Minnesota Department of Transportation Agreement Number 73807P

Minnesota Intelligent Transportation Systems

ITS System Specification

APPENDIX A: Architectural Trade-off Analysis

POLARIS
ITS Partnership

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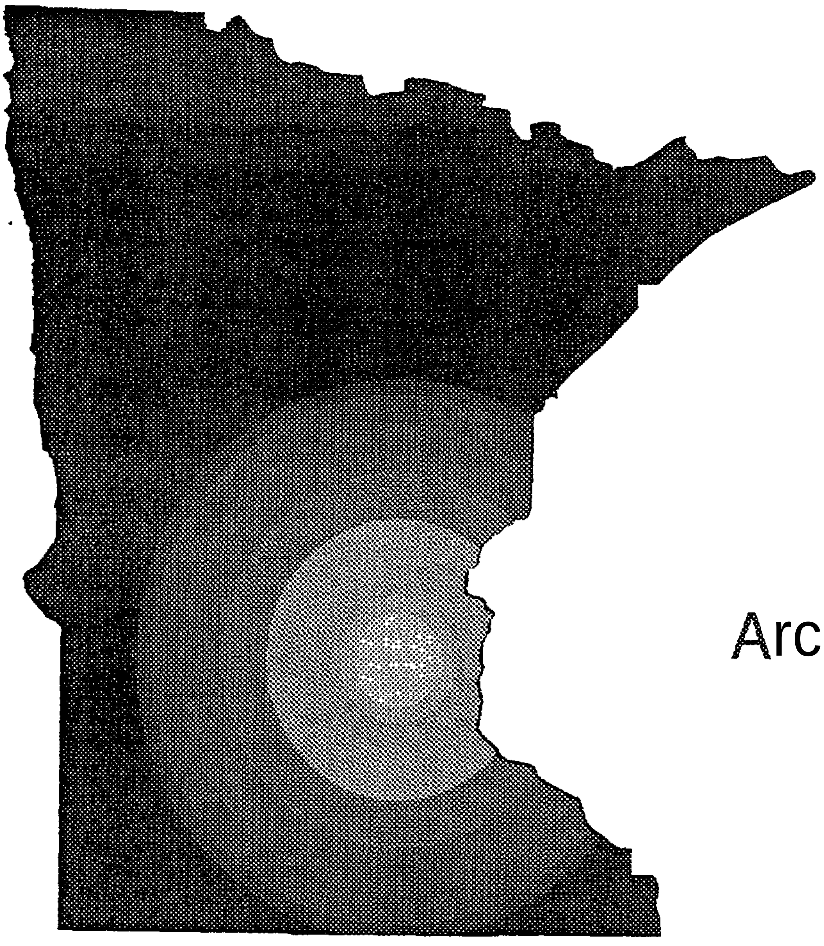

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Architecture Trade-Off Details

Account Management

Function Descriptions

Account Management (AM) Service

1. **Manage Pricing Requirements (MPR)**
   - collect pricing requirements for transportation services (e.g. parking, tolls, transit, traveler information)
   - consider: travelers' needs, public agency needs and private company needs

2. **Manage Pricing Strategies (MPS)**
   - analyze pricing requirements and service usage statistics
   - develop pricing strategies for optimum use of transportation services

3. **Manage Service Pricing Structures (MSPS)**
   - establish prices, rates, fares and tolls for various transportation services
   - consider: pricing strategies and pricing requirements

4. **Administer User Accounts (AUA)**
   - create and maintain user accounts for billing of transportation services
   - create and maintain user profiles for Advanced Traveler Information and Mayday Services
   - create and maintain provider profiles for Demand Responsive Transit Service providers

5. **Manage Service Usage Data (MSU)**
   - collect service usage data for various transportation services (e.g. parking, tolls, transit, traveler information)
   - calculate service usage statistics that are used in planning pricing strategies

6. **Manage Service Billing and Payments (SBP)**
   - calculate charges for transportation services used and invoice users
   - track payments for transportation services and credit user accounts

Account Management Service Architecture Approach Summary

	Recommeuded Architecture
Public Agencies - Parking Management Center(s) - Transit Management Center(s) - Toll Authority Center(s)	a. Creation and maintenance of pricing strategies and pricing structures b. Creation and maintenance of user account information for billing of transportation services d. Calculate charges for transportation services e. Collect payments for transportation services f. Generate service usage statistics
Demand Responsive Transit Center(s)	a. Creation and maintenance of pricing strategies and pricing structures b. Creation and maintenance of user account information for billing of transportation services c. Creation and maintenance of user service profiles and Demand Responsive Transit provider profiles d. Calculate charges for transportation services e. Collect payments for transportation services f. Collect service usage data and generate serviceusage statistics
Informatiou Providcr(s)/Service Provider(s) - Tailored Traveler Information Provider(s) - Mayday Service Provider(s)	a. Creation and maintenance of pricing strategies and pricing structures b. Creation and maintenance of user account information for billing of transportation services c. Creation and maintenance of user service profiles d. Calculate charges for transportation services e. Collect payments for transportation services f. Collect service usage data and generate service usage statistics
Transit Service Provider(s)	a. Creation and maintenance of pricing strategies and pricing structures b. Creation and maintenance of user account information for billing of transportation services c. Creation and maintenance of user service profiles and Demand Responsive Transit provider profiles d. Calculate charges for transportation services e. Collect payments for transportation services f. Collect service usage data and generate service usage statistics

Account Management Service Architecture Approach Summary

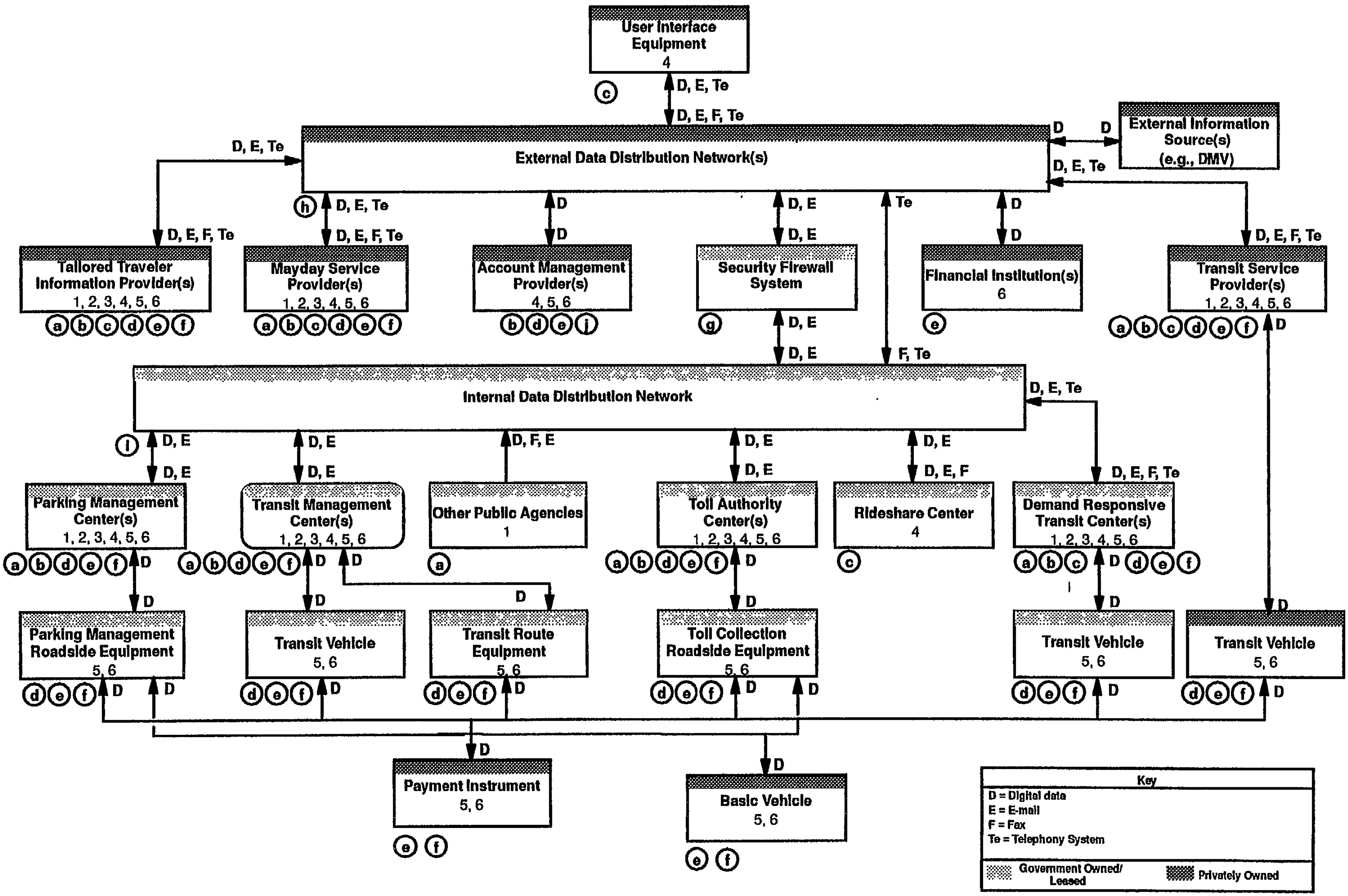
	Recommended Architecture
Account Management Provider(s)	b. Creation and maintenance of user account information for billing of transportation services d. Calculate charges for transportation services e. Collect payments for transportation services f. Provide consolidated billing services for multiple public'and/or private agencies
Rideshare Center	c. Creation and maintenance of user service profiles and nrovider profiles for van/car pooline
Fiuancial Institutions	c. Payment of transportation service invoices via ele ctronic funds transfer
Roadside Equipment/Transit Route Equipment/Transit Vehicles	d. Calculate charges for transportation services e. Collect payments for transportation services f. Collect service usage data
Payment Instrument	e. Payment of transportation services f. Transmit service usage data
Basic Vehicle	e. Payment of transportation services f. Transmit service usage data
User Interface Equipment	c. Creation and maintenance of user service profiles
Security Firewall System	g. Provide secure firewall for two way data exchange between government owned/leased and privately owned networks
External Data Distribution Network	h. Provide public access, statewide ITS communication network with security for accounting and user account and profile information
Internal Data Distribution Network	i. Provide limited access, regional public agency ITS network with security for accounting and user account information

Account Management Service Architecture Approach Summary

<u>Approach Topic Codes</u>

a. = Management of service pricing
b. = User account information management
c. = Profile management
d. = Manage transportation service charges
e. = Manage transportation service payments
f. = Service usage data management
g. = Security tirewall
b. = External data access
i. = Internal data access
j. = Consolidated billing

Account Management Recommended Architecture



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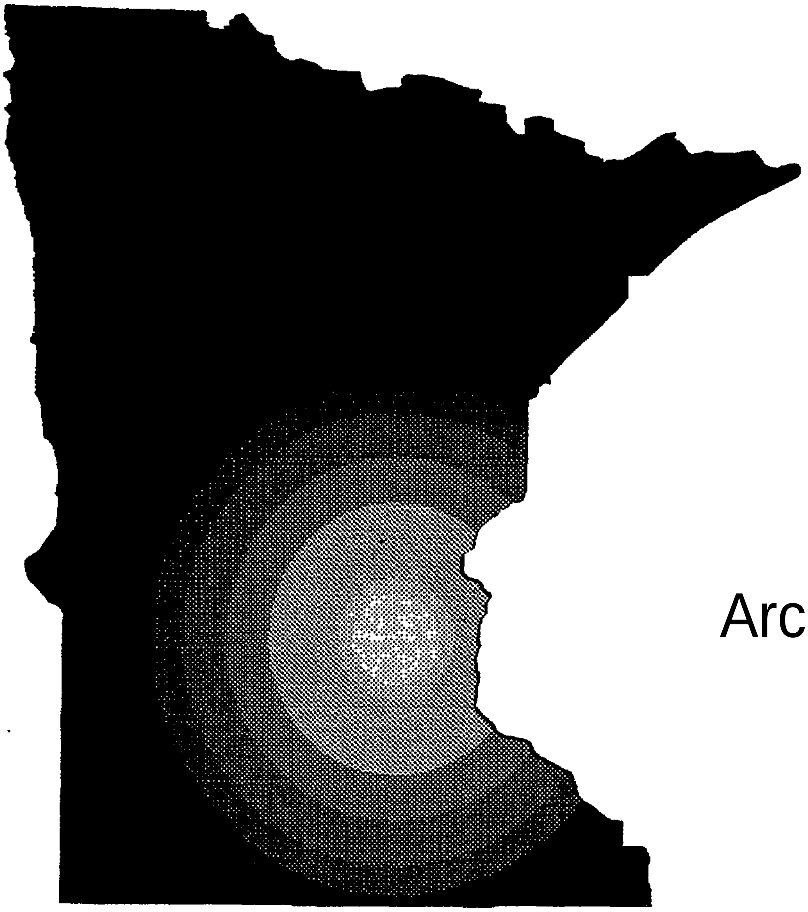

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Architecture Trade-Off Details

Incident Management

Incident Management (IM)
Function Descriptions

1. Manage Response Requirements

- collect requirements from public/private agencies and other users
- maintain requirement repository

2. Manage Response Plans and Procedures

- analyze response performance
- develop response plans and procedures
- maintain response plans and procedures

3. Manage Response Routes

- develop response routes
- maintain response routes

4. Detect and Acknowledge incidents

- utilize data inputs from various sources and devices to detect incidents and emergencies
- acknowledge receipt of detection of incidents and emergencies

5. Manage Mayday Requests

- receive request and cancellation notices for Mayday Service
- verify service level authorization prior to allowing access to emergency service
- acknowledge receipt of Mayday requests and cancellations
- maintain appropriate records of each service usage

6. Classify and Record Incident

- utilize incident data to classify and code incidents and emergencies
- classification and coding will be consistent with ITS standards
- retain active incident data in the incident file

7. **Initiate Response Plans, Procedures, and Routes**
   - select appropriate response plans and procedures per current incident data
   - select appropriate response routes per current incident data
   - determine need for signal preemption requests for incident resources per ,current incident data
   - determine need for cancellation notice for any incident resource that is no longer needed

8. **Track Response Progress**
   - track progress of incident resources assigned
   - use resource location, response route, and travel conditions to determine estimated time of arrival
   - monitor incident status until incident is resolved
   - maintain incident file

9. **Manage Incident Log**
   - log incident files and response status in the incident log
   - generate incident history from data contained in the incident log

10. **Manage Incident Resource Assignments**
    - assign resources from multiple agencies and jurisdictions to the incident
    - resource assignments will consider resource requests, location, condition, maintenance, training, and off-duty/out-of-service status

11. **Track Incident Resource Status**
    - resource location and status will be monitored for all resources assigned to an incident

Incident Management Service Architecture Approach Summary

	AS-IS	Architecture # 1 (distributed)	Architecture # 2 (hybrld)	Architecture # 3 (centralized)
Incident Dispatch Centers	**a.** Assign resources to incidents with manual coordination of incident management and resource assignmnent **b.** Limited access to non-sensitive incident information by service providers and Incident Dispatch Centers **c.** Sensitive information manually protected by agency recording information **d.** Non-standardized incident information recorded and reported per local organizational and jurisdictional requirements **e**. Distributed repository of hardcopy data and computer tiles requires independent agency data management procedures for backup and recovery of data	**a.** Each public/private agency assigns resources to incidents utilizing computer information to aid in coordination of incident management and resource assignment **b.** Non-sensitive incident information is distributed from individual agencies **c.** Sensitive incident information protected by semi-automated process at recording agency **d.** Standardize incident information recorded and tailored reports provided for various organizations and jurisdictions **e**. Same as As-Is	**a.** Same as architecture # 1 **b.** Non-sensitive incident information is distributed from Regional ITS Management System **c.** Same as architecture #l **d.** Same as architecture #I e. Distributed repository of hardcopy data and computer files requires independent agency data management procedures for backup and recovery of data maintained by by agencies, centralized backup and recovery of data maintained by Regional ITS Management System	**a.** Same as architecture #1 except Regional Incident Management Center coordinates consolidated resources **b.** Same as architecture # 2 **c.** Sensitive incident information protected by semi-automated process at Regional ITS Management Center **d.** Same as architecture # 1 e. Same as architecture #2

Incident Management Service Architecture Approach Summary

	As-Is	Architecture # 1 (distributed)	Architecture # 2 (hybrid)	Architecture # 3 (centralized)
State Patrol Dispatch Ceuter (E911 service)	**a - e.** Same As Incident Dispatch Center As-Is item a - e **f.** Provides initial contact for E911 request for assistance and then requests resources from appropriate agencies	**a - e.** Same As Incident Dispatch Center Architecture I, item a - e **f.** Provide **E911** computer aided dispatch to enable more efficient communication of data to minimize amount of time required to resolve incidents	**a- e.** Same As Incident Dispatch Center Architecture 2, item a - e **f.** Same,as architecture # 1	**a - e.** Same As Incident Dispatch Center Architecture 3, item a - e **f.** State Patrol E911 functions centralized at Regional Incident Management Center
Traffic Signal Center	**g.** Provide Traffic Control during an incident to optimize incident resource response time and to minimize traffic congestion as a result of the incident **h.** Identify incidents and/or emergencies	**g.** Same as As-Is **h.** Same as As-Is	g. Same as As-Is **h.** Same as As-Is	**g.** Same as As-Is **h.** Same as As-Is
Freeway Traffic Management Centers and Translt Management Center	**a - e.** Same As Incident Dispatch Center As-Is item a - e **h.** Identify incidents and/or emergencies	**a - e**. Same As incident Dispatch Center Architecture 1, item a - e **h.** Same as As-Is	**a** - e. Same As Incident Dispatch Center Architecture 2, item a - e **h.** Same as As-Is	**a.** Same as Incident Dispatch Center Architecture #l, item a **b** - e. Same As Incident Dispatch Center Architecture 3, item b - e **h.** Same as As-Is
Mayday Service Provider	Not Applicable	**i.** Provides initial contact for Mayday request for assistance and then requests resources from appropriate agencies	I. Same as architecture # 1	1. Same as architecture # 1

Incident Management Service Architecture Approach Summary

	As-Is	Architecture # 1 (distributed)	Architecture # 2 (hybrid)	Architecture # 3 (centralized)
Regional ITS Management System	Not Applicable	Not Applicable	**b.** Same As Incident Dispatch Center Architecture 2, item b **d.** Provide alternate source of non-sensitive tailored reports **e.** Same as Incident Dispatch Center Architecture #2, item e	**b - c.** Same As Incident Dispatch Center Architecture 3, item b - c **d.** Same as architecture # 2 **e.** Same as Architecture# 2
External Information Sources and Broadcast Information Providers	**h.** Identify incidents and/or emergencies	**h.** Same as As-Is	**h.** Same as As-Is	**h.** Same as As-Is
Inter Jurisdictional Incident Management System	**j.** Inter jurisdictional control of incident management resources (limited - e.g. Highway Helpers)	**j.** Inter jurisdictional control of incident management resources	**j.** Same as Architecture# 1	**j.** Same as Architecture # 1
Regional ITS Management Center	Not Applicable	Not Applicable	Not Applicable	**a** - e. Same As Incident Dispatch Center Architecture 3, item a - e **k.** Prpvide centralized incident management
Division of Emergency Management	**k.** Provide state level incident management when an incident exceeds predetermined levels	**k.** Same as As-Is	**k.** Same as As-Is	**k.** Same as As-Is
Security Firewall System	**c.** Provides secure Iirewall for two way data exchange between government owned/leased and privately owned networks (limited function)	**c.** Provide secure firewall for two way data exchange between government owned/leased and privately owned networks	**c.** Same as architecture #I	**c.** Same as architecture #l

