operations					
Public Transportation Management	39.95	$83,692,267	20 yrs/$4,184,613	1,076,250 Hrs	$3.89

***1 of programmed projects in Birmingham**
***2 Based on LOS Increase in Average delay in seconds/veh for each User Service**
Source: Transportation Planning and Air Quality, ASCE, 1992, p. 307

Table 2 compares the recommended User Services by cumulative emissions reduction, initial and annual cost, life cycle cost, total hours of delay reduction, and cost per hour of delay reduction. The emissions reduction amounts were taken from the Post Buckley CMAQ report for Birmingham. Cost estimates are based on the detailed cost estimates contained in Appendix Chapter V. The annual life cycle cost was based on the expected life of the initial investment for each user service divided into the cost. The hours of delay reduction were based on the expected level of service improvement, and corresponding V/C improvement, from existing level of service to the improved level of service expected after implementation of the user service (with the worst case being a signalized intersection) multiplied by the VMT of system (120 miles of freeway x 50,000 AADT + 150 miles of arterial x 30,000 AADT). The average delay reduction for level of service was derived from Transportation Planning and Air Quality, proceeding of the national conference, ASCE 1991 paper on "Developing Protocols for Motor Vehicle Air Quality Modeling" Peter H. Gulidberg, p. 307. Each user service was assigned an average delay in sec./vehicle based on level of service (LOS) improvement expected as shown below:

LOS	Avg. Delay (sec./veh.)
A	9
B	9
C	23
D	39
E	52
F	236
F+	421

Level of Service improvement and corresponding average delay calculation is as shown below:

User Service	LOS	Average Delay Reduction (sec./veh.)
Traffic Control	F+ to D	382
Incident Management	F to E+	185
Route Guidance	F- to E+	93
Enroute Driver Information	F- to E	46
Traveler Services Information	F- to E+	70
Pre-Trip Travel Information	F- to E+	70
Ride Matching And Reservations	F to E	185
Commercial Fleet Management	F to E	185
Public Transportation Management	F+ to E	369

Hours of delay were calculated as follows:

$$HD_A = \frac{D_A \times VMT_{IA}}{3600}$$

Where: HD_A = Average Hours of Delay Reduction / VMT Reduction.
D_A = Average Hours of Delay Reduction for the User Service.
VMT_{IA} = Vehicle miles traveled on Interstate and Arterial Network

CHAPTER IX

PERFORMANCE MONITORING PLAN

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INTRODUCTION

Quantifiable performance measures were developed based on the user services directed at the Birmingham congestion problem areas. A data base inventory, which included existing and future peak hour volumes, average daily traffic (ADT), accident data, geometric features for segments of the roadway network, was developed, refined and reviewed by the various affected agencies and oversight committees. This data base inventory analyzed the operation, accident affect on congestion, and resulted in a quantifiable congestion index.

The congestion index was used to assess the acceptable level of congestion toward addressing the goals and objectives of this study. The use of traditional capacity and level of service measures of system performance was used only as a check of control data. This check of control data was for verification of the data base inventory and resulting congestion index output data and procedure.

From the data base inventory and congestion indexes by segment, levels of acceptable congestion were selected and graphically depicted on maps and on plan-size node maps. Segments were identified as congested or uncongested. Twenty-five study locations were identified to collect additional data in order to evaluate study performance.

PERFORMANCE MONITORING PLAN

The additional data collected was further refined and identified for development of the Performance Monitoring Plan. The elements of CMS/IVHS user services recommended in the user services plan were identified and set in categories of system-wide planning elements and user service strategy elements.

The elements of the performance measures were developed through a process of determining the requirements for attaining the goals of objectives of this study, and then measuring the desired affects of maintaining acceptable levels of congestion. The user services were matched with the desired goals and objectives in detail, as shown in Table 1 - Mapping of User Services to IVHS/CMS Goals and Objectives. The congestion management process and system criteria are outlined in Table 2 - Birmingham Performance Measures. The elements of the user services are identified with the quantifiable performance measures.

