STRATEGIC DEPLOYMENT PLAN

Wichita Metropolitan Area

ITS INTELLIGENT TRANSPORTATION SYSTEM

EARLY DEPLOYMENT STUDY

FINAL REPORT
December, 1998

City of Wichita
Public Works Department

HNTB

ITS EARLY DEPLOYMENT STUDY

FINAL REPORT

CITY OF WICHITA DEPARTMENT OF PUBLIC WORKS

DECEMBER 1998

Prepared By:

HNTB

ARCHITECTS ENGINEERS PLANNERS
7007 College Boulevard
Suite 150
Overland Park, KS 66211

HNTB Job No. 28411-PL-001-001

in association with

TransCore/SAIC

1900 North Beauregard Street
Suite 300
Alexandria, Virginia 22311
and

The Baughman Company

315 Ellis Avenue
Wichita, KS 67211

ITS Early Deployment Study

Project Advisory Committee Participants

Name	Agency
Steve Lackey	City of Wichita Department of Public Works
Mike Lindebak	City of Wichita Department of Public Works
Kevin Woodard	City of Wichita Department of Public Works
Scott Canfield	City of Wichita Department of Public Works
Paul Gunzelman	City of Wichita Department of Public Works
Matt Volz	Kansas Department of Transportation
Chris Beightel	Kansas Department of Transportation
Mark Borst	Sedgwick County Bureau of Public Services
Benny Tarverdi	Kansas Department of Transportation
Bruce Baldwin	Federal Highway Administration
Bob Alva	Federal Highway Administration
John Walters	Kansas Highway Patrol
Jon Potter	Kansas Turnpike Authority
Paul Cater	Kansas Turnpike Authority
Bill Stockwell	Metropolitan Area Planning Department
Jamsheed Mehta	Metropolitan Area Planning Department
Diane Gage	Sedgwick County Emergency Communications
Stan Zienkowicz	Wichita Transit
Mike Vinson	Wichita Transit

ITS Early Deployment Study
Incident Management Committee Participants

Name	Agency
Kevin Woodard	City of Wichita Department of Public Works
Scott Canfield	City of Wichita Department of Public Works
Paul Gunzelman	City of Wichita Department of Public Works
Jim Parks	City of Wichita Department of Public Works
Mike Hampel	City of Wichita Department of Public Works
Matt Volz	Kansas Department of Transportation
Chris Beightel	Kansas Department of Transportation
Benny Tarverdi	Kansas Department of Transportation
Sammi Ford	Kansas Department of Transportation
Mark Borst	Sedgwick County Bureau of Public Services
Bruce Baldwin	Federal Highway Administration
Bob Alva	Federal Highway Administration
John Walters	Kansas Highway Patrol
John Gaunt	Kansas Highway Patrol
Jon Potter	Kansas Turnpike Authority
Paul Cater	Kansas Turnpike Authority
Bill Stockwell	Metropolitan Area Planning Department
Jamsheed Mehta	Metropolitan Area Planning Department
Diane Gage	Sedgwick County Emergency Communications
John Coslett	Sedgwick County Emergency Communications
Georgi Scantlin	Sedgwick County Emergency Communications
Kent Koehler	Sedgwick County Emergency Communications
Mike Pulice	Sedgwick County Sheriff's Department
Elaine Mitchell	Sedgwick County Sheriff's Department
Dennis Mark	Sedgwick County Emergency Medical Services
Bill Auchterlonie	Sedgwick County Emergency Medical Services
Tom Pollan	Sedgwick County Emergency Medical Services
Curtis Wilson	Sedgwick County Fire Department
Larry Garcia	Fire Chief – City of Wichita Fire Department
Mike Bruce	Wichita Police Department
John Hershberger	Wichita Police Department
Ron Harris	Wichita Police Department
Bob Circle	Wichita Police Department
Jack Galvin	Wichita Police Department
Normal Williams	Wichita Police Department
Dan Dillon	KFDI Radio

Table of Contents

Each Chapter Is A Hyperling To That Chapter

Executive Summary ES-1

Chapter 1 **Introduction** 1-1
- 1.1 Introduction 1-1
- 1.2 Participating Agencies 1-1
- 1.3 Intelligent Transportation Systems 1-1
- 1.4 Focus of ITS Study 1-2
- 1.5 Focus of Strategic Deployment Plan 1-2