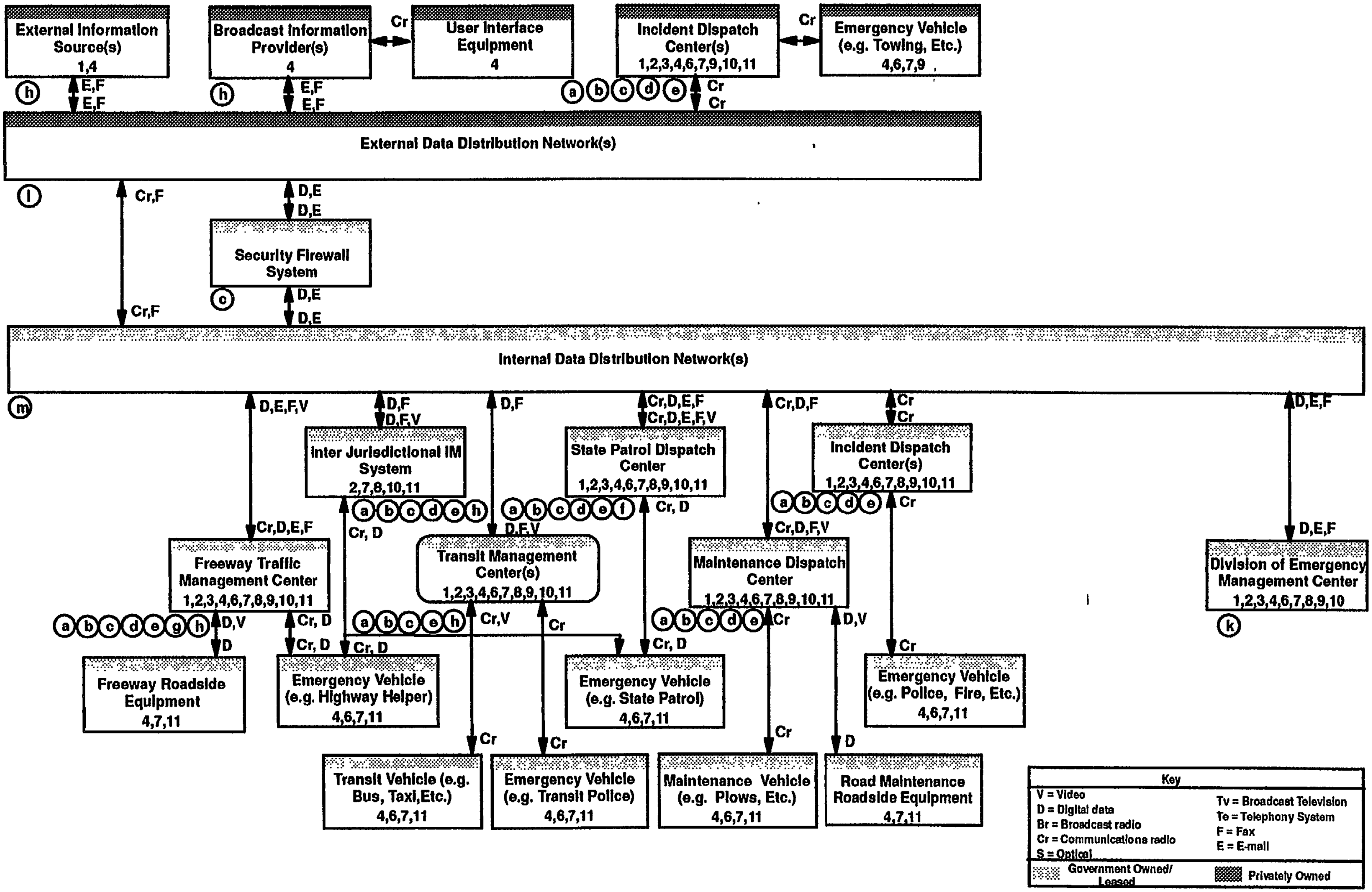
Incident Management Service Architecture Approach Summary

	As-Is	Architecture # 1 (distributed)	Architecture # 2 (hybrid)	Architecture # 3 (centralized)
External Data Distrlbutlon Network	l. Provides public access, statewide communication network (limited access)	l. Provide public access, statewide ITS communication network	**l .** Same as architecture #I	I. Same as architecture #I
Internal Data Distrlbutlon Network	**m.** Provides limited access, regional public agency network	**m.** Provide limited access, statewide public agency ITS network	**m.** Same as architecture #l	**m.** Same as architecture #1

Approach Topic Codes

a.=Resource management
b.=Accessability of non-sensitive information
c.=Accessability of sensitive information
d.=Information recording and reporting
e.=Information backup/recovery
f.=E9 1 I service
g.=Trafftc control
h.=Incident detection
I.=Mayday Service
J.=Control of incident management resources
k.=Centralized incident management
I.=Extemal data access
m.=Internal data access

Incident Management Service
AS-IS Architecture



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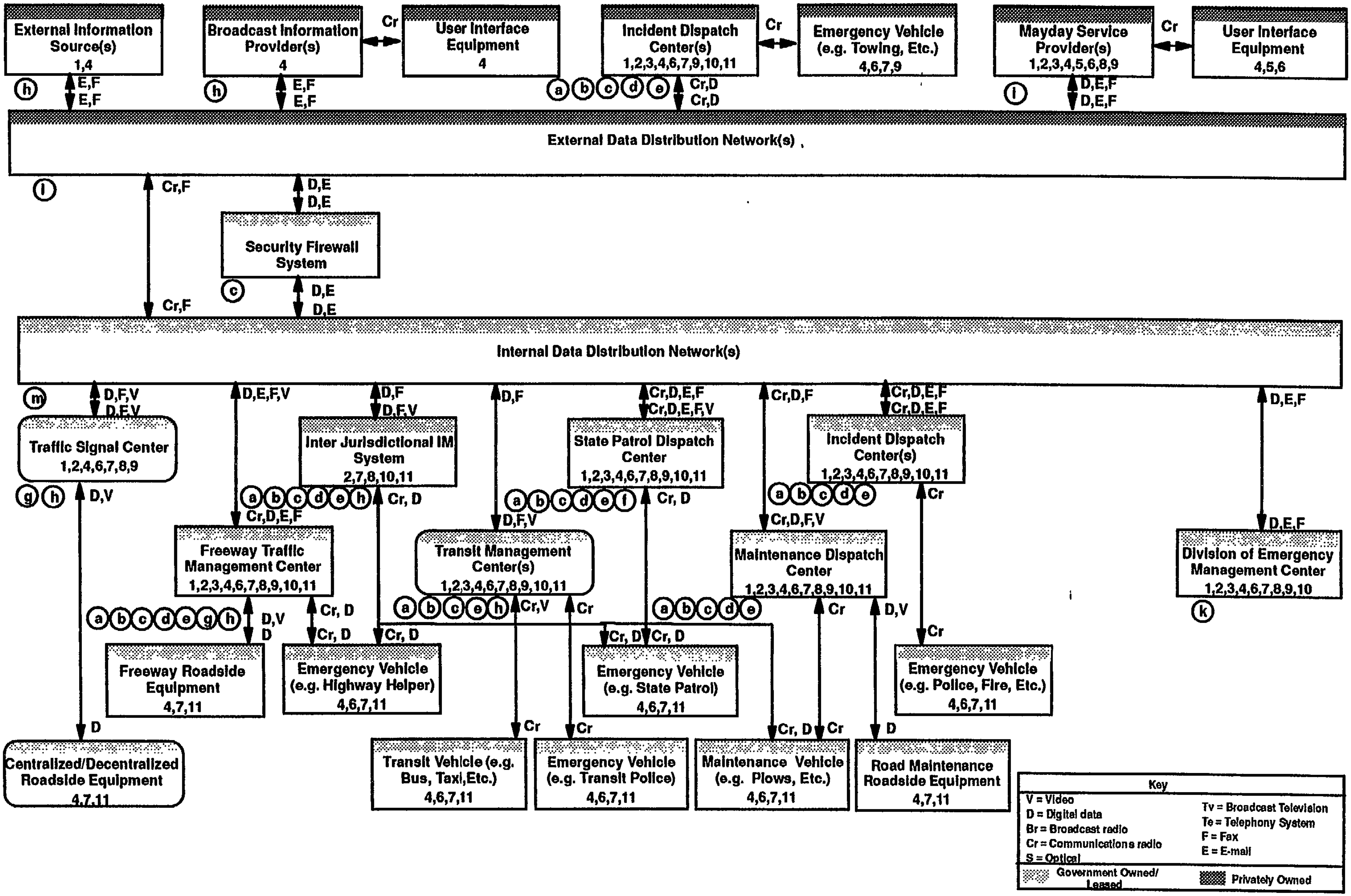
As-Is Architecture
Incident Management Service

Advantages
- Clear Line of authority and responsibility
- It is currently working (still have room for improvement)
- Data security is very good

Disadvantages
- Difficult for the public to access data
- Need to improve communications - ineficiciency due to duplication of effort slows response time
- Coordinated response planning requires significant effort
- Communication messages evolve as dispatch centers are contacted
- Non-standard communications add confusion to message interpretation
- Not enough time to contact all agencies
- Inter-agency planning is not done as often as it should be
- Multiple agencies think they are controlling the response
- Can not review consolidated incident data to improve performance

Issues
- Large number of jurisdictions with different goals/objectives/methods complicate incident response

Incident Management Service Architecture #1



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Architecture #1

incident Management Service

Advantages

- Least change from As-Is architecture
- Minimal institutional impact
- Graceful degradation due to failures (no single point of failure)
- Not dependant on what other agencies do to incorporate new technology

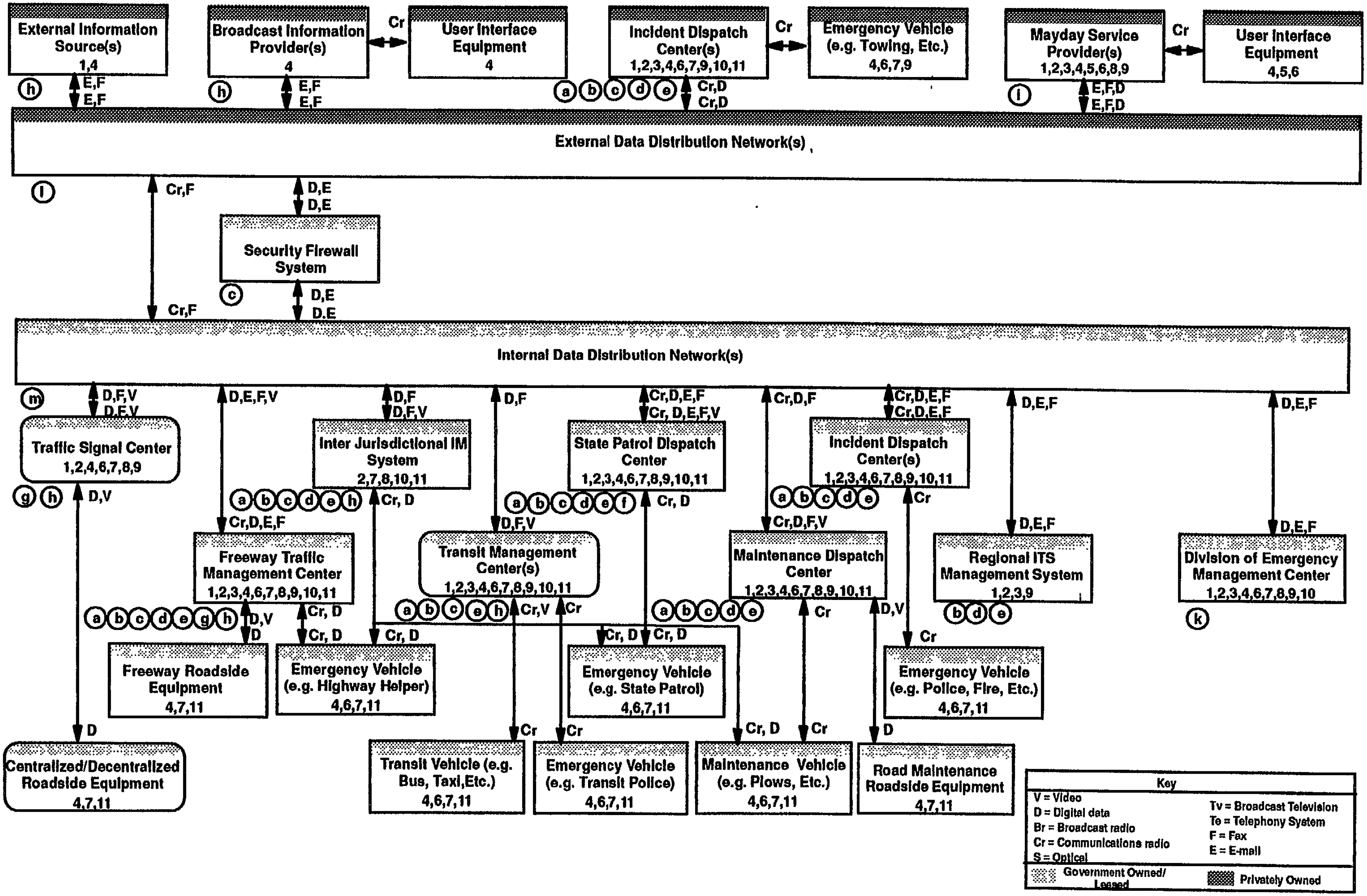
Disadvantages

- Requires staffing at multiple centers (less efficient)
- Must access multiple agencies to obtain data
- Inability to cross-check data consistency
- Additional effort to implement data conventions
- Public access to data requires mutiple interfaces

Issues

- Requires compatable technology/equipment at private sector agencies

Incident Management Service Architecture #2



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Architecture #2

Incident Management Service

Advantages

- Access to non-sensitive data is centralized at Regiorial ITS Management System
- Minimal institutional implementation impact
- Data consistancy/validation/verification checking can be performed
- Public access of information will be made easier (single point of access)

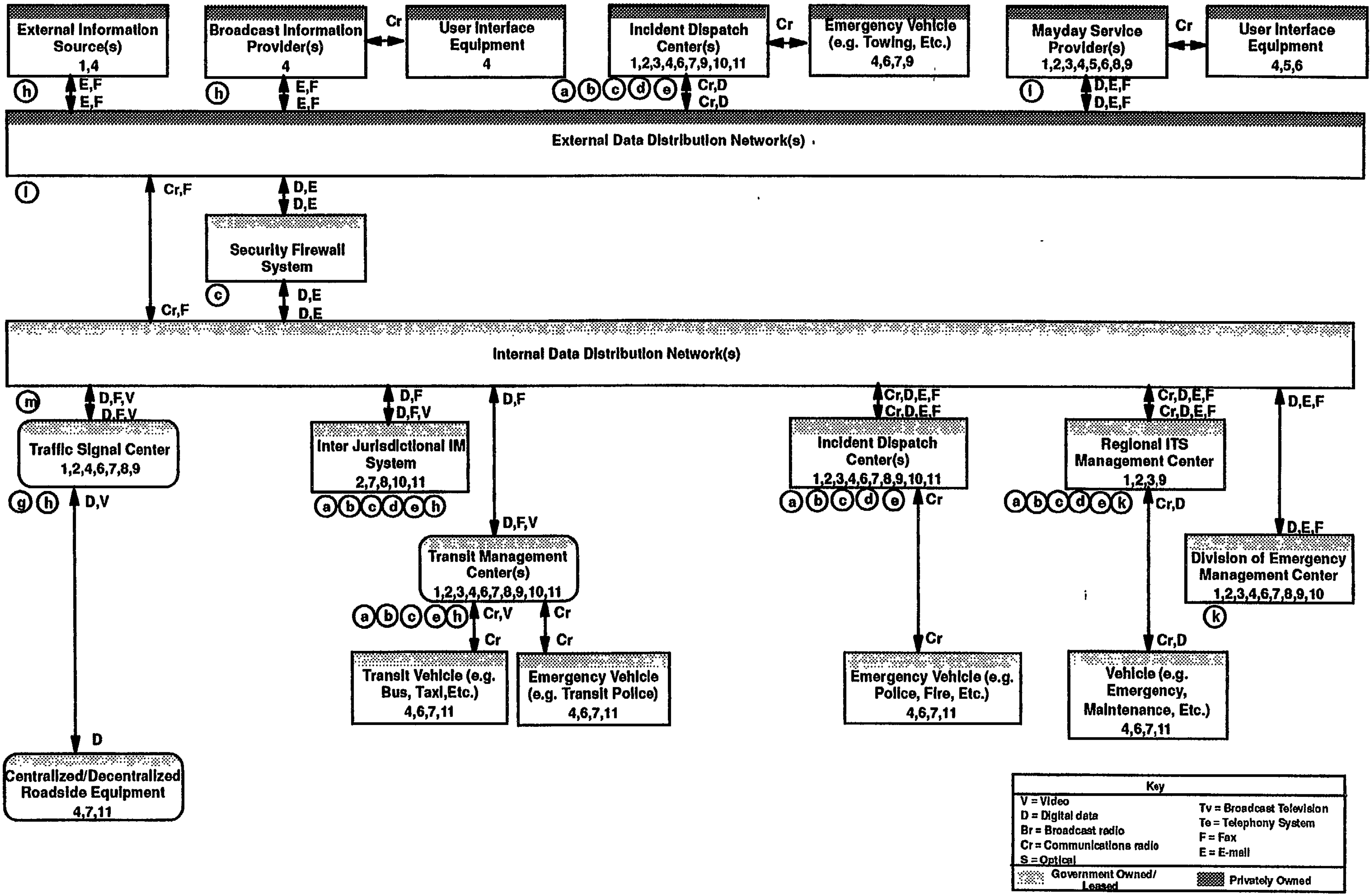
Disadvantages

- Degraded mode capability is more complicated
- Single point of failure
- More interfaces to manage

Issues

- Who owns/operates/funds/maintains Regional ITS Management System
- Need to link information from multiple sources to a single incident
- Incident history record needs to be protected from general public access
- Data distribution process

Incident Management Service Architecture #3



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Architecture #3

Incident Management Service

Advantages

- Reduced staffing by consolidating dispatch operations
- Can access common information systems
- Fewer incident management systems (CAD, other equipment)
- Easier to infuse new technology at central site
- Forces agencies to pool resources to improve efficiency

Disadvantages

- Requires co-location of resources
- Most difficult to implement (requires new facilities)

Issues

- Who owns/controls/maintains the Regional ITS Management Center
- Coordination - multiple jurisdictions governing center operations

Incident Management Service
Architecture Trade-off Evaluation

	AS-IS	Architecture #1	Arichitecture #2	Architecture #3
Function: ***Information Completeness***	* Each dispatch center and resources assigned to the dispatch center utilize local procedures to gather and maintain incident information	++ Incident information gathering will be standardized for consistency and completeness across dispatch centers and resources	++ Same as architecture #l	++ Same as architecture #I
Performance: ***Incident Response Time:***	* Dispatch centers communicate verbally and digitally (limited) with other dispatch centers and resources assigned to incidents which results in longer incident response times due to inefficient communication techniques	+ Increased amount of digital communication to provide incident alerts and information on resource assignments to allow dispatch centers to be better prepared to respond to resource requests	t Same as architecture #1	+ Same as architecture #l
Inter-jurisictional Response	* Plans are coordinated manually across jurisdictions and between dispatch centers	+ Increased inter-jurisdictional planning utilized to improve incident response time and decrease time required to clear incidents, aided by improved communication via computer network	+ Same as architecture # 1	++ Co-location of dispatch centers will provide better inter-jurisdictional cooperation along with improvement in incident response time

Incident Management Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2	Architecture #3
Information Sharing: ***Ability to Share Data/Data Standardization:***	* Incident information is maintained utilizing local procedures with minimal information sharing between agencies and service providers	+ Standardized information will allow incident information to be entered into computers such that data can be shared between agencies and the general public on a need-to-know basis	+ Non-sensitive incident information maintained in a centralized repository such that data can be shared between agencies and the general public on a need-to-know basis	+ Incident information maintained in a centralized repository such that data can be shared between agencies and the general public on a need-to-know basis
Security of Sensitive Information:	* Data is gathered for use by individual agency and service provider and is shared on a need-to know basis	= Same as As-Is	= Same as As-Is	=Same as As-Is except sensitive and non-sensitive data is stored in a centralized repository
Upgradabillty: ***Does not constrain future plans:***				
• Adding Public/Private Agencies:	* Each agency must add new interfaces	+ Each agency connects to the computer network	+ Same as architecture #l	+ Same as architecture #1
- Openness:	* Limited communication standard for protocols, messaging, and information sharing	+ Standards based communication protocols and data sharing between networked computer systems	+ Same as architecture #I	+ Same as architecture #1