The monitoring criteria, data that has been collected as part of this study, and the required data to be collected in order to continue this analysis procedure and develop a comprehensive congestion management system for the entire Birmingham Planning Area, was developed and is shown in Table 3 - Birmingham CMS/IVHS Performance Monitoring Criteria. Each element of the system planning category and user services strategies category has a detailed procedure outlined for developing quantifiable performance measure monitoring criteria, along with the data needs that exist or will be required in the future. The CMS/IVHS study data base inventory is the basis for data input to the performance monitoring program. Other data has been collected as part of previous work in the additional data collection phase of this study. The 25 study locations were used as the control sections for data collection and selective monitoring of the existing and future conditions. Birmingham Regional Planning Commission or the Alabama Department of Transportation would collect the future data after implementation of the recommended user services.

DATA COLLECTION PROGRAM

In order to assess the impact of the user services, monitoring criteria outputs should be evaluated and new data collected (especially traffic volume and accident data) at least every three years. Existing and future conditions (without user service implementation) should be compared to the improved conditions after implementation of the recommended user services. The existing and future conditions (straight line projections), provided in Chapter II of this Phase I Report, used the IVHS/CMS Study data base inventory and the additional data collected for the 25 study locations identified in the additional data collections phase of this study.

Other data needs are shown on the last column of Table 3. This data should be collected in order to develop a comprehensive congestion management system program for the entire Birmingham Planning Area with the addition of collector and local roadway facilities. Other locations could be selected, as was done for the 25 locations in additional data collections work, after the data base inventory is completed for all collector and local roadways. These select locations could be included with the existing 25 locations to complete the data base inventory. The data base inventory should then be updated and new congestion index data calculated and reviewed to determine the affect of the user services on congestion levels in the Birmingham Planning Area.

CMS/IVHS PLANNING PROCESS

A matrix that shows the results of the tables that were developed as part of the performance monitoring program should be developed by the operating agency. User services that do not result in improved congestion levels (based on monitoring criteria) should not be recommended for further funding, or they should be re-evaluated from a system implementation viewpoint. Other user services showing the desired affect should then be expanded or accelerated for future implementation.

TABLE 1
MAPPING OF USER SERVICES TO CMS/IVHS GOALS AND OBJECTIVES

MAPPING OF USER SERVICES	TRAVEL AND TRAFFIC MANAGEMENT								PUBLIC TRANSPORTATION MANAGEMENT		COMMERCIAL VEHICLE OPERATIONS
TO IVHS/CMS STATEGIC GOALS	Pre-Trip Travel Info.	En-Route Driver Info.	Route Guidance	Incident Management	Travel Demand Managem	Traffic Control	Ride Matching & Reserv	Traveler Services Informati	En-Route Transit Informatio	Public Transportation	Commercial Fleet Management
Improve Safety											
Reduce injuries and fatalities	I			I	I	I					
Reduce the number of impaired drivers	I										
Enhance traveler security	I		I					I	D	I	
Reduce the number and severity of accidents				I							
Improve EMS/Roadway services responsiveness			I			I					
Improve the ability to identify/track HAZMAT											
Improve traffic safety law enforcement											
Increase Efficiency											
Increase Efficiency by smoothing flows	I	I	I	D		D		I			
Increase average vehicle occupancy	I				D		D		D	D	
Increase capacity of existing facilities	I								I		I
Reduce vehicle miles traveled	I				D		D	D	I	I	
Reduce time lost in intermodal interchange	D	I	I				D		D	D	D
Reduce time delay associated with congestion	D	D	D	D	D	D	D	D	I	I	D
Reduce Energy and Environment Impact											
Reduce harmful emissions per unit of travel	I	I	I	I	D	I	I		I	I	I
Reduce energy consumption per unit of travel	I		I	I	I	I	D		I	I	I
Reduce new right-of-way requirements		I		I	D		I			I	
Reduce fuel wasted	I	I	I	I	D	I	D	D	I	I	I
Enhance Productivity											
Reduce costs incurred by fleet operators				I	I	I			D	D	D
Reduce cost and improve equity of fee collection											
Reduce delays and cost of regulating vehicles											
Reduce cost and improve quality of data collection										I	
Reduce travel time	D	D	D	D	I	D					D
Reduce cost to transportation-dependent industrie	I		I	I	I	I				D	D
Enhance Mobility											
Improve accessibility to transportation	D						D		I	D	
Improve quality of travel options information	I	I	I		D		D	D	I	I	
Reduce travel stress	D	D	D	I				D	D	I	
Improve travel time predictability	D	D	D				D		D	D	I
Improve transportation affordability							I				D