Chapter 2 **Transportation System Characteristics** 2-1
- 2.1 Jurisdictions and Affected Agencies 2-1
- 2.2 Existing Transportation Network and Activities 2-2
  - *Existing Highway System* *2-2*
  - *Incident Management Activities* *2-11*
  - *Public Transit* *2-11*
  - *System Characteristics* *2-12*
- 2.3 Current and Planned ITS Activities and Projects 2-25
  - *Traffic Signal System* *2-25*
  - *Incident Management* *2-25*
  - *Public Transit* *2-25*
  - *Railroad Crossing Safety* *2-25*
- 2.4 Future Traffic Trends 2-26
  - *Anticipated ADT* *2-26*
  - *Future Recurring Congestion* *2-26*
  - *Future Congestion Due to Accidents* *2-27*
- 2.5 Issues, Concerns and Opportunities for ITS Deployment 2-32
  - *Incident Management* *2-32*
  - *Traffic Control* *2-32*
  - *Transit* *2-32*
  - *Railroad Crossing Safety* *2-33*
  - *Obstacles to Implementation* *2-33*
  - *Institutionalization of Early Deployment Plant* *2-33*

Chapter 3 **ITS User Services and Market Packages** 3-1
- 3.1 ITS User Services and Their Local Applicability 3-1
  - *Travel and Transportation Management* *3-1*
  - *Public Transportation Operations* *3-7*
  - *Electronic Payment* *3-9*
  - *Commercial Vehicle Operations* *3-10*
  - *Emergency Management* *3-12*
  - *Advanced Vehicle Safety Systems* *3-13*
- 3.2 Agency Rankings of ITS User Services 3-15

Chapter 3 Continued

High Priority ... 3-15
Medium Priority ... 3-15
Low Priority ... 3-16
3.3 Short, Medium, and Long Term ITS User Services ... 3-18
Existing or Planned ITS User Services ... 3-19
User Services for Implementation in the Short Term ... 3-21
User Services for Implementation in the Medium Term ... 3-21
User Services for Implementation in the Long Term ... 3-21
3.4 Market Packages ... 3-21
3.5 Recommended Market Packages ... 3-22
3.6 Other Market Packages ... 3-34

Chapter 4 System Architecture ... 4-1
4.1 System Architecture ... 4-1
4.1.1 Introduction ... 4-1
4.1.2 Functional Requirements Development Process ... 4-2
User Service and Market Package Relationship ... 4-2
Market Package – Subsystem – Equipment Package Relationship ... 4-2
4.1.3 Wichita Subsystems ... 4-11
4.1.4 Wichita Functional Requirements ... 4-15
4.1.4.1 Center Subsystems ... 4-15
Traffic Management Subsystem ... 4-15
Information Service Provider Subsystem ... 4-18
Transit Management Subsystem ... 4-20
Emergency Management Subsystem ... 4-22
Toll Administration Subsystem ... 4-23
Fleet and Freight Management Subsystem ... 4-23
Commercial Vehicle Administration Subsystem ... 4-24
Emissions Management Subsystem ... 4-25
4.1.4.2 Roadway Subsystems ... 4-26
Roadway Subsystems ... 4-26
Toll Collection Subsystem ... 4-28
Parking Management Subsystem ... 4-29
Commercial Vehicle Check Subsystems ... 4-29
4.1.4.3 Vehicle Subsystems ... 4-31
Vehicle Subsystem ... 4-31
Transit Vehicle Subsystem ... 4-33
Emergency Vehicle Subsystems ... 4-35
Commercial Vehicle Subsystems ... 4-35
4.1.4.4 Traveler Subsystems ... 4-36
Personal Information Access Subsystem ... 4-36
Remote Traveler Support Subsystem ... 4-37
4.2. Logical Architecture ... 4-39
4.2.1 Overview of Logical Architecture ... 4-39
4.2.2 Logical Architecture for Short Term Market Packages ... 4-39