Incident Management Service
Architecture Trade-off Evaluation

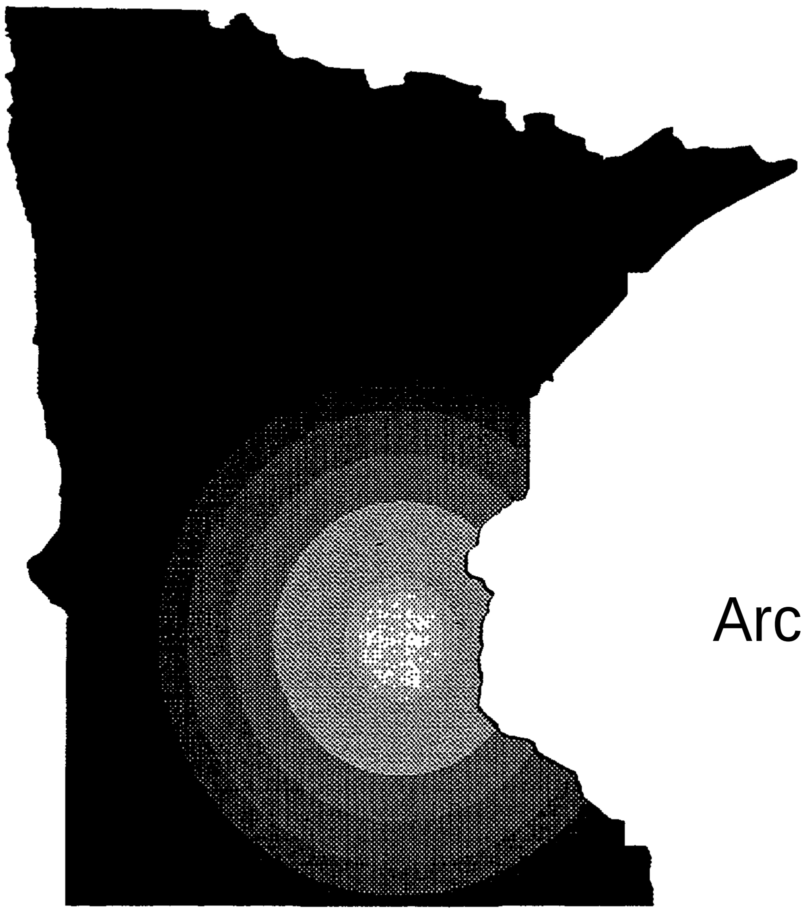
	AS-IS	Architecture #1	Architecture #2	Architecture #3
Availability: ***Hours of Operations***	* System available 24 hrs/day, with backup procedures available for obtaining appropriate resources outside of normal business hours for those services that are not available 24 hrs/day	= Same as As-Is	= Same as As-Is	= Same as As-Is
Failure Modes	* Communications links between dispatch centers and between dispatch centers and resources are the main point of failure	+ Computer network provides the main communication link between dispatch centers with previous communication link as a backup	+ Same as architecture #1	++ Co-location of dispatch adds face-to-face backup communication
Recovery Modes	* Utilize alternative communication links, data management procedures performed on an individual agency basis	= Same as As-Is	+ Utilize alternative communication links as in As-Is, non-sensitive data management procedures utilize central repository backup and recovery procedures	+ Utilize alternative communication links as in As-Is, data management procedures utilize central repository backup and recovery procedures
Impact of System Failure	* Response time to incident is increased or resource unavailable	= Same as As-Is	= Same as As-is	+ Regional ITS Management Center is single point of failure

Incident Management Service
Architecture Trade-off Evaluation

	As-Is	Architecture #l	Architecture #2	Architecture #3
Life Cycle Costs: ***Utilizes Existing Infrastructure***	* Not applicable	:= May be able to utilize some existing equipment	= Same as architecture # 1	= Same as architecture #1
Minimize Implementationn Costs:	* Not applicable	= Smallest implementation cost which requires additional computers and computer network to link agencies	- Same as architecture #1 plus requires addition@ equipment to establish a Regional ITS Management System	Same as architecture #2 plus requires additional equipment and facility to establish a Regional ITS Management Center
Minimize Operation and Maintenance Costs:	* Not applicable	=Will require additional effort to establish standards and procedures needed to implement digital communications along with equipment required by each agency	- Same as architecture #1 except requires additional resources to operate and maintain the Regional ITS Management System	+ Same as architecture #2 except potential exists to reduce cost for operation and maintenance due to one Regional ITS Management Center replacing several dispatch centers
Useability: ***Ease of Operation:***	* Each agency has their own system implementation	+ Use of standards will reduce the training burden due to all agencies following standard procedures and using the same equipment and technology	+ Same as architecture #1	+ Same as architecture #I
Operations Workload.	* Operation of multiple dispatch centers and associated resources is resource intensive	:= Same as As-Is	= Same as As-Is	+ Potential exists to reduce cost by co-locating dispatch personnel
System Management:	* Each dispatch center requires system management personnel	:= Same as As-Is	= Same as As-Is	+ Potential exists to reduce cost by co-locating management personnel
Customer Preferences/Constraints: ***Reflects Current Practices:***	* Not Applicable	+ Improves incident response efficiency by better planning, coordination, and communication	= Same as architecture #I	+ Encourages improvements to effkiency by co-locating personnel

Incident Management Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2	Architecture #3
Other: ***Compatible With Other Services:***	* Not Applicable	* TBD	* TBD	* TBD
Category Summary		+ 11 = 9 - 0	+ 11 = 7 - 2	+ 17 = 3 - 3



Polaris

Architecture Trade-Off
Details

Public Transit Fleet Management

Function Descriptions

Public Transit Fleet Management (TFM) Service

1. Plan Fixed/Flexible Routes, Trips and Runs (PFR)

- develop and update transit routes, blocks and runs
- factor in planned transfers between agencies
- distribute transit routes to transit agencies

2. Schedule Trip Times (STT)

- generate schedules for use in transit operations and public distribution
- factor schedule adherence information and service usage data into collection / computation of schedule adherence statistics
- factor in planned transfers between agencies
- distribute transit schedules to transit agencies

3. Plan Fleet Operating Procedures (POP)

- analyze transit performance
- provide analysis / simulation support to transit planner
- maintain, evaluate and continuously improve fleet operating procedures and transit mode use instructions

4. Manage Transit Assignments (MTA)

- balance assignment of transit vehicles and drivers to support fleet operations, maintenance, training and incident / emergency response

Function Descriptions

Public Transit Fleet Management (TFM) Service

5. Track Resource Operational Status (TRS)

- gather fleet vehicle and driver information in order to track vehicle condition, transit conditions and driver hours

6. Manage Route Changes (MRC)

- coordinate route changes to support flexible route operations and assist vehicle detours around congestion and incidents

7. Manage Schedule Adherence (MSA)

- compare actual vs. planned vehicle location to determine how well vehicle is adhering to route schedule
- assist fleet dispatcher in regaining schedule when required

8. Manage Passenger Usage Data (MPU)

- gather passenger usage data for use in fare payment computation and billing and for use in planning future routes and schedules

9. Manage Passenger Transfers (MPT)

- coordinate passenger transfers at hubs within and between transit agencies

Public Transit Fleet Management (TFM) Service Architecture Approach Summary

	As-Is	*Architecture #1 ("Distributed")*	*Archltecture #2 ("Hybrid")*	*Architecture #3 ("Centralized")*
Metro Transit Management Center and Other Transit Management Center(s)	a. Perform manual route planning using data collected manually/semi-automatically b. Semi-automated route scheduling using data collected manually/semi-automoticnlly c. Limited and manual schedule adherence determination and correction. No AVL. e. Limited data availability, access and sharing f. Independent interface management at each agency g. Manual passenger transfer coordination	a. More automated route planning using data collec\ed automatically b. More automated route scheduling using data collected automatically c. AVL monitoring supports semi-automated schedule adherence and correction e. Broader set of data collected andshared in standard format f. Standard interfaces managed by each agency g. Interfaces with Inter-Jurisdictional Transit System to coordinate transfers	a, b, c, e, f, g. Same as #1	a, b, c, e, f, g. Not applicable. Metro Transit Management Center merged into Regional ITS Management Center.
Regional ITS Management System (RITSMS)	h. Does not exist in "As-Is" architecture	h. Does not exist in Architecture#1	h. ***RITSMS*** adds central data repository to support centralized backup and system administration. Distributes bus route, schedule to external organizations.	h. ***RlTMS*** merged into Regional ITS Management Center (RITSMC - see below)
Reglonal ITS Management Center (RITSMC)	a, b, c, e, f, g, h. Does not exist in "Ask" architecture	a, b, c, e, f, g, h. Does not exist in Architecture #I	a, h, c, e, f, g, h. Does not exist in Architecture #2	a, b, c, e, f, g, h. Same as Metro Transit Management Center Architecture Ill, except multiple Transit Management Centers are co-located with other ITS service centers
Demand Responsive Translt Centers	g. Manually facilitate passenger transfers	g. Add electronic connectivity and data access to better facilitate transfer planning and handling	g. Same as #I	g. Same as #1, except some Demand Responsive Transit Centers are merged into Regional ITS Management Center

Public Transit Fleet Management (TFM) Service Architecture Approach Summary

Inter-Jurisdictional Transit System	**a, b, g.** Does not exist in "As-Is" architecture.	**a.** Coordinate cross-jurisdictional planning **b.** Coordinate cross-jurisdictional scheduling **g.** Coordinate cross-jurisdictional transfers Note: A virtual, regional shared system, spanning multiple (but probably not all) Centers. Provides some combination of one or more, but not necessarily all functions.	**a, b, g.** Same as #1	**a, b, g.** Same as #1, except expect some (but not all) functions merge into RITSMC.
Transit Route Eqpt., Centralized / Decentralized and Freeway Roadside Equipment	**c.** Supports fleet schedule measurement, adherence and signal priority. Data collection and analysis is highly manual.	**c** Replace roadside schedule adherence and passenger counting devices with automated data collection devices that collect and report standardized data directly from the vehicle to the operations facility. Continue to support roadside signal priority capability.	**c.** Same as #1	**c.** Same as #1
Transit Maintenance Garage	**d.** Vehicle condition is not tracked. On-demand maintenance performed.	**d.** Automatically sense and report vehicle condition to maintenance garages to support pre-planned, preventative maintenance	**d.** Same as #1	**d.** Same as #1
Transit Vehicles	**c.** Manual vehicular support for schedule adherence adjustments **g.** Highly manual support for passenger transfer planning and execution	**c.** Add AVL to help automate schedule adherence adjustments **g.** Add AVL to help automate passenger transfer planning and execution	**c, g.** Same as #1	**c, g.** Same as #1
Transit Service Providers	**g.** Manually facilitate passenger transfers	**g.** Add AVL and electronic connectivity and data access to better facilitate passenger transfers	**g.** Same as #1	**g.** Same as #1
Security Firewall System	**k.** Provide secure firewall for two way data exchange between government owned / leased and privately owned networks	**k.** All external information processed through Firewall	**k.** Same as #1	**k.** Same as #1
External Data Distribution Network	**I.** Provide external public access, statewide ITS communication network	**I.** Provide full electronic communications access to authorized users	**I.** Same as #1	**I.** Same as #1
Internal Data Distribution Network	J. Provide limited access, regional public agency ITS nehvork	J. Public limited access, statewide public agency ITS network	J. Provide fill1 ITS team access to authorized users	J. Same as #2

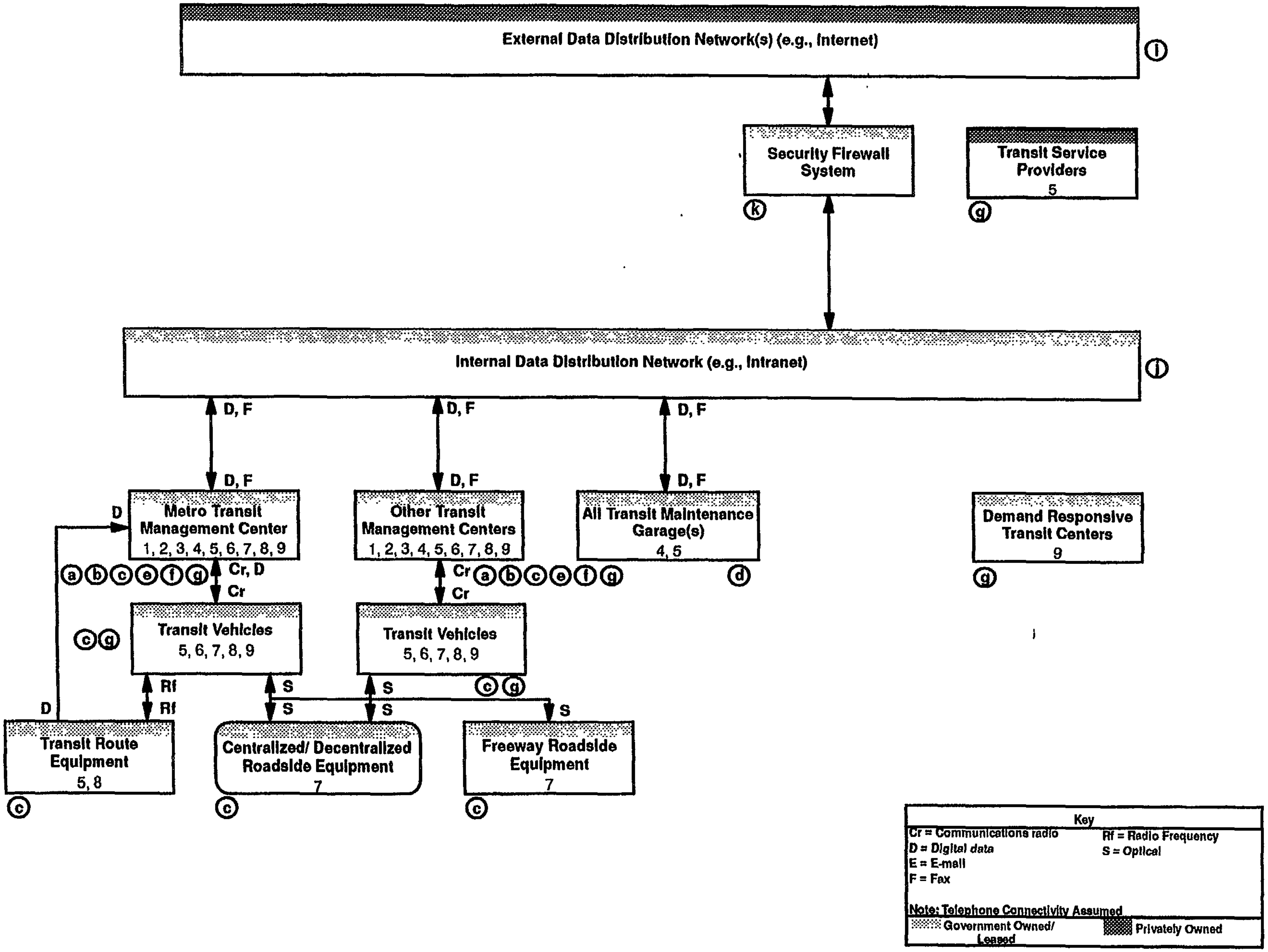
December 30, 1996

Public Transit Fleet Management (TFM) Service Architecture Approach Summary

Approach Topic Codes

a. Route planning
b. Schedule planning
c. Schedule adherence
d. Vehicle maintenance
e. Data sharing and access
f. Interface management
g. Passenger transfer
h. Data log and repository
I. External data access
j. Internal data access
k. Security firewall

Public Transit Fleet Management
As-Is Architecture



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As-Is Architecture

Public Transit Fleet Management (TFM) Service

Advantages

- Good communications and dispatch with garages
- Radio communications between control center and buses is good (but can be improved)

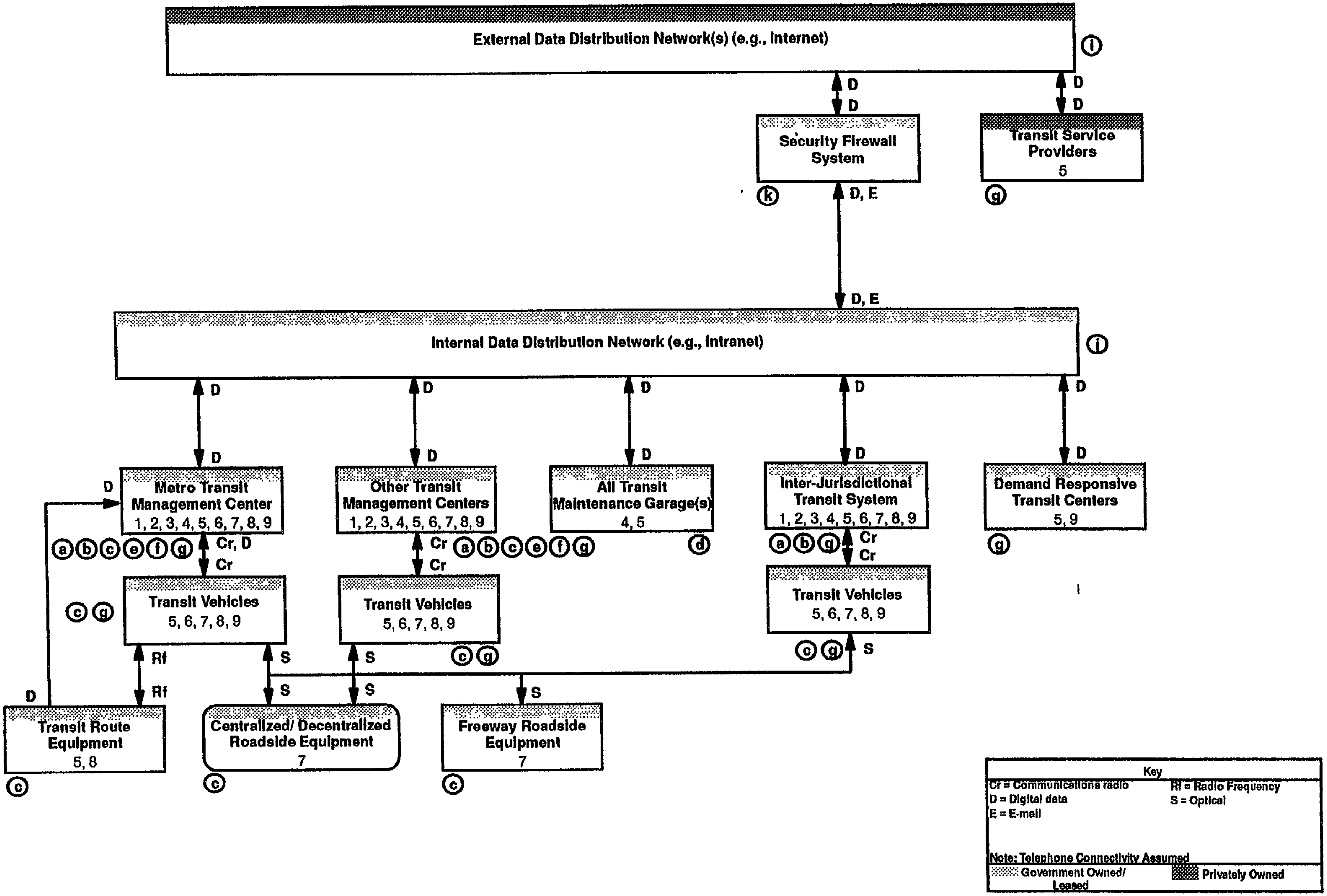
Disadvantages

- Poor data available regarding on-time performance, driver performance, incidents, schedule adherence
- All data collection is manual
- Roadway incident monitoring and awareness is weak
- Need good link to weather information
- Inability to manage time transfers (involving MCTO and other buses)
- Communications with other providers

Issues

- Need AVL - this is a “big piece that’s missing”
- Using older technology and paper. Need digital data.