TABLE 2

BIRMINGHAM CMS/IVHS PERFORMANCE MEASURES

PURPOSE:

Development of a Congestion Management System (CMS) for the Metropolitan Planning Area which, through a systematic and continuing process, provides information on transportation system performance to decision-makers for selecting and implementing cost-effective strategies to manage transportation facilities so that traffic congestion is reduced and the mobility of persons and goods is enhanced.

Development of an Intelligent Vehicle Highway System (IVHS) Planning and Project Development process which allows for the selection, planning and implementation of IVHS technologies as part of an integrated transportation system.

THROUGH:

>The identification of existing and future areas where congestion occurs or will occur;
>The identification of the causes of congestion;
>The evaluation of both traditional and non-traditional strategies for managing congestion.
>Analysis and Optimization using congestion index based on data base analysis.

TO:

>Provide information on the operational performance status of the elements of the transportattion system included in the IVHS/CMS process.
>Identify and assess effective and efficient strategies and actions to reduce traffic congestion.
>Provide input into the planning process which will lead to the implementation of strategies and actions to reduce congestion and enhance the mobility of persons and goods.
>Monitor the effectiveness of strategies and actions specifically implemented to reduce congestion and enhance the mobility of persons and goods.

VALUES:

>Enhance mobility of people and goods.
>Develop partnership between all levels of government and private sector.
>Coordinate land use, air quality, and transportation planning decisions.

SYSTEM WIDE PLANNING ELEMENTS:

>Percentage of roadway sections classified as congested during peak hours by facility type.
>Percentage of congested lane miles by facility type.
>Average duration of congested periods by facility type.
>Vehicle occupancy/or usage by mode during the congested periods on a typical day.
>Increase in VMT by facility type.

USER SERVICE STRATEGY ELEMENTS:

ELEMENT	PERFORMANCE MEASURES
Travel Time	>Average travel time during peak hours by facility type. >Average speed during peak hours by facility type by mode.
Delays	>Percent incident delays during peak hours by facility type of VMT. >Duration of delay per occurence by facility type. >Delay during peak hours due to recurring delay by facility type. >Person hours of delay during peak hour.
Acceptable Flow Rate	>Congestion index by facility type.
Level of Acceptance	>Input from surveys/public involvement, meetings, and civic/group comments.
Air Quality Impact	>Emission reductions based on trips displaced by user service from SOV by trip length ET= T X L X ER.*

*SOURCE: CMAQ Improvements Study for Birmingham, Alabama non-attainment area, PBS&J, October 1994.