Chapter 4 Continued

Network Surveillance 4-40
Surface Street Control 4-41
Freeway Control 4-42
Traffic Information Dissemination 4-43
Multi-Modal Coordination 4-44
Incident Management System 4-45
HAZMAT Management 4-46
Standard Railroad Crossing 4-47
Advanced Railroad Crossing 4-48
Railroad Operations Coordination 4-49
Broadcast Traveler Information 4-50
Interactive Traveler Information 4-51
Emergency Response 4-52
Emergency Routing 4-53
Mayday Support 4-54
Commercial Vehicle Administrative Processes 4-55
Weigh-In-Motion 4-56
Roadside CVO Safety 4-57
Transit Vehicle Tracking 4-58
Transit Passenger and Fare Management 4-59
4.2.3 Logical Architecture for Medium-Term Market Packages 4-60
Regional Traffic Control 4-60
Probe Surveillance 4-61
Traffic Network Performance Evaluation 4-62
Demand-Response Transit Operations 4-63
Dynamic Toll/Parking Fee Management 4-64
Yellow Pages and Reservations 4-65
Autonomous Route Guidance 4-66
Dynamic Route Guidance 4-67
Transit Fixed-Route Operations 4-68
Transit Security 4-69
Transit Maintenance 4-70
Fleet Administration 4-71
Electronic Clearance 4-72
ITS Planning 4-73
4.2.4 Logical Architecture for Long Term Market Packages 4-74
Emissions and Environmental Hazards Sensing 4-75
ISP – Based Route Guidance 4-76
Integrate Transportation Management/Route Guidance 4-77
In-Vehicle Signing 4-78
On-Board CVO Safety 4-79
CVO Fleet Maintenance 4-80

Chapter 4 Continued

4.3 Physical Architecture 4-81
4.31 Overview of ITS Physical Architecture 4-81
4.3.2 Physical Architecture Systems and Subsystems 4-81
4.3.3 Center Subsystems 4-81
Roadside Subsystems 4-82
Vehicle Subsystems *4-83*
Traveler Subsystems *4-83*
4.3.4 Wichita Physical Architecture 4-84
4.4 Center Subsystem Configuration Alternatives 4-89
4.4.1 Regional Center Subsystem Configuration 4-89
Centralized Subsystem Configuration *4-89*
Distributed Subsystem Configuration *4-92*
Hybrid Subsystem Configuration *4-95*
4.5 Recommended Subsystem Configuration for Wichita Region 4-97

Chapter 5 Technology Alternatives 5-1
5.1 Introduction 5-1
5.2 Surveillance Technologies 5-1
Vehicle Detection *5-2*
CCTV Surveillance *5-6*
Cellular Phone Call-Ins *5-11*
Vehicle Probes *5-12*
5.3 Communications Technologies 5-13
Commercially Owned Facilities *5-13*
Agency Owned Facilities *5-17*
5.4 Traveler Interface Technologies 5-21
In-Route Motorist Information *5-21*
Pre-Trip Motorist Information *5-26*
5.5 Data Processing 5-28
Detector Data Processing *5-28*
Incident Detection Algorithms *5-30*
Incident Detection Algorithms *5-31*
5.6 Public Transportation Technologies 5-31

Chapter 6 Implementation 6-1
6.1 ITS Applications 6-1
Short, Medium and Long-Term Priorities *6-1*
Implementation Schedule *6-2*
6.2 Operations Plan 6-16
Agreements and Memorandums of Understanding *6-16*
Specialized Control Plans *6-18*
Hours of Operation *6-18*
TOC Operators *6-19*
Equipment Maintenance *6-20*
System Management *6-20*

Chapter 6 Continued

Implementation Plan ... 6-21
Traffic Operations Center Concept ... 6-21
6.3 Interagency Coordination ... 6-22
Agency Roles and Responsibilities ... 6-22
6.4 Implementation Issues ... 6-25
Maintenance Issues ... 6-25
Operations Issues ... 6-26
Open Issues ... 6-26
6.5 Funding Issues ... 6-26
Federal Sources ... 6-26
State/Local Sources ... 6-32
Public/Private Sources ... 6-32
6.6 Contracting Alternatives ... 6-35
Existing Agency Methodologies ... 6-36
Formal Contracting Arrangements ... 6-38

Chapter 7 Benefits and Costs ... 7-1
7.1 Introduction ... 7-1
7.2 Background ... 7-1
7.3 Anticipated Benefits ... 7-2
Travel Delay Time ... 7-2
Fuel Use and Emissions ... 7-4
Total Benefits ... 7-8
7.4 Estimate of Probable Costs ... 7-8
7.5 Cost Allocation and Funding Options ... 7-13
7.6 Benefit Cost Ratios – Freeway Management System ... 7-14