Public Transit Fleet Management Service Architecture #1



TFM$AR1-g

Architecture #1
Public Transit Fleet Management (TFM) Service

Advantages

- Fix data sharing/access/standardization problem
- Improve performance on transfer coordination issue

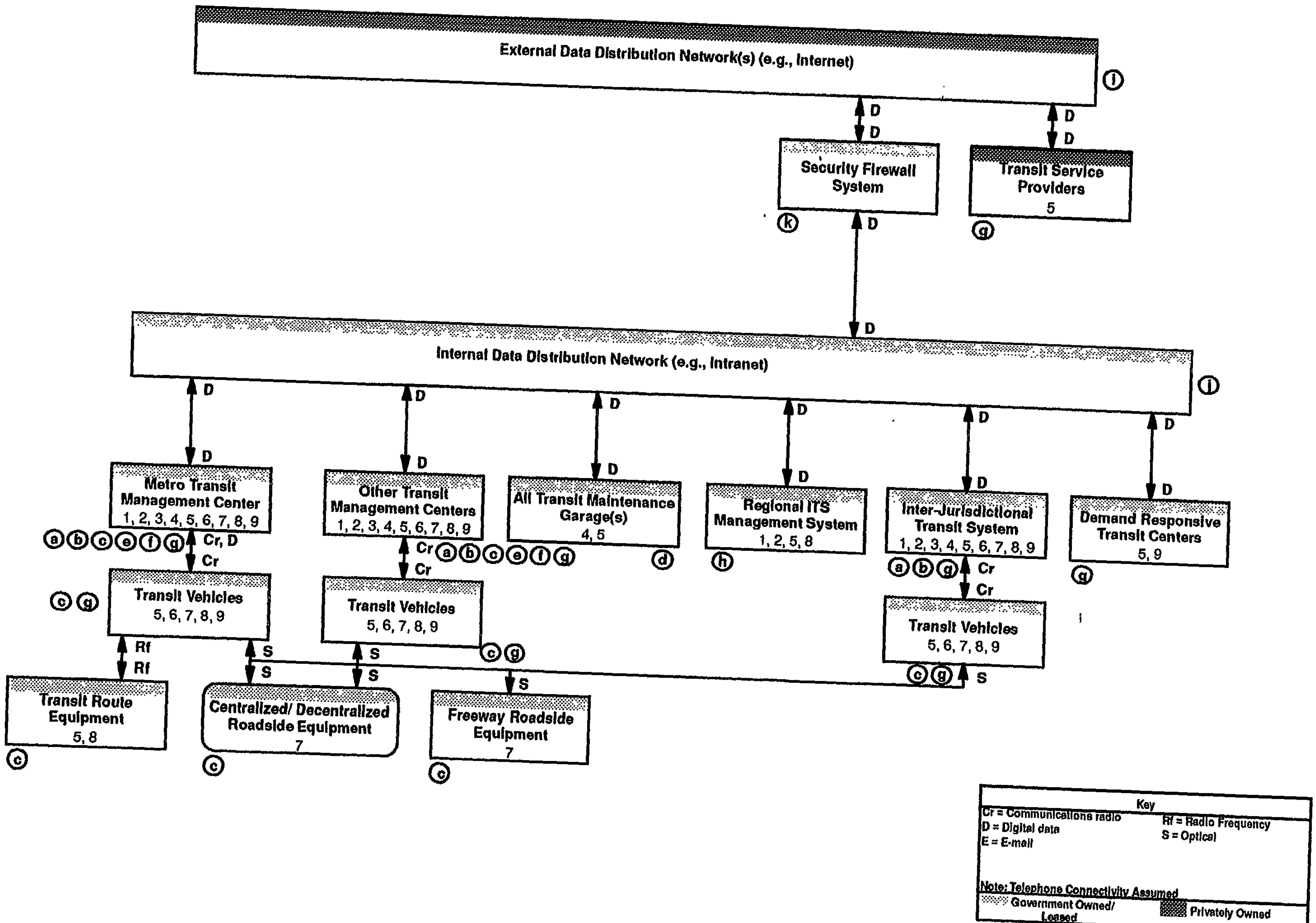
Disadvantages

- Still have transfer “challenge” regarding timing between separate systems

Issues

- Gaining Inter-Jurisdictional Transit System (IJTS) support (for operations, support, etc.)
- Who is responsible for and owns the IJTS?

Public Transit Fleet Management Service Architecture #2



TFM$AR2-g

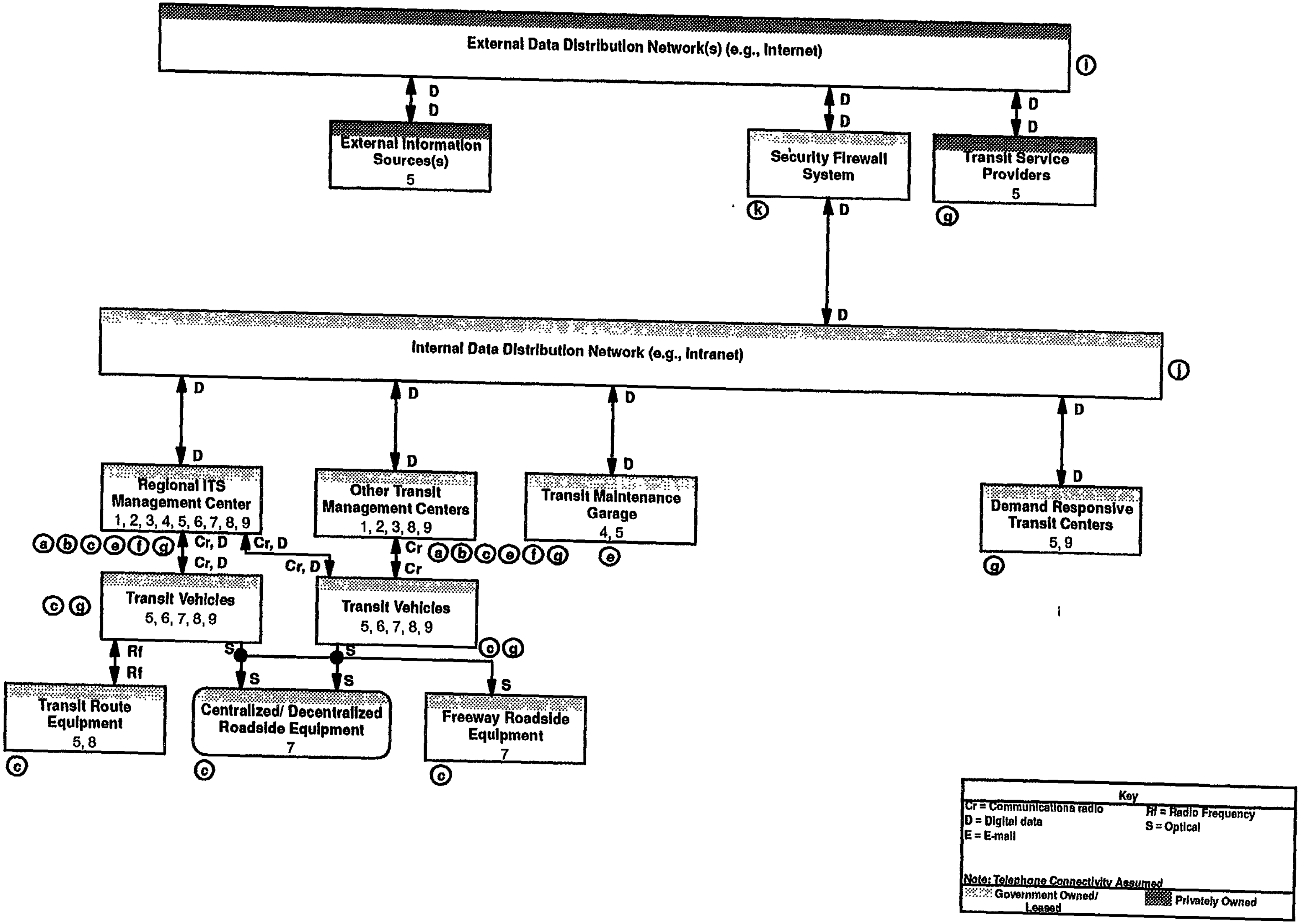
Architecture #2
Public Transit Fleet Management (TFM) Service

Advantages
- Regional ITS Management System (RITSMS) provides one place to go for data access
- RITSMS eases data access for planning purposes
- RITSMS provides central backup/repository/data administration

Disadvantages
- RITSMS represents single point failure item
- RITSMS represents potential data security issues to be addressed

Issues
- Possibly limited potential per benefit compared to anticipated cost
- Not clear how required RITSMS actually is at this time (9/96)
- Who is responsible for and owns the RITSMS?

Public Transit Fleet Management Service Architecture #3



TFM$AR3-h

Architecture #3

Public Transit Fleet Management (TFM) Service

Advantages

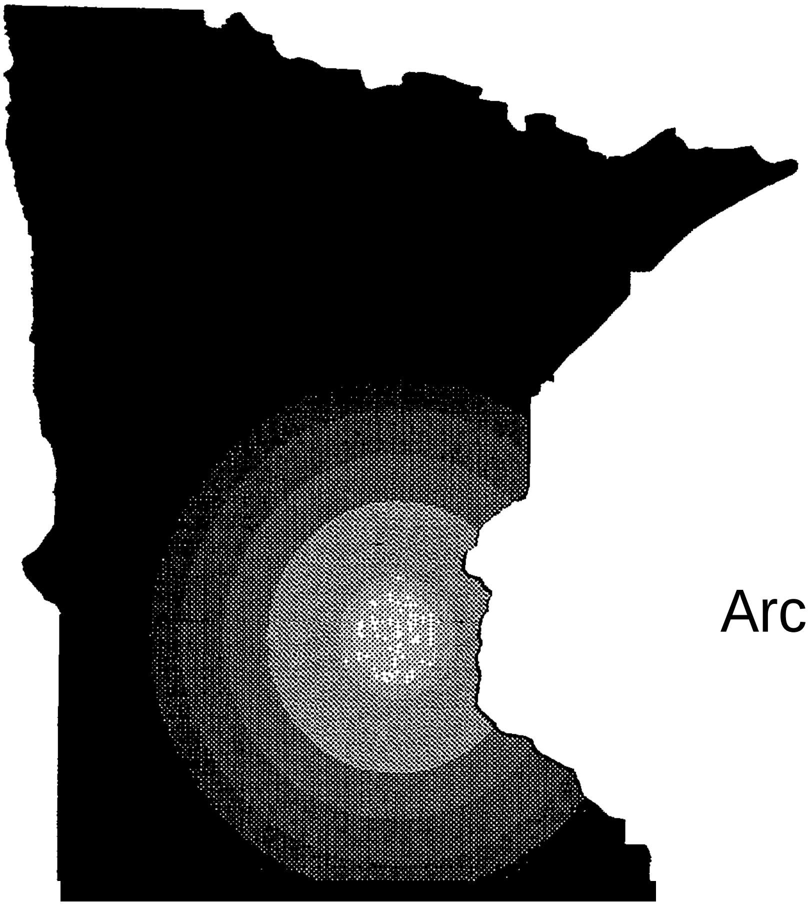
- Best fits Metro Council policy
- Better non opt-out vehicle control
- Data rich operational and planning environment
- Automated data collection
- Improved bus incident handling
- Improved route performance
- Improved “other provider” communications (with Transit Maintenance Garage)

Disadvantages

- Opt-out connectivity problem persists

Issues

- Question as to how powerful Policy will be to minimize opt-outs



Polaris

Architecture Trade-Off Details

Ride Matching & Reservations

Function Descriptions

Ride Matching and Reservations (RMR) Service

1. Manage Rider Requests (RRQ)

- maintain list of users authorized to use ride matching and reservatibn services
- provide interface with transit rider, allowing rider to specify trip request and review information about available rideshare options
- request reservation for transit rider when rider accepts available rideshare option

2. Distribute Rideshare Information (DRI)

- provide rider with updated rideshare acknowledgement, imminent arrival notification and general information about rideshare program and providers

3. Manage Rideshare Offers (RSO)

- maintain list of authorized ride providers
- collect and maintain provider trip offers and profile information for use in matching providers with riders

4. Match Rider with Provider (MRP)

- match future day ride request with planned vehicle routes
- match real-time demand responsive ride requests with vehicle position and planned routes
- make rider seat reservation on provider when match is found
- balance assignment of rideshare vehicles and personnel to support rideshare operations, vehicle maintenance and driver training

Function Descriptions

Ride Matching and Reservations (RMR) Service

5. Plan Rideshare Routes (PRR)
- develop optimum route plans for random-route operations
- develop individual daily route plans and maintain advance plans

6. Distribute Transit Service Provider Information (DTSPI)
- generate reports and vehicle manifests needed to support provider operations

7. Manage Rideshare Service Usage Data (RSU)
- gather passenger usage data for use in fare payment computation and billing and in planning future routes and schedules

8. Manage Rideshare Schedule Adherence (RSA)
- gather vehicle location information from vehicles for schedule adherence tracking and demand responsive dispatch
- determine how well vehicle is adhering to route schedule
- assist dispatcher and / or vehicle driver in regaining route adherence when required
- coordinate route changes to support vehicle detours around congestion and incidents
- coordinate passenger transfer

9. Provide Demand Responsive Services (DRS)
- coordinate real-time rideshare requests with drivers to support demand responsive operations

10. Plan Rideshare Operating Procedures (PRO)
- analyze rideshare performance
- maintain, evaluate and continuously improve rideshare operating procedures and rideshare use instructions

Ride Matching and Reservations (RMR) Service Architecture Approach Summary

	As-Is	Architecture #1 *("Distributed")*	Architecture #2 *("Hybrid")*	Architecture #3 *("Centralized")*
Metro Transit Management Center and Other Transit Management Center(s)	**g.** Manual passenger transfer coordination	**g.** See Inter-jurisdictional Transit System (below)	**g.** Same as #1	**g.** Not applicable. Metro Transit Management Center merged into Regional ITS Management Center.
Regional ITS Management System (RITSMS)	**h.** Does not exist in "As-Is" architecture	**h.** Does not exist in Architecture #1	**h.** Provide central data re-pository to support centralized backup and system administration. Distributes bus route, schedule to external organizations.	**h.** RITSMS merged into Regional ITS Management Center (RITSMC - see below)
Regional ITS Management Center (RITSMC)	**a, c, d, e, f, g, h.** Does not exist in "As-Is" architecture	**a, c, d, e, f, g, h.** Does not exist in Architecture #1	**a, c, d, e, f, g, h.** Does not exist in Architecture #2	**a, c, d, e, f, g, h.** Same as Demand Responsive Transit Center Architecture #1, except multiple Demand Responsive Transit Centers are co-located with other ITS service centers
Rideshare Center (RSC)	**a.** Performs matching of carpool/vanpool participants with similar arrival/departure times and places. **d.** Manual data entry of rider request information. **f.** Manual data entry of provider information.	**a.** Provide automated matching in real-time. Provide capability for single trip carpools. **d.** Telephony added to automate some of the rider request data entry. **f.** Telephony added to automate some of the provider data entry.	**a, d, f.** Same as #1	**a, d, f.** Same as #1
Demand Responsive Transit Center(s) and Transit Service Provider(s)	**a.** Perform manual demand responsive route planning and scheduling using rideshare offers and requests **c.** Limited and manual schedule adherence determination and correction. No AVL. **d.** Manual data entry of customer telephone requests for trips **e.** Limited data availability, access and sharing **f.** Manual data entry of provider offers via telephone **e.** Manual passenger transfer coordination	**a.** More automated route planning and scheduling using data collected automatically **c.** AVL monitoring supports semi-automated schedule adherence and correction **d.** Telephony added to reduce manual data entry **e.** Data standardized to facilitate data sharing **f.** Telephony added to reduce manual data entry **g.** Interfaces with Inter-Jurisdictional Transit System to coordinate transfers	**a, c, d, e, f, g.** Same as #1	**a, c, d, e, f, g.** Same as #1

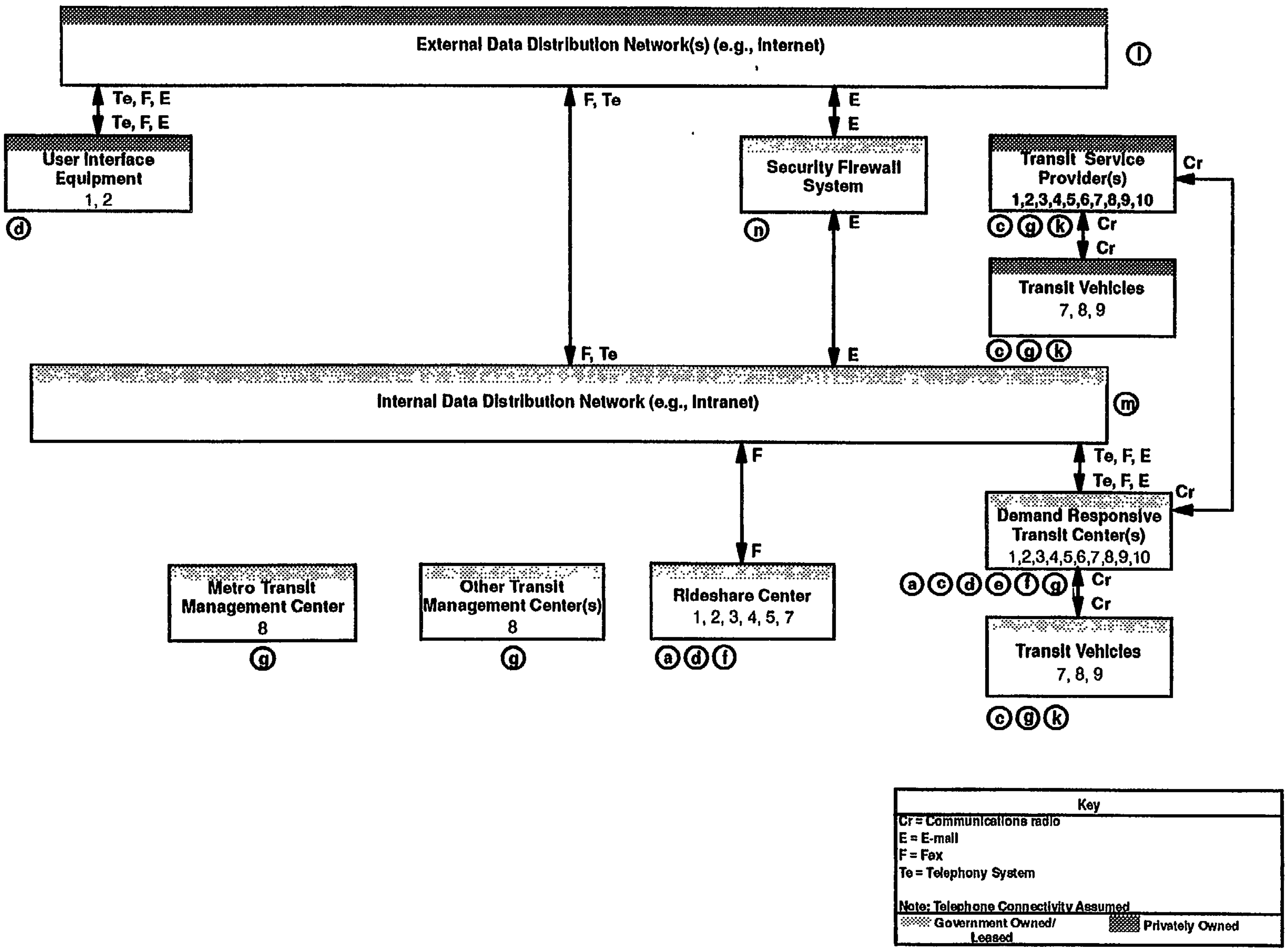
Ride Matching and Reservations (RMR) Service Architecture Approach Summary

Inter-Jurisdictional Transit System	a, g. Does not exist in "As-Is" architecture.	a. Coordinate cross-jurisdictional planning and scheduling when required g. Coordinate cross-jurisdictional transfers Note: A virtual, regional shared system, spanning multiple (but probably not all) Centers. Provides some combination of one or more, but not necessarily all functions.	a, g. Same as #1	a, g. Same as #1
Transit Vehicles	c. Manual vehicular support for schedule adherence adjustments g. Highly manual support for passenger transfer planning and execution k. Limited and highly manual demand responsive dispatch capability	c, g, k. Add AVL and electronic connectivity to help automate schedule adherence, passenger transfers and demand responsive dispatch	c, g, k. Same as #1	c, g, k. Same as #1
User Interface Equipment	d. No customer notifications of vehicle arrival	d. Telephony permits notification of imminent vehicle arrival	d. Same as #1	d. Same as #1
Security Firewall System	n. Provide secure firewall for two way data exchange between government owned / leased and privately owned networks	n. All external information processed through Firewall	n. Same as #1	n. Same as #1
External Data Distribution Network	l. External data access	l. Provide full electronic communications access to authorized users	l. Same as #1	l. Same as #1
Internal Data Distribution Network	m. Internal data access	l. Public limited access, statewide public agency ITS network	m. Provide full ITS team access to authorized users	l. Same as #2

Approach Topic Codes

a. Route planning and scheduling
b. "N/A"
c. Schedule adherence
d. Rider request and information interface
e. Data sharing and access
f. Rideshare coordinator interface and management functions
g. Passenger transfer coordination
h. Data log and repository
i. "N/A"
j. "N/A"
k. Demand responsive operations
l. External data access
m. Internal data access
n. Security Firewall

Ride Matching and Reservations Service
As-Is Architecture



RMR$ASIS-e

As-Is Architecture

Ride Matching & Reservation (RMR) Service

Advantages

- Meets ADA requirements
- It is working today
- Metro Mobility is experiencing 97% on-time service (but not all agencies are experiencing this on-time service level)