TABLE 3
BIRMINGHAM CMS/IVHS PERFORMANCE MONITORING CRITERIA

ELEMENTS	MONITORING CRITERIA	DATA COLLECTED	DATA TO BE COLLECTED
SYSTEM PLANNING			
1. Percent of roadway sections classified as congested during peak hours by facility type.	a. Assembly data base segments by facility type - i.e. interstate/freeway; arterial; local (not now included in data base). b. Total all segments; and segments with congestion index greater than or equal to 1.00 by facility type. c. Divide number of congested segments by total segments for each facility type to arrive at percent. d. Assemble and group percents by facility type for existing and future conditions. e. Plot percents on node maps and color code by group.	1. Data base inventory (see report documentation).	a. Inventory data base input's (see data inventory section of report) for remaining arterial and all local roadways. b. Update all data bases every three years.
2. Percent of congested lane miles by facility type.	a. Retrive from data base inventory segment data - i.e., length in miles from milepost A to milepost B; and number of lanes from A-B lanes plus B-A lanes. b. Calculate total lane miles by facility type (see 1a., above). c. Calculate total congested lane miles (see 1b., above) by facility type. d. Divide 2c. by 2a. for each facility type. e. Assembly percents from 2d. by facility type for existing and future conditions. f. Plot percents onto node maps by color coded groups.	2. Data base inventory (see report documentation).	a. Inventory data base input's (see data inventory section of report) for remaining arterial and all local roadways. b. Update all data bases every three years.
3. Average duration of congested periods by facility type.	a. Retrieve congested roadway segments by facility type from 1b. b. Retrieve select uncongested roadway sections at random from data base inventory from 1a. as control sections. c. Determine length of congested period through analysis of flow rates for each roadway compared to acceptable flow rates (see definition of congestion). d. Calculate duration in total hours of congestion for congested segments and control segments by facility type for existing and future conditions. e. Prepare table and compare to previous duration totals and with control sections.	3. Data base inventory (see report for documentation).	a. Inventory data base input's (see report) for all remaining arterial and local roadways. b. Update all data bases every three years.
4. Vehicle occupancy or usage by mode during the congested periods on a typical day.	a. Assemble roadway congested segments by congested roadways by facility type from database inventory. b. Inventory congested periods and uncongested select locations for existing and future conditions. c. Collect vehicle occupancy by field observation during these congested periods on a typical day (weekday). CCTV or video may be used for this purpose and on a continuing basis for control roadways. A representative sample is sufficient to determine vehicle occupancy (normally 15 d. Assemble data into table and compare previous (historical data). Compare with control roadways.	a. Data base inventory (see report documentation). b. Additional data collection - vehicle occupancy and percent occupancy or usage of transit vehicles.	a. Inventory database input's (see data inventory section in report) for all remaining arterials and local roads. b. Vehicle occupancy by facility type. c. Percent occupancy or usage of transit vehicles by roadway and facility type. d. Update all data bases every three years.

TABLE 3
BIRMINGHAM CMS/IVHS PERFORMANCE MONITORING CRITERIA

ELEMENTS	MONITORING CRITERIA	DATA COLLECTED	DATA TO BE COLLECTED
4. Vehicle occupancy or usage by mode during the congested periods on a typical day.	e. For transit - Inventory transit usage including van pools on same roadway sections as 4 (a-d) in percent occupancy of transit vehicle. This can be a field observation. Document this data in tabular form and compare to historical data. Determine percent increase/decrease by roadway and facility type.		
5. Increase in VMT by facility type.	a. Compute VMT for 25 locations shown in additional data to be collected section of CMS/IVHS study report (i.e., peak hour volume X segment length for existing and future conditions). b. Assemble in table by facility type	a. Data base inventory.	a. Complete database inventory for local roadway facility type.
USER SERVICE STRATEGIES 1. Travel Time	a. Inventory travel time and speed (average) by floating car method during peak hour (am or pm) on select facilities (see 25 locations in additional data collection section of IVHS/CMS study report) for each facility type. b. Average speed for 25 locations in Birmingham planning area. c. Compare existing and future data with improved conditions after implementation of user service.	a. Average travel time for 25 locations in Birmingham Planning Area. b. Average speed for 25 locations in Birmingham planning area.	a. Collect average travel time and speed for local roadway facility type. b. Update data base every three years. c. Compare data
2. Delays	**Incident delay caused by accidents as percent of VMT.** a. Compute VMT during peak hours (i.e. peak hour volume X segment length for 25 additional data locations). b. Measure delay (average stopped time in seconds divided by peak hour volume) for each segment in 25 study locations. c. Divide accident factor by VMT and multiply by average stopped delay for facility type for 25 locations. d. Assemble data in table by facility type for 25 locations (in additional data collection). e. Compare existing and future conditions (by straight line estimation) to improved condition after user service implementation.	a. Data base inventory. b. Average stopped delay in seconds for 25 study locations. c. Duration of delay period during am or pm peak hour for 25 study locations. d. Inventory of average vehicle occupancy by facility location from 25 study locations.	a. Collect data base inventory for collector and local select roadways. b. Collect average stopped delay for these roadways. c. Determine average delay period (in minutes) during delay period (am or pm) for collector and local roadways by facility types. d. Inventory average vehicle ocucpancy for collector and local facilities during peak period at select locations.
	Type (SEC/VEH) due to recurring delay. a. Measure delay in average stopped delay for 25 locations (see 2 above). b. Assemble by facility type in a table. c. Compare existing conditions and future conditions by straight line estimation (percent of ADT for existing delay X future volume) to improved conditions after user service implementation.		
	Duration of delay per occurrence by facility type. a. Measure delay in average stopped delay for 25 study locations (see above). b. Record time in minutes that the average delay occurs during either the am or pm peak for these 25 study locations. c. Compare this data on existing conditions and future conditions (use straight line estimation) with improved conditions after implementation of user service.		