Chapter 8 Conclusion ... 8-1

Appendix A Accidents at Railroad Crossings
Appendix B Agencies Interviewed for Wichita Metropolitan Area Early Deployment Study
Appendix C Agency Rankings of ITS User Services
Appendix D Glossary of ITS User Services
Appendix E Calculation of Anticipated Benefits
Appendix F Estimate of Probable Cost Calculations

List of Tables

Tables are Hyperlinked to Chapter

Table ES-1	Benefit-Cost Ratio by Phase	ES-5
Table 2-1	Accident Types at Railroad Crossings	2-4
Table 2-2	Intersections with Railway Train Accidents	2-10
Table 3-1	Travel and Transportation Management User Services	3-2
Table 3-2	Public Transportation Operations User Services	3-7
Table 3-3	Electronic Payment User Services	3-9
Table 3-4	Commercial Vehicle Operations Users Services	3-10
Table 3-5	Emergency Management User Services	3-12
Table 3-6	Advanced Vehicle Safety Systems User Services	3-14
Table 3-7	Overall Priority Ranking of ITS User Services by Local Agencies	3-17
Table 3-8	Priority and Implementation Time Frames for ITS Users	3-20
Table 3-9	Market Package to User Service Relationships	3-22
Table 3-10	Recommended Market Packages for the Wichita Metropolitan Area	3-25
Table 4-1	Travel and Transportation Management User Services	4-2
Table 4-2	Public Transportation Operations User Services	4-7
Table 4-3	Electronic Payment User Services	4-9
Table 4-4	Commercial Vehicle Operations User Services	4-10
Table 4-5	Emergency Management User Services	4-12
Table 4-6	Advanced Vehicle Safety Systems User Services	4-14
Table 4-7	Overall Priority Rankings of ITS User Services by Local Agencies	4-17
Table 4-8	Priority and Implementation Time Frames for ITS User Services	4-20
Table 5-1	Market Packages to User Service Relationships	5-2
Table 5-2	Recommended Market Packages for the Wichita Metropolitan Area	5-3
Table 7-1	Travel Delay Time Savings – Short Term	7-3
Table 7-2	Travel Delay Time Savings – Medium Term	7-4
Table 7-3	Travel Delay Time Savings – Long Term	7-4
Table 7-4	Fuel Use Savings – Short Term	7-4
Table 7-5	Fuel Use Savings – Medium Term	7-5
Table 7-6	Fuel Use Savings – Long Term	7-5
Table 7-7	Emissions Reductions – Short Term	7-7
Table 7-8	Emissions Reductions – Medium Term	7-7
Table 7-9	Emissions Reductions – Long Term	7-7
Table 7-10	Benefits per Phase	7-8
Table 7-11	Initial Implementation	7-9
Table 7-12	Short Term Implementation	7-10
Table 7-13	Medium Term Implementation	7-11
Table 7-14	Long Term Implementation	7-12
Table 7-15	Annual Costs per Phase	7-12
Table 7-16	Cumulative Benefit-Cost Ratio for Each Phase	7-14
Table 7-17	Incremental Benefit-Cost Ratio for Each Phase	7-15