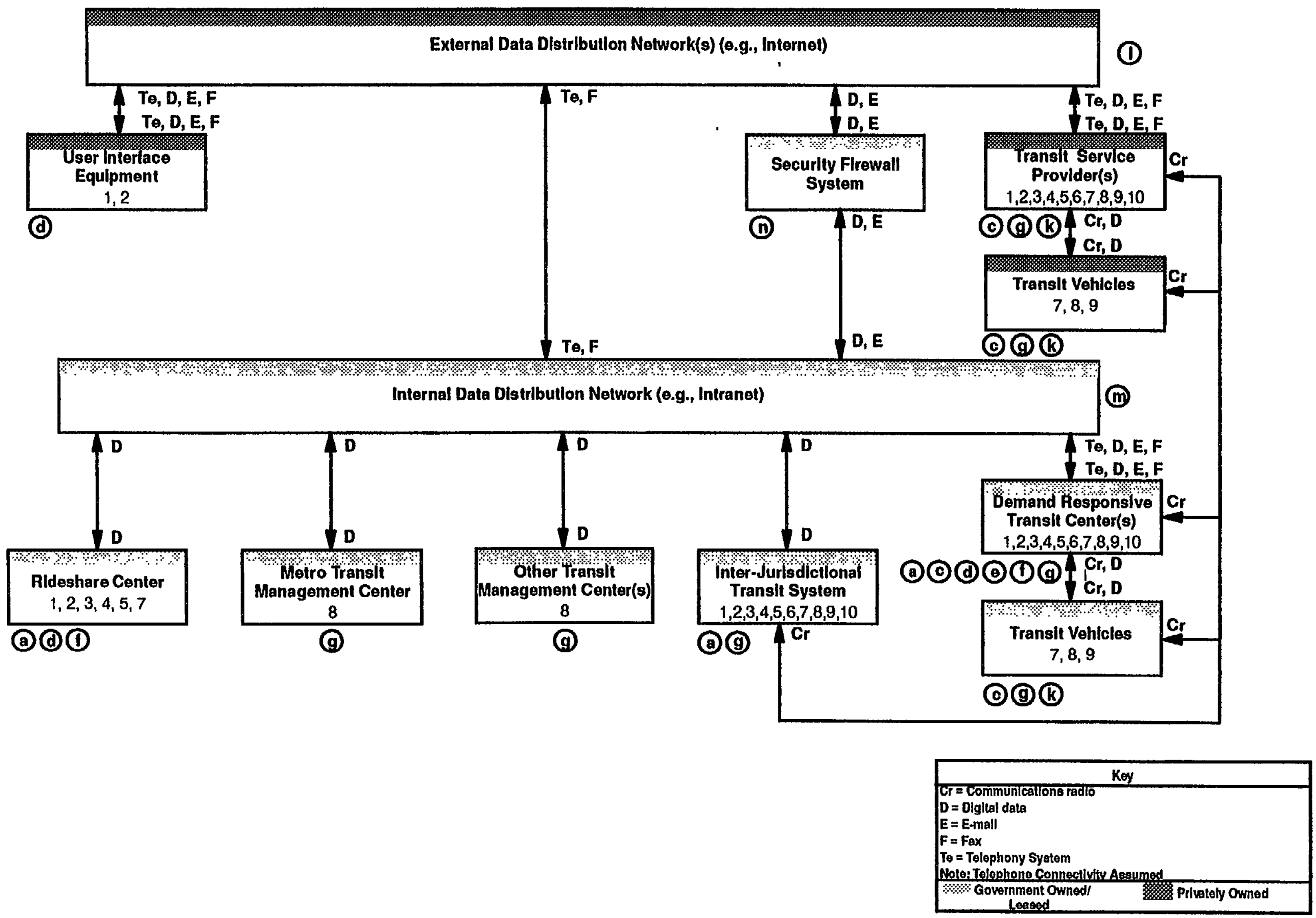
Disadvantages

- Lack of data between different centers/operations
- Difficult to contact riders when not adhering to the planned schedule
- Not all operations have good operational/on-time data
- Inability to manage time transfer coordination times and transfer times
- Communications with other providers

Issues

- None captured for this architectural candidate

Ride Matching and Reservations Service Architecture #1



RMR$AR1-f

Architecture #1

Ride Matching & Reservation (RMR) Service

Advantages

- Continues meeting ADA requirements
- Fixes data sharing/access/standardization problem
- Improves performance on transfer coordination issue

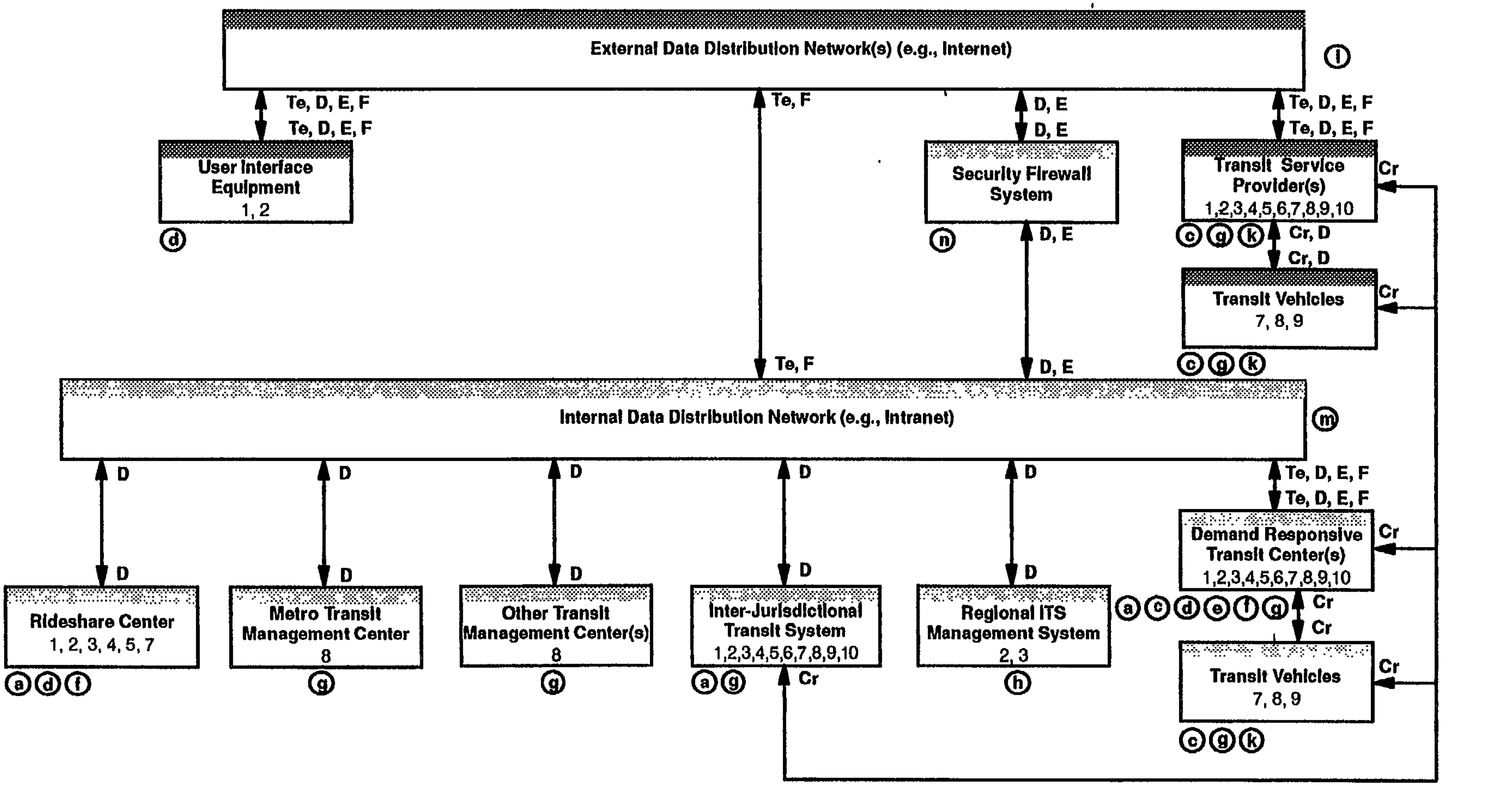
Disadvantages

- Still have transfer “challenge” regarding timing between separate systems

Issues

- Gaining Inter-Jurisdictional Transit System (IJTS) support (for operations, support, etc.)
- Who is responsible for and owns the IJTS?

Ride Matching and Reservations Service Architecture #2



Key

Cr = Communications radio
Te = Telephony System
D = Digital data
E = E-mail
F = Fax

Note: Telephone Connectivity Assumed

Government Owned/Leased
Privately Owned

RMR$AR2-g

Architecture #2

Ride Matching & Reservation (RMR) Service

Advantages

- Regional ITS Management System (RITSMS) provides one place to go for data access
- RITSMS eases data access for planning purposes
- RITSMS provides central backup/repository/data administration

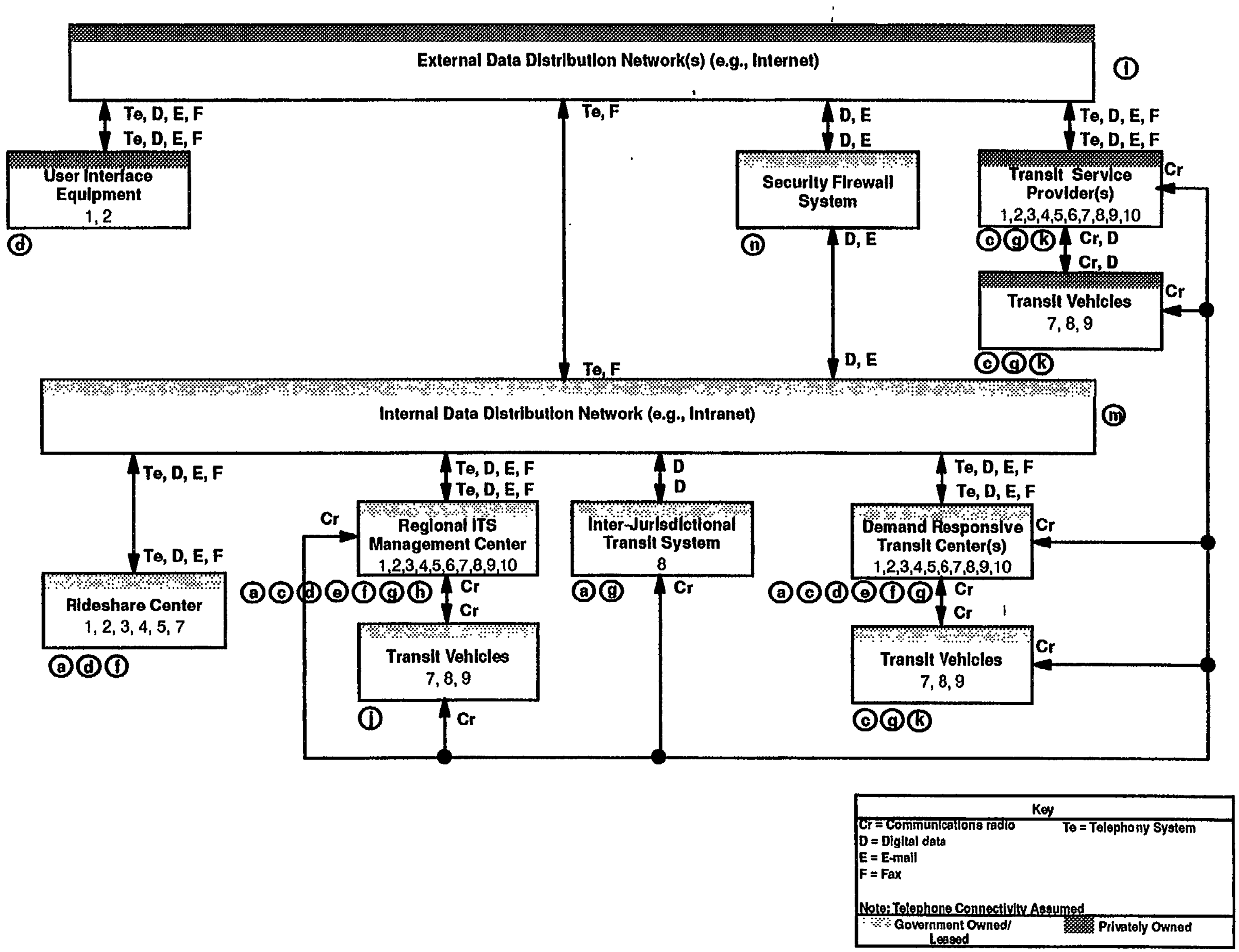
Disadvantages

- RITSMS represents single point failure item
- RITSMS represents potential data security issues to be addressed

Issues

- Possibly limited potential per benefit compared to anticipated cost
- Not clear how required RITSMS actually is at this time (9/96)
- Who is responsible for and owns the RITSMS?

Ride Matching and Reservations Service Architecture #3



RMR$AR3-h

Architecture #3

Ride Matching & Reservation (RMR) Service

Advantages

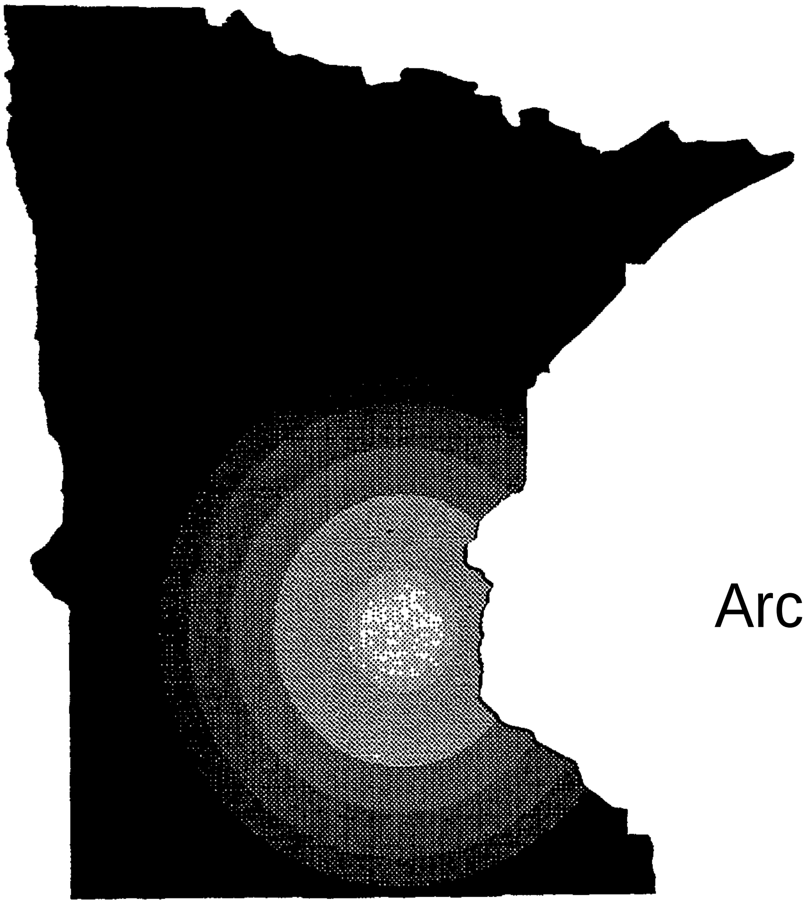
- Eliminates overhead of multiple Centers
- Data rich operational and planning environment
- Automated data collection
- Improved incident handling
- Improved route performance

Disadvantages

- Opt-out connectivity problem persists

Issues

- Question as to how powerful Policy will be to minimize opt-outs



Polaris

Architecture Trade-Off Details

Traffic Control

Function Descriptions

Traffic Control (TC) Service

1. Manage Traffic Control Requirements (TCRQ)

- collect and maintain traffic control requirements
- consider: travelers' needs, agency needs - various counties, cities, regional, state (e.g.; DPW, MnDCT, TMC, St. Paul

2. Manage Traffic Control Strategies/Plans (TCP)

- analyze traffic control requirements and historical performance data
- develop traffic control strategies for optimum flow, incident response
- develop and maintain coordinated signal timing and signing plans for wide area and cross jurisdiction optimization
- store historical traffic performance data

3. Manage Signal Resources (MSR)

- allocate signaling operations responsibilities among agencies
- allocate signal equipment maintenance responsibilities among agencies
- operate and maintain signals per agency agreements
- provide for shared signal operations

4. Control Signal Modes (CSM)

- provide capability to select multiple operational signaling modes: automatic, manual override, pre-emption and priority
- support signal pre-emption for emergency vehicle operations
- support signal priority for transit vehicle operations

Function Descriptions

Traffic Control (TC) Service - (Cont)

5. Implement/Adapt Signal Timing Plans (STP)

- provide arterial/freeway signal resource control: traffic signals, intersection controllers, freeway ramp meters, HOV lane signals
- dynamically implement/adapt signal timing/control plans to optimize regional traffic flow under varying traffic and incident conditions
- support coordinated real-time selection/modification of signal timing/control plans across wide area/multiple jurisdictions
- transmit timing/control plans to signaling equipment via on-demand real-time communications
- support real-time sharing of active signal timing/control plan information across multiple jurisdictions

6. Manage Signing Resources (MSIR)

- allocate signing operations responsibilities among agencies
- allocate signing equipment maintenance responsibilities among agencies
- operate and maintain signs per agency agreements
- provide for shared signing operations

7. Control Sign Modes (CSIM)

- provide capability to select multiple operational signing modes: automatic, manual update

Function Descriptions

Traffic Control (TC) Service - (Cont)

8. Implement/Adapt Signing Plans (SIP)

- provide freeway/arterial signing control: changeable message signs, variable message signs (fixed and portable)
- dynamically implement/adapt control of signing devices to optimize traffic flow
- support coordinated real-time selection/modification of signing plans and messaging across wide area/multiple jurisdictions
- transmit signing controls to sign equipment via on-demand real-time communications
- support real-time sharing of active sign information across multiple jurisdictions

9. Collect Traffic Surveillance Data (CTD)

- process and store traffic parameters information transmitted from multiple detectors

10. Determine Traffic Conditions (DETC)

- determine geo-referenced traffic conditions using sensed traffic surveillance data: average traffic speeds, congestion levels

11. Distribute Traffic Conditions (DITC)

- distribute traffic conditions information to requesting agencies and in support of other ITS services
- provide traffic surveillance data and traffic conditions feedback to support real-time, adaptive signaling and signing control

12. Sense Traffic Surveillance Data (STD)

- detect and transmit traffic parameters information along roadways: volume, occupancy, density, speed

Traffic Control Service Architecture Approach Summary

	As-Is	Architecture # 1	Architecture # 2	Architecture # 3
Traffic Center(s) (Freeway Central and Decentralized)	a. Each jurisdiction controls its own roadside equipment	a. Same as As-Is	a. Same as As-Is	a. Same as As-Is
	b Collect and process jurisdiction specific view of trafftc conditions and control data (Freeway)	b. Collect and process jurisdiction specific traffic conditions and control data (Freeway and Arterials)	b. Same as Architecture # 1	**b.** Same as Architecture #l
	c. Not Applicable	**c.** Maintain regionwide comprehensive traffic conditions and control data information at each Traffic Center	c. Same as Architecture # 1	c. Same as Architecture #I
	d. Distribute traffic conditions and control data (limited agencies)	**d.** Distribute jurisdiction specific traffic conditions and control data to other traffic control center(s) and public agencies (with filters, if needed)	**d.** Distribute jurisdiction specific traffic conditions and control data to Regional ITS Management System	**d.** Same as Architecture #1
	e. Each traffic center independently recovers their own data	e. Automated traffic conditions and control data recovery from source location(s)	e. Automated traffic conditions and aontrol data base recovery from Regional ITS Management Center of source location(s)	e. Same as Architecture #2
	f. Each agency archives jurisdictional data for historical purposes	**f.** Same as As-Is	**f.** Not Applicable	f. Not Applicable
	g. Each agency negotiates their specific interface with other public / private agencies	g. Same as As-Is	g. Not Applicable	g. Not Applicable

Traffic Control Service Architecture Approach Summary

Interjurisdict - ional Traffic System	**a.** Cross jurisdictional traffk control of roadside equipment (operational test) **h.** Not Applicable	**a.** Cross jurisdictional traffic control of roadside equipment **h**. Provide cross jurisdictional traffic control recommendations to traffic control agencies	**a.** Same as Architecture # I **h.** Same as Architecture#l	**a.** Not Applicable **h.** Not Applicable
Regional Traffic Management Center	**a.** Not Applicable **b.** Not Applicable **c.** Not Applicable **d.** Not Applicable **h.** Not Applicable	**a.** Not Applicable **b.** Not Applicable **c.** Not Applicable **d.** Not Applicable **h**. Not Applicable	**a.** Not Applicable **b.** Not Applicable c. Not Applicable **d.** Not Applicable **h.** Not Applicable	**a.** Provide control of all roadside equipment in the region **b.** Collect and process jurisdiction specific views of traffic conditions and control data (Freeway and Arterials) c. Maintain current regionwide comprehensive traffic conditions and control information **d.** Distribute regionwide specific traffk conditions and control data to Regional ITS Management System **h.** Provide cross jurisdictional traffic control recommendations to other traffic control centers