TABLE 3
BIRMINGHAM CMS/IVHS PERFORMANCE MONITORING CRITERIA

ELEMENTS	MONITORING CRITERIA	DATA COLLECTED	DATA TO BE COLLECTED
2. Delays (continued).	**Person hours of delay during peak hour** a. Measure delay in average stopped time (see above). b. Measure average vehicle occupancy for each facility type (from 25 study locations) (see system planning elements 4c). c. Multiply a X b above and divide by 60 for each facility location. d. Assemble data by facility type in table for existing and future conditions (straight line calculation). e. Compare person hours of delay for existing and future conditions with improved conditions after user service implementation.		
3. Acceptable Flow Rate.	a. For 25 study locations assemble congestion index's in table for existing conditions and for future conditions (using straight line estimation) (i.e. using future peak hour volume calculate congestion index's). b. Compare existing and future congestion index's with improved congestion index's after user service implementation.	a. Data base inventory for 25 study locations.	a. Collect data base inventory for collector and local roadways at select locations. b. Update database inventory every three years.
4. Level of Acceptance	a. Compare user survey recommended user service and congested locations with implemented user service elements. b. Conduct user surveys of local groups/civic groups during and after user service implementation. c. Conduct public hearings during and after user service implementation. d. Review comments of these public involvement meetings/user surveys.	a. User surveys of local officials and citizens committee of MPO. b. CMS/IVHS video and public hearings.	a. Public involvement meetings in design phase and during implementation of user services. b. User surveys after user service is implemented.
5. Air Quality Impact	a. Calculate emission reductions based on trips displaced from S.O.V. recommended user service by trip length: ET = T x L x ER where: ET=Total emissions, grams T=Number of trips L=Average trip length, miles ER=Emission rate at average operating speed, grams/mile b. Assemble emissions in table and compare with calculated emissions after implementation of user services.	a. Post Buckley CMAQ Study for Birmingham non-attainment area - total emissions for each recommended user service.	a. Calculate emissions (ET) for each user service after implementation. b. Compare data.

CHAPTER X

PRELIMINARY OPERATIONS PLAN

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INTRODUCTION

This IVHS/CMS Study for the Birmingham Planning area has resulted in several user services that should be implemented as recommended in the implementation issues chapter of this report. The funding sources with funding amounts available to the Birmingham Planning Area is presented in Appendix Chapter X. Adequate funding is available for implementation of the recommended projects shown below in priority order. The MPO and State would select projects based on areawide project selection criteria.