List of Figures

Figures are Hyperlinked to Chapter

Figure ES-1 Freeway Management System Implementation ES-3
Figure ES-2 Short Term implementation ES-4
Figure 2-1 Existing Roadway Network 2-5
Figure 2-2 Traffic Signal System 2-6
Figure 2-3 Downtown Area Traffic Signal System 2-7
Figure 2-4 Existing Railway Network 2-8
Figure 2-5 Existing Railway Network - Downtown Area 2-9
Figure 2-6 Fire, Police, EMS, Hospital Locations 2-14
Figure 2-7 Fixed Transit Routes 2-15
Figure 2-8 Existing Traffic Volumes on Freeway Facilities 2-16
Figure 2-9 Existing Traffic Volumes on Arterial Facilities 2-17
Figure 2-10 Existing Traffic Volumes on Local Street Network 2-18
Figure 2-11 Existing Recurring Congestion Areas 2-19
Figure 2-12 Existing Incident Related Congestion Areas 2-20
Figure 2-13 Critical Accident Ranking – Freeways 2-22
Figure 2-14 Critical Accident Ranking – Arterials 2-23
Figure 2-15 Accidents Per Year at Local Arterials (1997) 2-24
Figure 2-16 2020 Projected Recurring Congestion Areas with Committed Conditions 2-28
Figure 2-17 2020 Projected Recurring Congestion Areas with Planned Conditions 2-29
Figure 2-18 2020 Projected Incident Related Congestion Areas with Committed Conditions 2-30
Figure 2-19 2020 Projected Incident Related Congestion Areas with Planned Conditions 2-31
Figure 4-1 Network Surveillance Logical Architecture 4-40
Figure 4-2 Surface Street Control Logical Architecture 4-41
Figure 4-3 Freeway Control Logical Architecture 4-42
Figure 4-4 Traffic Information Dissemination Logical Architecture Functions 4-43
Figure 4-5 Multi-Modal Coordination Logical Architecture 4-44
Figure 4-6 Incident Management System Logical Architecture 4-45
Figure 4-7 HAZMAT Management Logical Architecture 4-46
Figure 4-8 Standard Railroad Crossing Logical Architecture 4-47
Figure 4-9 Advanced Railroad Crossing Logical Architecture 4-48
Figure 4-10 Railroad Operations Coordination Logical Architecture 4-49
Figure 4-11 Broadcast Traveler Information Logical Architecture 4-50
Figure 4-12 Interactive Traveler Information Logical Architecture 4-51
Figure 4-13 Emergency Response Logical Architecture 4-52
Figure 4-14 Emergency Routing Logical Architecture 4-53
Figure 4-15 Mayday Support Logical Architecture 4-54
Figure 4-16 CV Administrative Processes Logical Architecture 4-55
Figure 4-17 Weigh-In-Motion Logical Architecture 4-56
Figure 4-18 Roadside CVO Safety Logical Architecture 4-57
Figure 4-19 Transit Vehicle Tracking Logical Architecture 4-58
Figure 4-20 Transit Passenger and Fare Management Logical Architecture 4-59
Figure 4-21 Regional Traffic Control Logical Architecture 4-60
Figure 4-22 Probe Surveillance Logical Architecture 4-61

Figure 4-23 Traffic Network Performance Evaluation Logical Architecture 4-62
Figure 4-24 Demand-Response Transit Operations Logical Architecture 4-63
Figure 4-25 Dynamic Toll/Parking Logical Architecture 4-64
Figure 4-26 Yellow Pages and Reservations Logical Architecture 4-65
Figure 4-27 Autonomous Route Guidance Logical Architecture 4-66
Figure 4-28 Dynamic Route Guidance Logical Architecture 4-67
Figure 4-29 Transit Fixed-Route Operations Logical Architecture 4-68
Figure 4-30 Transit Security Logical Architecture 4-69
Figure 4-31 Transit Maintenance Logical Architecture 4-70
Figure 4-32 Fleet Administration Logical Architecture 4-71
Figure 4-33 Electronic Clearance Logical Architecture 4-72
Figure 4-34 ITS Planning Logical Architecture 4-73
Figure 4-35 Emissions and Environmental Hazards Sensing Logical Architecture 4-75
Figure 4-36 ISP-Based Route Guidance Logical Architecture 4-76
Figure 4-37 Integrate Transportation Management/Route Guidance Logical Architecture 4-77
Figure 4-38 In-Vehicle Signing Logical Architecture 4-78
Figure 4-39 On-Board CVO Safety Logical Architecture 4-79
Figure 4-40 CVO Fleet Maintenance Logical Architecture 4-80
Figure 4-41 Wichita Physical Architecture – Existing Conditions 4-85
Figure 4-42 Wichita Physical Architecture – Short Term Market Packages 4-86
Figure 4.43 Wichita Physical Architecture – Medium Term Market Packages 4-87
Figure 4-44 Wichita Physical Architecture – Long Term Market Packages 4-88
Figure 6-1 CCTV Camera Implementation 6-4
Figure 6-2 VMS Implementation 6-5
Figure 6-3 Highway Advisory Radio Implementation 6-6
Figure 6-4 Vehicle Detection implementation 6-7
Figure 6-6 Summary of Contracting Types 6-39
Figure 7-1 Velocity vs. Emissions Curves 7-6