Traffic Control Service Architecture Approach Summary

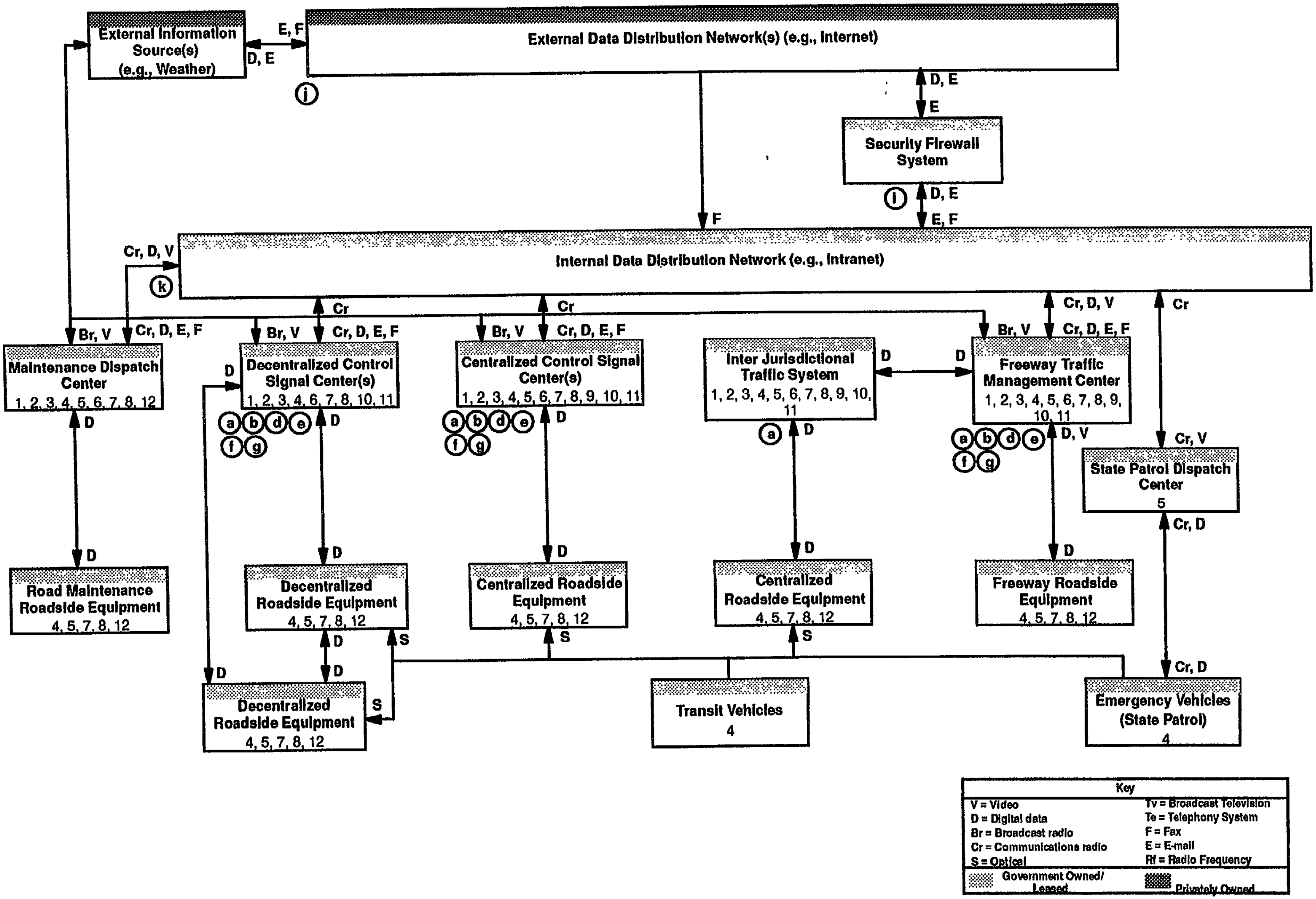
Reglonwlde ITS Management System	**c.** Not Applicable **d.** Not Applicable **f.** Not Applicable **g.** Not Applicable	**c.** Not Applicable **d.** Not Applicable **f.** Not Applicable **g.** Not Applicable	**c. Maintain regionwide comprehensive traffic conditions and control information for backup and recovery** **d.** Distribute basic traffic conditions and control data to other traffic center(s) and private agencies **f. Regional ITS Management System** archives regionwide data for historical purposes. g. Each private / public agency uses standardized interfaces. For public agencies, coordinated interface management is performed. For each traffic center, centralized interface management is performed.	**c.** Same as Architecture # 2 **d.** Same as Architecture # 2 **f. Same as Architecture #2** g. Each private / public agency uses standardized interfaces. Centralized interface management of all public / **private agencies**
Security Firewall System	l. Provide secure firewall for two way data and video exchange between government owned/leased and privately owned networks (limited function)	l. Provide secure firewall for two way data and video exchange between government owned/leased and privately owned networks	l. Same as Architecture #1	l. Same as Architecture #1
External Data Dlstrlbutlon Network	**j.** Provide public access, statewide ITS communication network (limited access)	**j.** Provide public access, statewide ITS communication network	j. Same as Architecture #1	j. Same as Architecture #1
Internal Data Dlstrlbutlon Network	**k.** Provide limited access, regional public agency ITS network	**k.** Provide limited access, statewide public agency network	**k.** Same as Architecture #1	**k.** Same as Architecture # 1

Traffic Control Service Architecture Approach Summary

Approach Topic Codes

a. = Roadside Equipment Control
b. = Jurisdictional Specific Data Views
c. = Traffic Conditions and Control Data Information Management
d. = Traffic Conditions and Control Data Distribution
e. = Data Recovery
f. = Data Archive
g. = Interface Management
h. = Traffic Control Recommendations
i. = Security Firewall
j. = External Data Access
k. = Internal Data Access

Traffic Co… ol Service
AS-IS Architecture



TC$ASIS2-e

62

As-Is Architecture
Traffic Control (TC) Service

Advantages

- Agencies control and maintain their own devices
- Good security over resources
- Sense of jurisdictional ownership of resources
- Meets today's requirements
- Reliable and consistant data

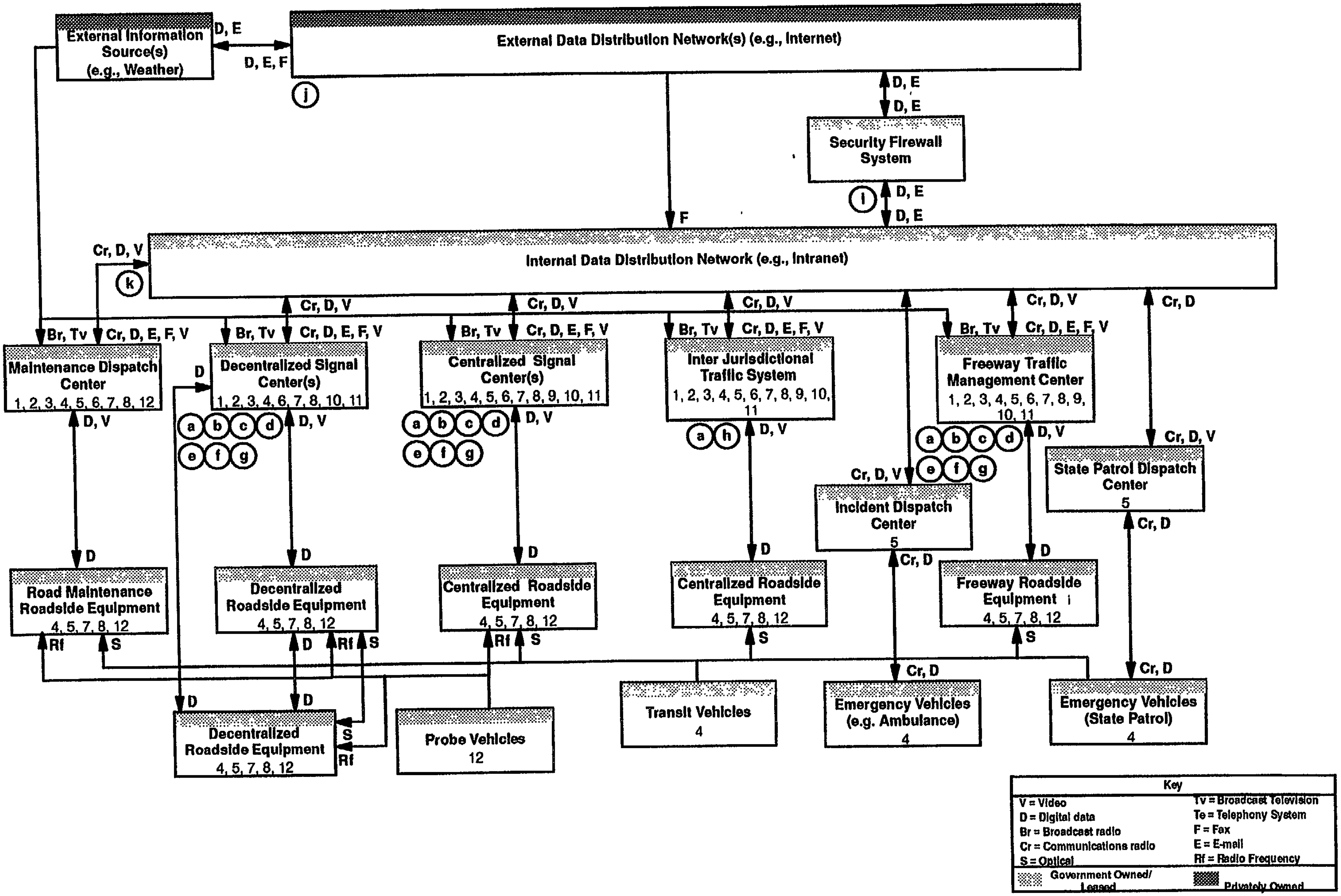
Disadvantages

- Limted information sharing between agencies
- Inefficient management of traffic across jurisdictions
- Clock synchronization (for maintaining timing offset for intersection controller
- Operation is not seamless
- Inconsistant data format

Issues

- Common geographic reference map
- Road segment naming conventions
- Inter-jurisdictional traffic conflicts

Traffic Co. .ol Service Architecture #1



TC$A1-f

Architecture #1

Traffic Control (TC) Service

Advantages

- Easier to provide phased implementation
- Facilitates better system managenment
- One stop shopping for data

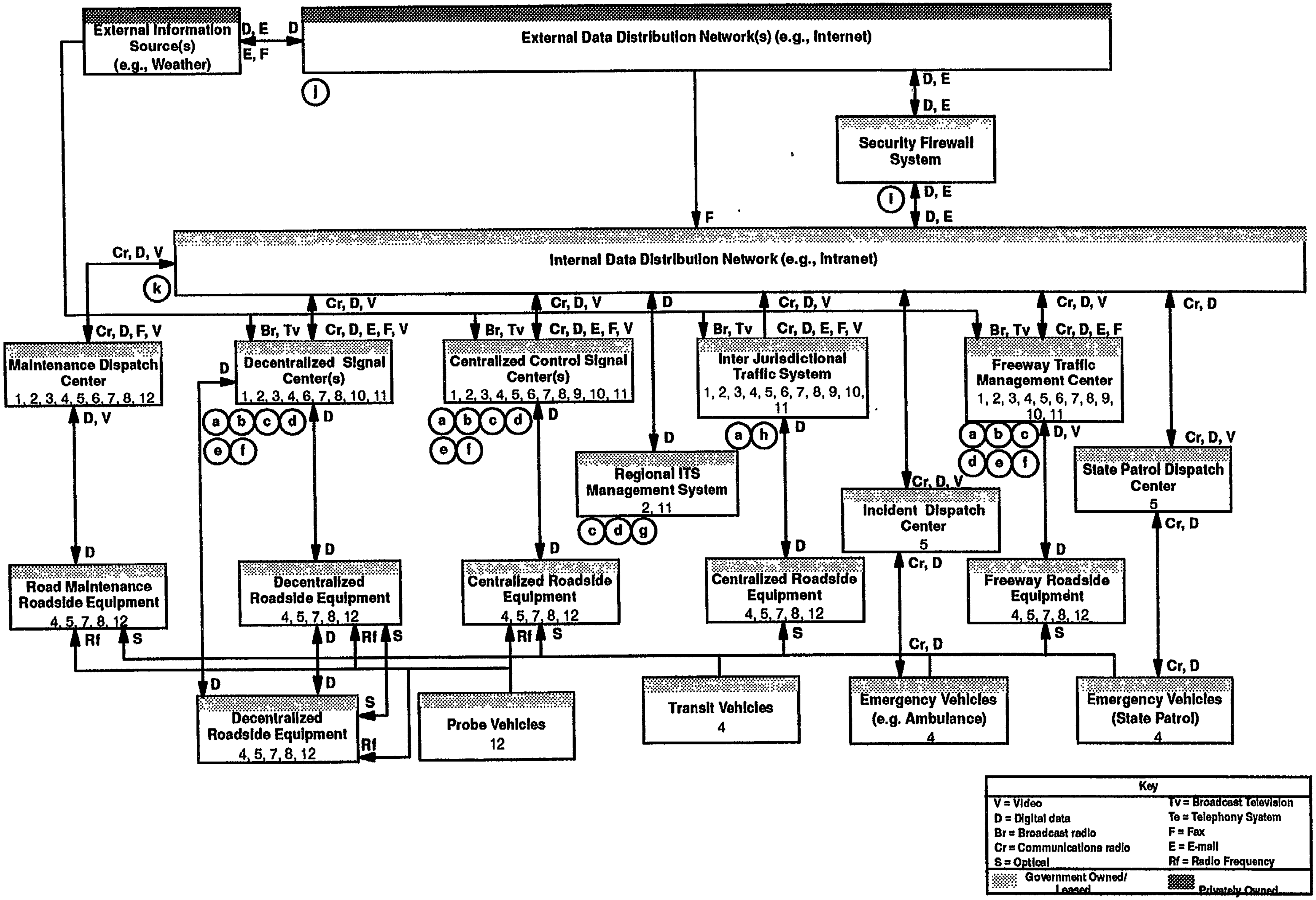
Disadvantages

- Single point of failure for regional view
- More bureaucracy associated with regional center

Issues

- Who decides region-wide strategy

Traffic Control Service Architecture #2



TC$A2-f

Architecture #2

Traffic Control (TC) Service

Advantages

- Fewer personnel, more cost effective
- Easy to provide seamless operations
- Better region-wide view and control

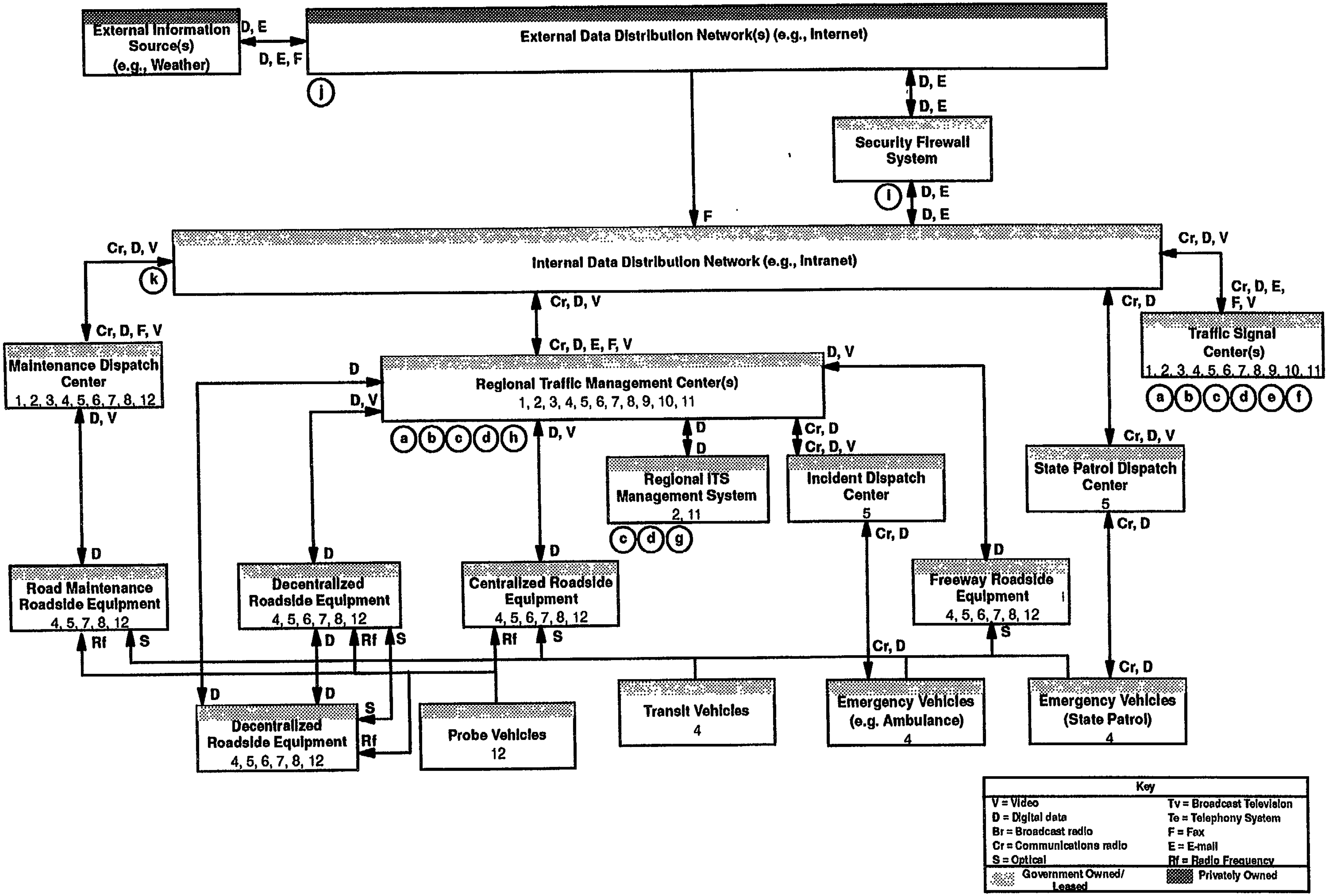
Disadvantages

- Difficult to implement (degree of departure from As-Is, phased approach for implementation not as viable, political viability)
- Requires relocation of communication links
- Major impact if center fails
- Less responsive to localized problems

Issues

- Requires strong management commitment from multiple jurisdictions to implement

Traffic Control Service Architecture #3



TC$A3-f

Architecture #3
Traffic Control (TC) Service

Advantages
- Maintains existing ownership and responsibilities
- Ability to share data
- Localized impact from failures

Disadvantages
- More interfaces to integrate
- Potential for multiple region-wide views to exist
- Independant decision making for control strategy

Issues
- Architecture does not allow for resources to be distributed for large/small staffed centers

Traffic Control Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2	Architecture #3
Function ***(Meets customer requirements):***				
Ability to share dynamic real time traffic conditions	* Freeway traffic conditions data collected but shared with selected with other agencies	+ Freeway and arterial traffic conditions data is shared with all traffic centers and agencies	+ Same as Architecture #1	+ Same as Architecture # 1
Ability to share control across jurisdiction (s)	* Shared control across jurisdictions is being evaluated on selected traffic corridors	+ Shared control across jurisdictions is supported on all identified traffic corridors	+ Same as Architecture #1	+ Same as Architecture #1
Ability to share resource across jurisdiction(s)	* Surveillance video shared between traffic centers and agencies.	= Same as As-Is	= Same as As-Is	= Same as As-Is
	* Not Applicable	* Not Applicable	+ Regional ITS Management System is shared for all jurisdictions and agencies	+ Same as Architecture #2
Sense of Ownership	* Jurisdiction specific operations are implemented based ***on*** regional priorities and policies	= Same as As-Is	= Same as As-Is	=Jurisdiction specific operations may not be implemented due to regional priorities and policies

Traffic Control Service
Architecture Trade-off Evaluation

	AS-IS	Architecture #1	Architecture #2	Architecture #3
Berforniance:	FR			
Timely information delivery: Minimize information delivery time from road detection to traffic center users/equipment	- Standardized communications protocols common data network allow sharing of freeway data.	+ Standardized communications protocols and high speed data networks allow sharing of freeway arterial and CBD data between centers.	#2 Same as Architecture +	+ Same as Architecture #1
	- Roadway data collection frequency is optimized for freeway operations but not other Traffic Centers	- Roadway data collection frequency is optimized and established for Freeway, Arterials, and CBD's	#1 Same as Architecture #1	=Same as Architecture #1
Provides real-time data between traffic centers	* Minimal electronic data exchange; limited non-jurisdictional traffic center access to data	++ Real-time (< 10 sec) digital information exchange among all traffic centers	+ Real-time (< 10 sec) digital information exchange among all traffic centers but information passes through Regional ITS Management System	++ Same as Architecture #1
Seamless across jurisdiction	* Timing plans co-ordinated manually across jurisdictions	+ Timing plans coordinated through inter-jurisdiction management system.	+ Same as Architecture #1	+ Timing plans coordinated through fewer jurisdictions
Ability to adapt traffic control strategies to dynamic real time conditions	* Supports manually updated adaptable timing plans across jurisdictions	+ Supports real time adaptable timing plans across jurisdictions	+ Same as Architecture #1	+ Same as Architecture #1
	* Not Applicable	+ Supports real time traffic control recomendatations to other traffic centers	+ Same as Architecture #1	+Same as Architecture #1