USER SERVICES

As recommended in Chapter VI - Detailed Screening of Alternatives, the following user services should be implemented for the Birmingham Planning Area in priority order:

1. Ridersharing Initiatives
2. Vanpooling
3. Traffic Control, ATMS
4. Incident Management
5. Public Transportation initiatives
6. Freeway Management and Control
7. Motorists Information/Education Systems, ATIS
8. Commercial Vehicle Policies and Control

A detailed list of projects by phase of work with cost estimates and funding sources is shown in Appendix Chapter X to this operations plan. Preliminary engineering for project planning and design should begin during fiscal year 1995 as shown in Table 1.

PHASE II PROJECT WORK

The user services in the priority order shown above should be implemented using congestion mitigation air quality federal funds with the matching funds required based on the ratios as shown in Table 2.

Consultant services could be used for project development and design based on the elements shown in Chapter IV - System Architecture Plan of this Phase I Report. Schematic layouts for the recommended alternatives were developed as part of the detailed analysis procedure discussed in the Appendix Chapter VIII - Cost Estimation. Implementation issues involving agency coordination, responsibility issues, funding, procurement, private options and regulatory changes were discussed in Chapter VII of this Phase I Report. Scopes of work could be prepared by the state or MPO based on the data contained in this report. Projects should be implemented as follows: Shown in Table 1 - Projects for Development.

TABLE 1

PROJECTS FOR DEVELOPMENT

Begin Date	Complete Date	Project Score	Responsible Agency
June 95	Dec. 95	Rideshare development; Park and Ride Lot planning and design; Van Pool Program and van purchases	BRPC/MAX
May 95	May 96	Closed loop signal system planning, design; Advanced Traffic Management System planning and design; Traffic Operations Center and fiber optic cable communications design	ALDOT/City of Birmingham Traffic Engineering Dept.
May 95	Dec. 95	Incident Management Program planning and design including Motorist Assistance Patrols, Push Bumper, Accident Investigation Sites, Motorist Information Education Program, Traffic Monitoring, CB/Cellular Phone Monitoring, Communications Center, Traffic Diversion Plan and Routing, and Media Access	ALDOT/City of Birmingham Planning Dept., Police, Fire, Jefferson Co. Sheriff, State Troopers, local police and fire depts.
May 95	Oct. 95	Public Transportation Headway Reduction Measures; Transit Operations Center planning and design; Communications and Bus Surveillance Program and Operations Plan and bus purchase specifications	MAX/BRPC
June 95	July 96	Freeway Management Operations Plan design to include: Traffic Surveillance and Monitoring, Variable Message Signs (12), Changeable Message Signs (25), Fiber Optic Communications connected to TOC, Transit Operations Center, and COM Center; Traffic Management Patrols and Innovative Construction Traffic Control Plans	ALDOT/ Birmingham Traffic Engineering Dept.
July 95	July 96	Motorists Information Education; Advanced Transportation Information System Program plan and design including media access to all TOC, TROC, traffic surveillance, and incident information via communications center interface	ALDOT/ State Troopers, Birmingham Planning Dept.
June 95	Oct. 95	Commercial Vehicle (truck) Policies and Programs for Congestion Reduction and Safety Plan including policies, ordinances and laws	ALDOT/ Birmingham/ BRPC

The project scopes should include program layouts, schematic, information flow (see Chapter VI - System Architecture Plan), cost estimates and quantities, specifications, detail design for bid to construction using state and FHWA design and bid requirements. Construction of each of these user service projects should be scheduled as soon as the project design plans are completed. The same funding ratio should be used for construction funding as shown in Table 2.

TABLE 2

CMAQ FUNDING/MATCH RATIOS

USER SERVICE	Federal Funds	State Match	Local Match
1. Rideshare Initiatives	80	10	10
2. Van Pooling	80	10	10
3. Traffic Control, ATMS, TOC	80	10	10
4. Incident management	80	20	0
5. Public Trans. Initiatives, TRMC	80	10	10
6. Freeway Mgt./Control, COMC	80	20	0
7. Motorists Info./ED, ATIS	80	10	10
8. Commercial Vehicle Policies and Control	80	10	10