Traffic Control Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2	Architecture #3
Information Sharing (Ability to Share Data):				
• Information Quality Checking	* Each agency responsible for its own data quality checking	= Same as As-Is	+ Data from multiple sources can be cross-checked at a central point to identify and correct inaccuracies	+ Same as Architecture #2
• Data standardization	* Stand-alone systems with limited data standardization	+ Data standards documented and enforced	+ Same as Architecture #1	+ Same as Architecture #1
	* Multiple link reference models used for geo-referencing	+ Data geo-referenced to common link reference mode1	+ Same as Architecture #1	+ Same as Architecture #1
• Flexibility to select alternate data source	* Originating traffic center is the single source of data	+ Multiple sources of data; each independent traffic center distributes data to each other	+ Multiple sources of data; each independent traffic center distributes data to the Regional ITS Management System and agencies	+ Single source of data; replicated to Regional ITS Management System
• Data Consistency	* Traffic data acquisition sampling rates not co-ordinated for traffic corridors.	+ Traffic data acquisition co-ordinated by Inter-jurisdictional Traffic System	+ Same as Architecture #1	+ Traffic data acquisition co-ordinated by Regional Traffic Management Center
• Security of information access	* Limited security risk because of limited information access points	Additional security risk due to additional information access points	+ Same as Architecture #1	+ Same *as* Architecture #1

Traffic Control Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2	Architecture #3
Upgradility				
Does not constrain future plans (Supports ***Phased Approach***= to implement):				
• Add or Modify Traffic Centers / Agencies	* Each traffic center negotiates inter-agency interfaces independently	= Same as As-Is	tt Private agency distribution is centralized at Regional ITS Management System	++ Same as Architecture #2
• Add resources (signs, signals and surveillance	* Resources added to meet jurisdictional standards independently; Limited cross jurisdictional standardization	+ Added resources comply with traffic management and data standards	+ Same as Architecture #1	t Same as Architecture #1
• Openness	* Standards based communications protocols (Limited Standards Usage)	+ Standards based communication protocols	+ Same as Architecture #1	+ Same as Architecture # 1
Technology insertion	* Done independently by traffic centers	= Same as As-Is	= Same as As-Is	= Same as As-Is

Traffic Control Service
Architecture Trade-off Evaluation

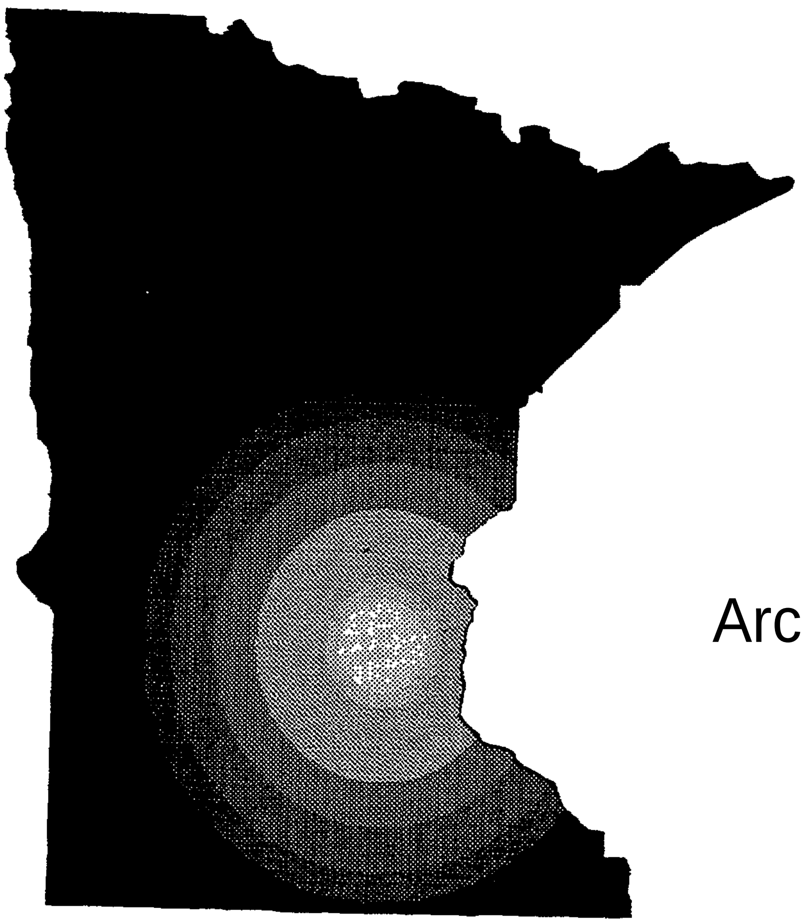
	As-Is	Architecture #1	Architecture #2	Architecture #3
Availability:				
When Needed: • Hours of operation	* Information availability limited to each traffic center's hours of operation	= Same as As-Is	= Same as As-Is	= Same as As-Is
• On-Demand	* On-demand access to traffic conditions limited to freeway data	+ On-demand access to regionwide traffic conditions information	+ Same as Architecture #1	+ Same as Architecture #1
• ***Recovery modes***	* Traffic center recovery performed independently	+Traffic centers can recover data from other traffic centers	+Traffic centers can recover data from the Regional ITS Management System	+ Regional TMC can recover data from Regional ITS Management System
• Probability of System Failure	* Low Probability due to distributed control and operation	= Same as As-Is	= Same as As-Is	- Lower probability of failure due to single location for all operations
• Impact of System Failure to users	* Most roadside equipment supports fail-safe modes of operation	= Same as As-Is	= Same as As-Is	= Same as As-is
	* Reduced information provided to users	= Same as As-Is	= Same as As-Is	= Same as As-Is
	* Not applicable	* Not applicable	- Regional management center is single point of failure	= Regional management center is single point of failure

Traffic Control Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2	Architecture #3
Life Cycle Costs:				
• ***Utilizes existhg infrastructure***	* Not Applicable	= Utilizes existing infrastructure	= Same as Architecture #1	- Requires new/modified management center and relocation of traffic agency resources; major organizational culture change
• Minimize ***implementation costs***	* Not Applicable	- Requires additional communications interface equipment to be deployed at each traffic center	- Same as Architecture # 1	- Same as Architecture # 1
	* Not Applicable	* Not Applicable	- Requires additional equipment to establish Regional ITS Management System	-- Requires large short term investment to transition to a Regional Traffic Management Center and establish Regional ITS Management System
. Minimize operations and maintenance costs	* Baseline Cost	- Requires communications maintenance at each traffic center(s)	- Requires communications maintenance at each Regional ITS Management System	- Same as Architecture #2
	* Not Applicable	* Not Applicable	- Requires additional resources to operate and maintain Regional ITS Management System	+ Potential exists to reduce cost for operations and maintenance due to one regionwide traffic management center

Traffic Control Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2	Architecture #3
Useability: (*Ease of Operations*):				
Traffic center specific information tailoring	* Only TMC users have basic traffic conditions and control display capability	++ Agency users can tailor display information to operational needs	++ Same as Architecture # 1	++ Same as Architecture #1
Coordinated decision making for assessing a common traffic conditions view	* Real time Inter-Jurisdictional common database does not exist	++ All traffic centers and agencies have access to real time regionwide database	++ Same as Architecture #1	t+ Same as Architecture #1
Operations workload: • ***Data Distribution***	* Data distribution is labor intensive due to limited standards	+ Supports electronic data distribution to traffic centers and agencies with corn standard defined	+ Same as Architecture #I	+ Supports electronic data distribution to agencies
• ***System Management***	* Each traffic center requires system management personnel	= Same as As-Is	+ Fewer personnel required to manage systems from a central location	+ Same as Architecture #2
Customer Preferences/Constraints:				
• ***Reflects current business practices***	* Not applicable	= Conforms to current business practices	= Same as Architecture #1	-- Changes organizational operations
Other: • ***Compatibility with Travel Conditions Information architecture***	* Not applicable	+ Compatible with all Travel Conditions Information architectures (1,2,3)	= Same as Architecture #1	= Same as Architecture #1
Category Sum		+ 22 = 12 - 3	+ 27 = 9 - 5	I- 29 = 6 - 7



Polaris

Architecture Trade-Off Details

Travel Conditions Information

Travel Conditions Information Service (TCI) Function Descriptions

1. Sense Travel Conditions Data (STD)

- detect traffic, weather and road surface conditions
- transmit for further processing

2. Collect Travel Conditions Source Data (CTC)

- store traffic, incidents (accidents, breakdowns), planned events (construction, special events), regional weather, road surface, parking, transit status
- monitor multiple sources: agencies, information providers, etc.
- support multiple input formats: voice, fax, video, digital, etc.

3. Determine Basic Travel Conditions and Travel Effects (BTC)

- map conditions source data and effects to transportation network model (e.g. freeways, arterials, etc.)
- maintain current basic travel conditions and travel effects

4. Determine Tailored Travel Conditions (TTC)

- determine affected users per user profile criteria
- tailor conditions per user profile criteria
- recommend travel alternatives as available

5. Distribute Travel Conditions Information (DTC)

- accept requests for travel conditions information
- distribute basic and tailored travel conditions information
- support multiple delivery devices: phone, computer, VMS, fax, e-mail, pager...

6. Determine Tailored Travel Effects (TTE)

- determine effects of conditions on a user's travel plans

Travel Conditions Information Service Architecture Approach Summary

	As-Is	Archltecture # 1	Architecture # 2	Architecture #3
Public Agencies	a. Provide independent management of each public and private agency interface b. Distribute travel conditions to other public agencies (limited) c. Current freeway travel conditions information maintained by TMC **d.** TMC performs recovery of freeway travel conditions data	a. Provide coordinated management of each public and private agency interface b. Distribute travel conditions to other public agencies and private agencies (with conditions filtered, if necessary, for private agency use) c. Maintain comprehensive, regionwide, current travel conditions independently at each public agency **d.** Automated travel conditions data recovery from pre-designated public agency	a. Provide coordinated management of each public agency interface b. Distribute travel conditions to other public agencies and Regional ITS Management System c. Same as Architecture #1 d. Automated travel conditions data recovery from Regional ITS Management System	a. Not Applicable b. Distribute travel conditions to Regionwide ITS Management System c. Same as Architecture #1 **d.** Same as Architecture #2
Regional ITS Management System	Not Applicable	Not Applicable	**a.** Provide centralized management of private agency interfaces **b.** Distribute travel conditions to private agencies (with conditions filtered, if necessary, for private agency use) c. Maintain comprehensive, regionwide, current travel conditions	**a.** Provide centralized management of public and private agency interfaces **b.** Distribute travel conditions to other public agencies and private agencies (with conditions filtered, if necessary, for private agency use) c. Same as Architecture #2

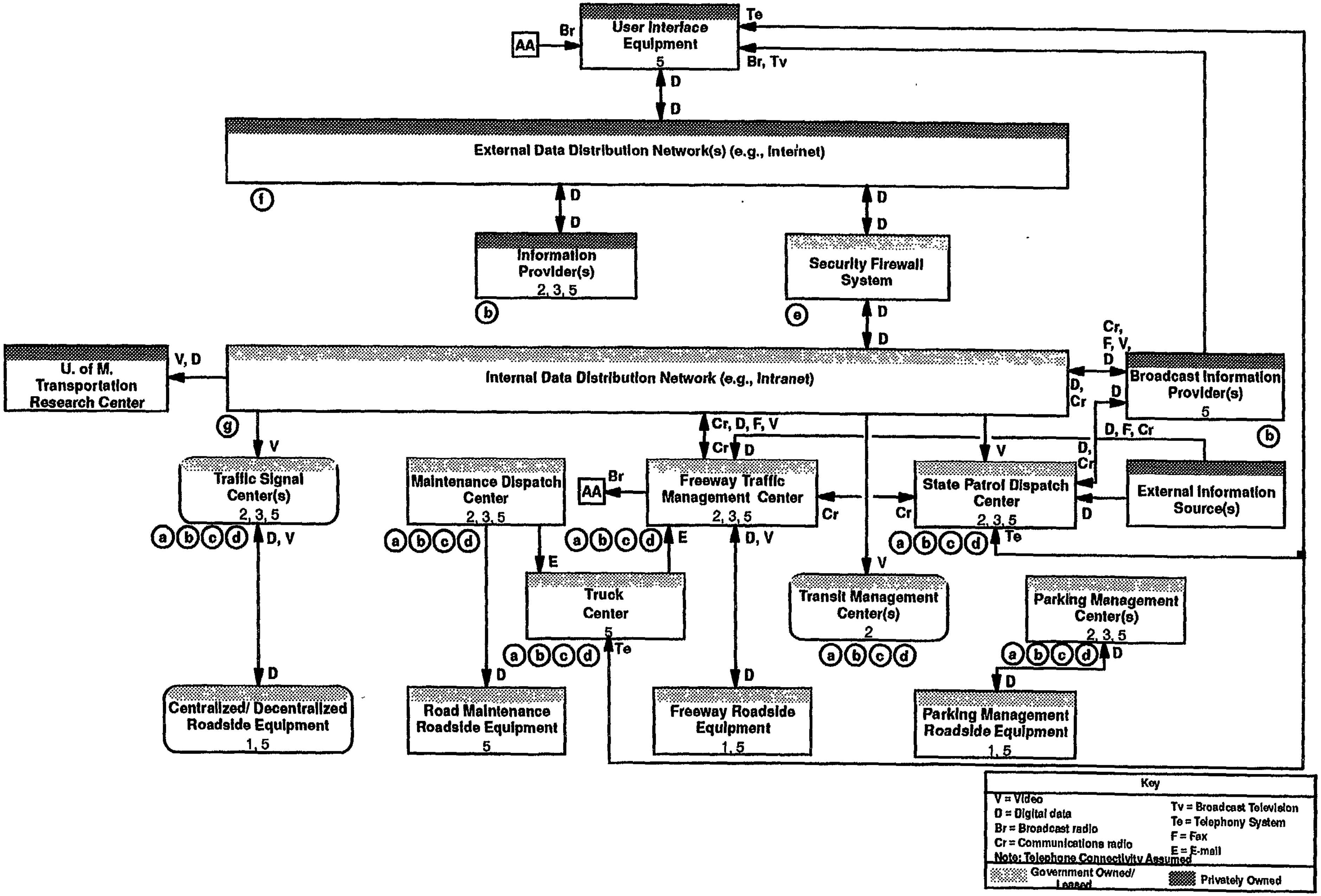
Travel Conditions Information Service Architecture Approach Summary

	As-Is	Architecture # 1	Architecture # 2	Architecture # 3
Information Provider(s)	**b.** Distribute basic travel conditions to service users	**b.** Distribute regionwide travel conditions to service users c. Maintain comprehensive, regionwide, current travel conditions independently at each private agency d. Automated travel conditions data recovery from pre-designated public agency	**b.** Same as Architecture #1 c. Same as Architecture #1 **d.** Automated travel conditions data recovery from Regional ITS Management System	**b.** Same as Architecture #1 c. Same as Architecture #1 **d.** Same as Architecture #2
Security Firewall System	e. Provide secure firewall for two way data exchange between government owned/leased and privately owned networks (limited function)	e. Provide secure firewall for two way data and video exchange between government owned/leased and privately owned networks	e. Same as Architecture #I	e. Same as Architecture #I
External Data Distribution Network	f. Provide public access, statewide ITS communication network (limited access)	**f.** Provide public access, statewide ITS communication network	f Same as Architecture #1	f. Same as Architecture #1
Internal Data Distribution Network	g. Provide limited access, regional public agency ITS network	g. Provide limited access, statewide public agency network	g. Same as Architecture #1	g. Same as Architecture #1

Approach Topic Codes

a. = Interface management
b. = Travel conditions information distribution
c. = Travel conditions information management
d. = Data recovery
e. = Security firewall
f. = External data access
g. = Internal data access

Travel Conditions Information Service
AS-IS Architecture



TCI$ASIS-e

Travel Conditions Information Service
AS-IS Architecture

Advantages

- Meets current needs
- The TMC Data Distribution Server (DDS) provides an open, reliable source of information
- Priority delivery devices are supported
- Data integrity checking is performed at the TMC
- Timely delivery of travel conditions is provided every 10 minutes (or continuously when needed) via broadcast radio

- MnDot Truck Center provides statewide weather-related travel conditions information

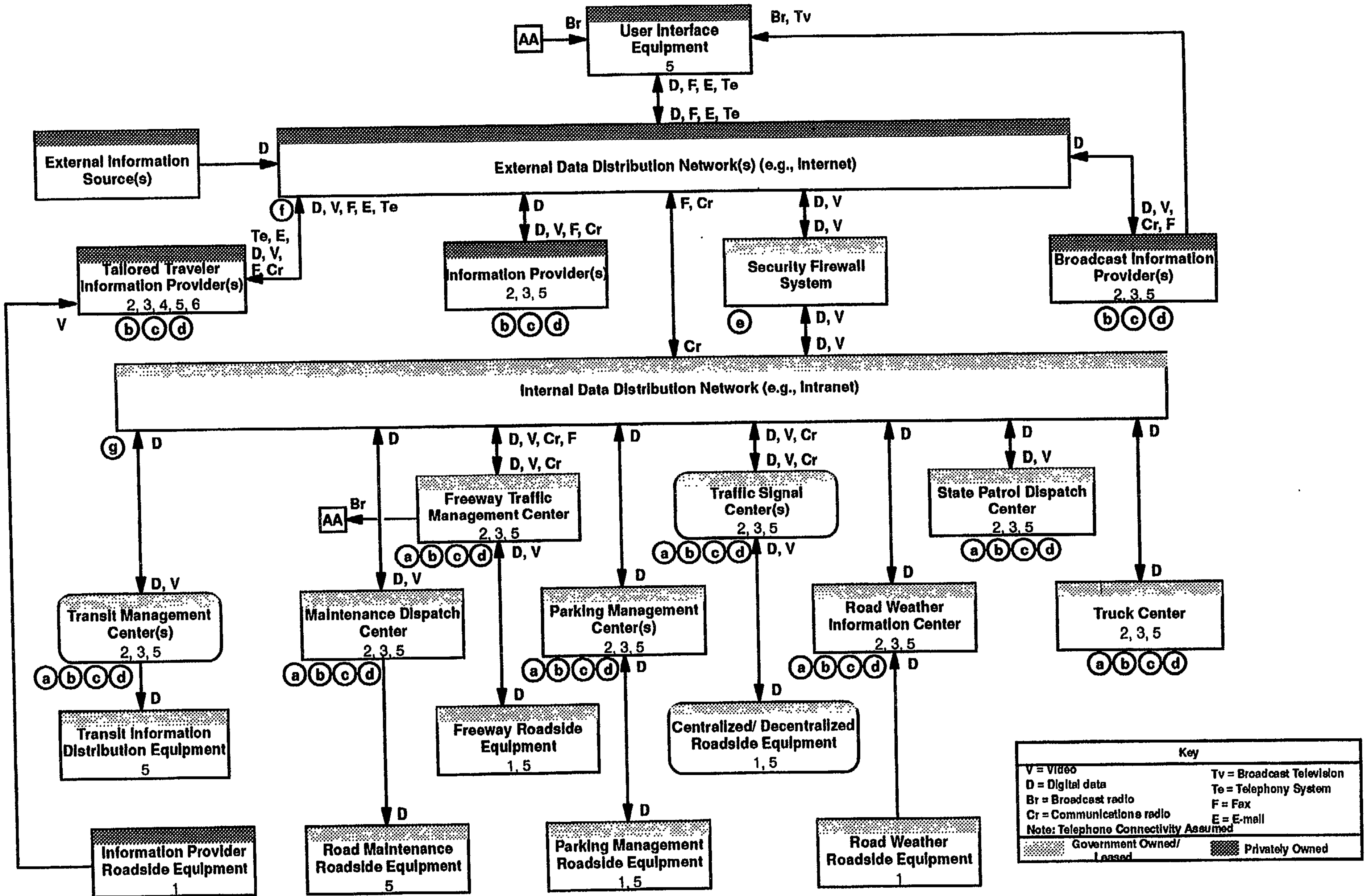
Disadvantages

- Standalone systems limit amount of data sharing
- Limited tailoring of user-specific travel conditions
- Other (non-TMC) information sources need to improve data integrity
- Information distribution is labor intensive
- Lack of information about alternate routes/arterials

Issues

- Need to assess cost/benefit of additional function

Travel Conditions Information Service Architecture #1



TCI$AR1-f

Travel Conditions Information Service Architecture #1

Advantages

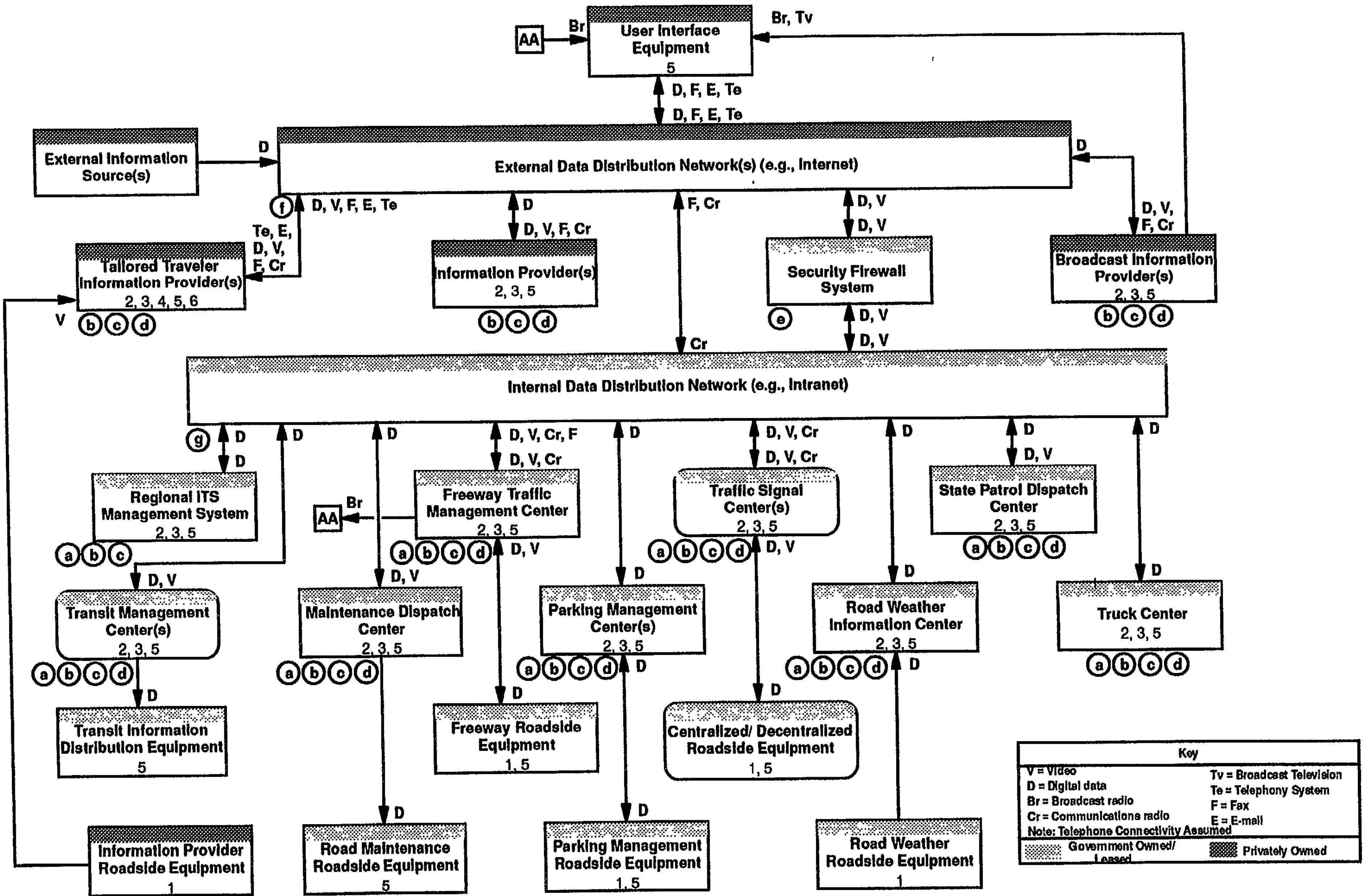
- Provides ability to maintain data consistency between agencies
- Offers flexibility to choose source of data
- Provides redundant alternate information access points
- Coordinated management of public and private agency interfaces using identified standards, policies and procedures
- No additional resources required to establish and maintain a Regional ITS Management System

Disadvantages

- Each agency must maintain interfaces with other agencies and Information Providers
- Filtering of travel conditions for private agency use must be done by each agency
- Doesn’t require an agency to give data in order to get data

Issues

Travel Conditions Information Service Architecture #2



TCI$AR2-f

85

Travel Conditions Information Service Architecture #2

Advantages

- Provides an easy way to maintain data consistency between agencies
- Provides back-up for recovery of agency-specific view of travel conditions
- Data is more accessible to Information Providers
- Provides redundant alternate information access points
- Centralized management of private agency interfaces
- Filtering of travel conditions for private agency use done by Regional ITS Management System

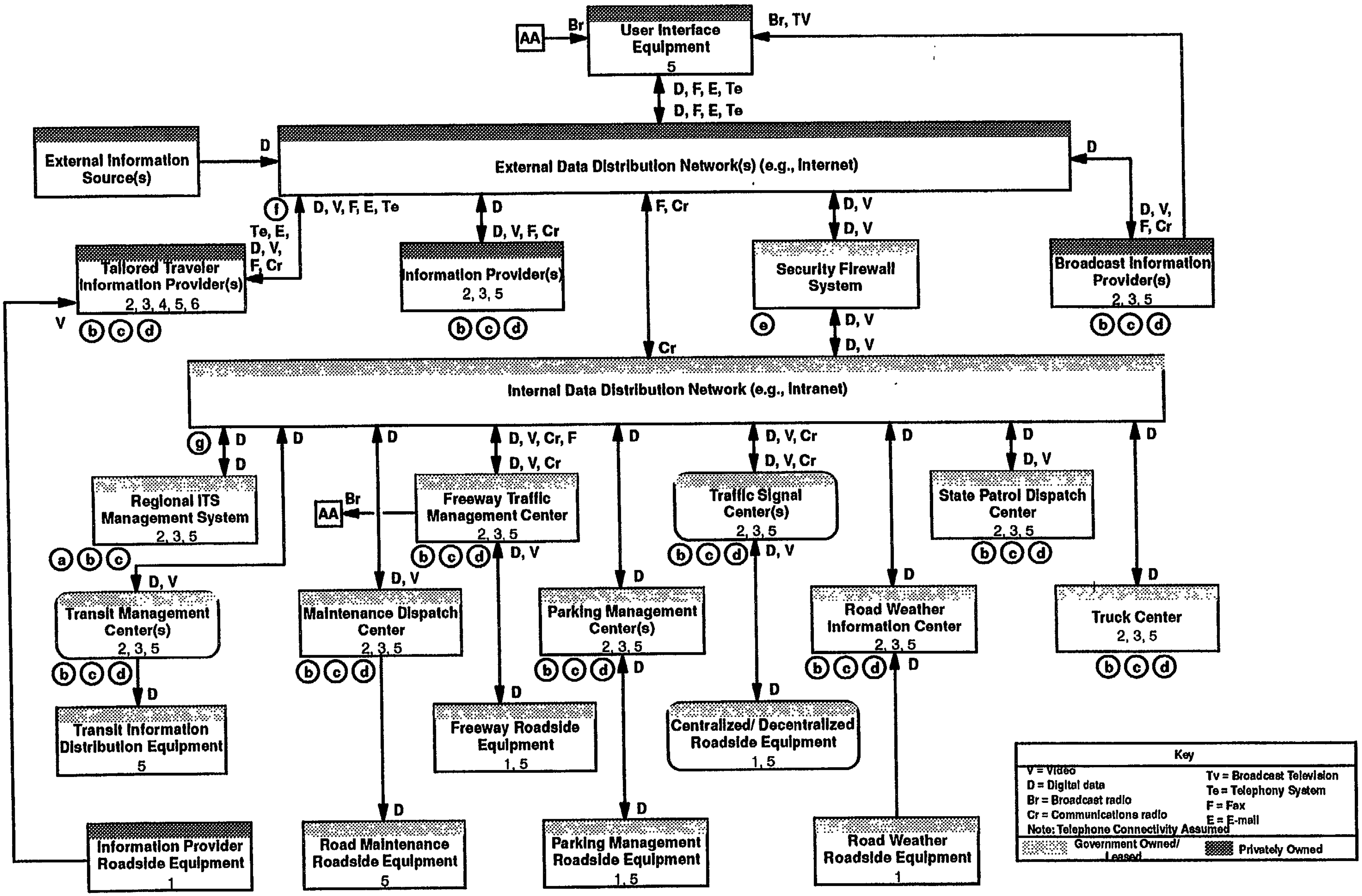
Disadvantages

- Additional resources required to establish and maintain a Regional ITS Management System
- Regional ITS Management System is single point of failure for private agency information sharing
- Duplication of data between centers and Regional ITS Management System
- Doesn’t require an agency to give data in order to get data

Issues

-

Travel Conditions Information Architecture #3



TCI$AR3-f

Travel Conditions Information Service Architecture #3

Advantages

- Provides an easy way to maintain data consistency between agencies
- Provides back-up for recovery of agency-specific view of travel conditions
- Data is more accessible to Information Providers
- Centralized management of public and private agency interfaces
- Filtering of travel conditions for private agency use done by Regional ITS Management System

Disadvantages

- Additional resources required to establish and maintain a Regional ITS Management System
- Regional ITS Management System is single point of failure for both public and private agency information sharing
- Duplication of data between centers and Regional ITS Management System
- No direct peer-to-peer communication of travel conditions information (all travel conditions information is routed through the Regional ITS Management System
- Doesn’t require an agency to give data in order to get data

Issues

•

Travel Conditions Information Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2a	Architecture #2b
Function: ***Data Completeness:***				
• Content (travel conditions and effects)	* Travel conditions content mostly incidents and traffic	+ Complete travel conditions content (incidents, traffic, weather, construction, etc.) -via access to other source info	+ Same as #1	+ Same as #1
• Coverage (freeway, arterial, CBD, etc.)	* Freeway travel conditions provided by TMC, limited arterial & CBD information	+ Extensive regional coverage (freeways, arterials, CBD, etc.)	+ Same as #1	+ Same as #1
Performance: ***Timely information delivery :***				
- Minimize time from condition occurrence to delivery of information to traveler	* Basic travel conditions broadcast every 10 mins. (or continuously when needed)	+Timely delivery of tailored travel conditions directly to affected travelers	+ Same as #1	+ Same as #1
- Provides real-time data to agencies	* Minimal electronic data exchange * Limited agency access to data	++ Real-time (< 10 sec) digital information exchange among agencies	++ Same as # 1	++ Same as #1

Travel Conditions Information Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2a	Architecture #2b
Information Sharing: *Information quality checking*	* Each agency responsible for its own data quality checking	= Same as As-Is	= Same as As-Is	+ Data from multiple sources can be cross-checked at a central point to identify and correct inaccuracies
Data standardization	* Stand-alone systems with limited data standardization * Multiple link reference models used for geo-referencing	+ Data standards documented and enforced + Data geo-referenced to common link reference model	+ Same as #1 + Same as #1	+ Same as #1 + Same as #1
• ***Flexibility to select alternate data source***	* Originating agency is the single source of data	+ Multiple sources of data - originating agency and Information Providers	+ Same as #1	++ Multiple sources of data: originating agency, Information Providers and Regional ITS Management System
• ***Data Consistency***	* Inconsistent, duplicate data entered independently at multiple agencies	+ Limits probability of duplicate data entry +Facilitates consolidation of inconsistent data	+ Same as #1 + Same as #1	+ Same as #1 + Same as #1
• Security of information access	* Limited security risk because of limited information access	- Additional security risk due to additional information access points (controlled by security gateway)	= Same as #1	= Same as #1

Travel Conditions Information Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2a	Architecture #2b
Upgradability: *Does not constrain future plans*				
• Adding agencies	* Each data source agency must add new agency to their distribution list	= Same as As-Is	= Same as As-Is	+ Regional ITS Management System adds new agency to its list; no impact to data source agencies
• Adding travelers	* Addition of Traveler Interface Equipment is not restricted by the architecture	= Same as As-Is	= Same as As-Is	= Same as As-Is
• Adding Information Providers	* Addition of Information Providers is the responsibility of each agency	+ Addition of Information Providers is not restricted by the architecture. All agencies have access to additional Information Providers	+ Same as #1	+ Same as #1

Travel Conditions Information Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2a	Architecture #2b
Upgradability: (continued)				
• ***Openness***	* Open communications supported via TCP/IP	= Same as As-Is	= Same as As-Is	= Same as As-Is
Technology insertion:				
• Public Sector	* Done independently by agency and jurisdiction	= Same as As-Is + Encourages use of ITS standards for cost effective procurement	= Same as As-Is + Same as #1	= Same as As-Is + Same as #1
• Private Sector	* Customized public sector-private sector arrangements made on an agency by agency basis.	+ Standardized public sector-private sector interface +Customized interfaces provided by the private sector	+ Same as #1 + Same as #1	+ Same as #1 + Same as #1

Travel Conditions Information Service
Architecture Trade-off Evaluation

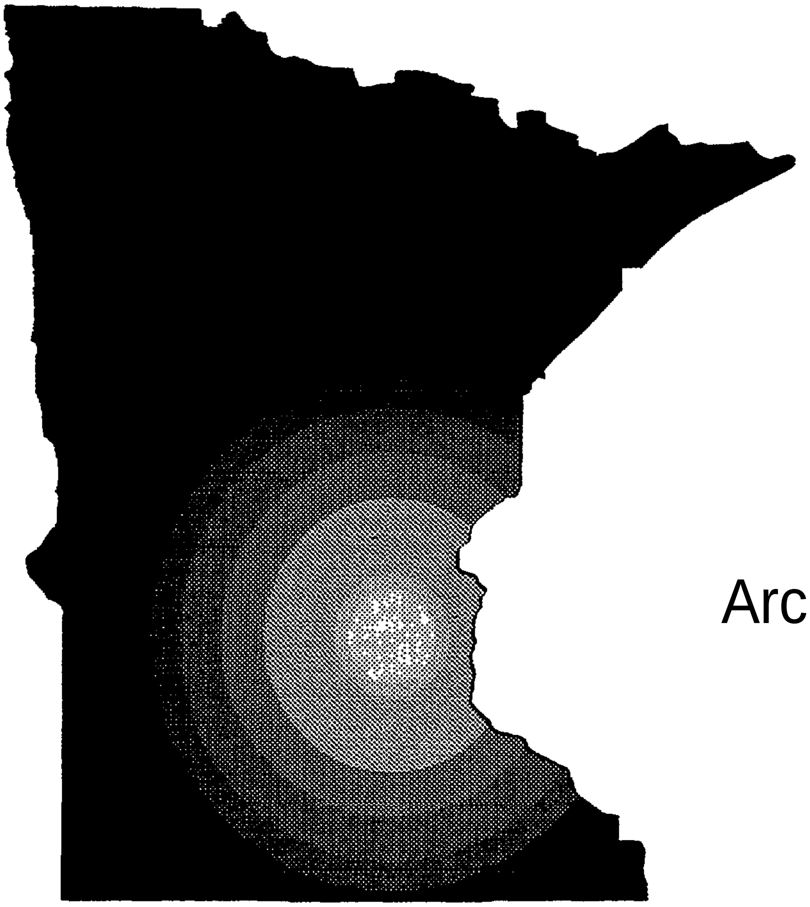
	As-Is	Architecture #1	Architecture #2a	Architecture #2b
Availability: When Needed: Hours of operation	Information availability (especially for a traveler) limited to each agency's hours of operation	= Same as As-Is	= Same as As-Is	- Information availability limited to Regional ITS Management System hours of operation
On-Demand	* On-demand support limited to freeway data and incidents	+ On-demand telephony access to regionwide travel conditions information	+ Same as #1	+ Same as #1
Recovery modes	* Agency recovery performed independently requiring manual reentry of lost data	+ Agencies can recover data From other agency systems	+ Same as #1	+Agencies can use Regional ITS Management System for recovery
Easy to access ***- Information access via many methods (eg. phone, fax, signs, computer)***	* Basic travel conditions to travelers via broadcast media (radio, TV) and some telephony systems	+ Basic travel conditions to travelers via broadcast media and expanded devices (e.g. computer, pager)	+ Same as #1	+ Same as #1
		+ Tailored travel conditions via telephony, computer, etc.	+ Same as #1	+ Same as #1
	* Basic travel conditions to agencies via phone, fax and limited computer	+ Basic travel conditions shared real-time among agencies via Internal Data Distribution Network	+ Same as #1	+ Same as #1

Travel Conditions Information Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2a	Architecture #2b
Life Cycle Costs:				
Utilizes existing infrastructure	* Not Applicable	= Utilizes existing infrastructure	= Same as #1	= Same as #1
Cost effective device support	* Each agency supports its own output devices for reporting conditions to travelers	+ Tailored Traveler Information Provider supports all output devices for reporting conditions to travelers	+ Same as #1	+ Same as #1
• ***Minimize deployment costs***	* Not applicable	- Requires additional communications interface equipment to be deployed at each agency	- Same as # 1	- Same as #1
			- Requires additional equipment to establish Regional ITS Management System	- Same as #2a
. ***Minimize operations and maintenance costs***	????	- Additional communications interface equipment needs to be maintained at each agency	- Same as #1	- Same as #1
			- Requires additional resources to operate and maintain Regional ITS Management System	- Same as #2a

Travel Conditions Information Service
Architecture Trade-off Evaluation

	As-Is	Architecture #1	Architecture #2a	Architecture #2b
Useability: ***Tailoring features:*** • Tailoring of travel conditions to users' needs	* Limited tailoring of user-specified travel conditions	++ Travel conditions tailored to a specific user's needs + Travel conditions filtered by agencies per their needs	++ Same as #1 + Same as #1	++Same as #1 + Same as #1
Operations workload • Data Management (includes information quality checking)	* Data distribution is labor intensive	+ Electronic data distribution among agencies	+ Same as #1	+ Same as #1 + Fewer personnel required to manage data from a central location
• System Management	* Each agency requires system management personnel	= Same as As-Is	+ Fewer personnel required to manage systems from a central location	+ Same as #2a
Customer Preferences/Constraints: • ***Reflects current business practices***	* Not applicable	= Conforms to current business practices	= Same as #1	= Same as #1
Other: • ***Compatibility with Traffic Control architecture***	* Not applicable	TBD	TBD	TBD
Category Sum		+ 24 = 9 - 3	+ 25 = 8 - 5	**+ 30** **= 5** **- 5**



Polaris

Architecture Trade-Off Details

Traveler Services Information

Function Descriptions

Traveler Services Information (TSI) Service

1. Collect Traveler Services Source Data (CTS)

- store restaurant, lodging, vehicle services, emergency medical facilities, tourist sight, planned event, recreational area, entertainment, shopping, airline **and rental vehicle information**
- store key attributes of each traveler services data element (e.g. name, address, type, phone number, etc.)
- support multiple input formats: voice, fax, digital, etc.

2. Manage Basic Traveler Services Information (BTS)

- map traveler services source data to transportation network model (e.g. roadways, bus routes, etc.)

3. Determine Tailored Traveler Services (DTTS)

- determine requested traveler services information based on user-specified parameters

4. Make Reservations (MR)

- allow a user to make reservations and/or purchase tickets for travel, dining, entertainment and parking
- support multiple devices: phone, computer, fax, e-mail,...

5. Distribute Traveler Services Information (DTSI)

- accept requests for traveler services information
- package traveler services information for delivery to the user
- support multiple devices: phone, computer, fax, e-mail, in-vehicle...
- provide traveler services source data (e.g.; parking lot location, transit mode use information, hotel/restaurant information, etc.)

Traveler Services Information Service Architecture Approach Summary

	Recommended Architecture
Tailored Traveler Information Provider(s)	**a.** Tailor traveler services information to a user's specific request gnd to criteria in a user's profile **b.** Collect and maintain comprehensive traveler services information **c**. Provide users with the capability to make reservations and/or purchase tickets for travel, dining, entertainment and parking **d.** Distribute traveler services information to users
Regional ITS Management Center and Other Transit Manaeement Center(s)	**e**. Distribute traveler services source data to Regional ITS Management System (e.g., information about how to use the transit system)
External Information Sources	**e.** Distribute traveler services source data (e.g., restaurant, lodging, special events, shopping, etc.) **f.** Provide transportation network model that is the base geographic reference (i.e. map) **c**. Accept and confirm reservations and ticket purchases for travel, dining and entertainment
Parking Management Center(s)	**c.** Accept and confirm reservations for parking **e.** Distribute traveler services source data to Regional ITS Management System (e.g., parking locations and parking facility information)
Regional ITS Management System	**g**. Centralized management of private agency interfaces for public traveler services source data **e**. Distribute public traveler services source data to private agencies (e.g., parking locations, transit mode use information)
User Interface Equipment	**a.** Tailor traveler services information to a user's specific request and to criteria in a user's profile (optional) **b.** Maintain comprehensive traveler services information (optional) **c.** Provide users with the capability to make reservations and/or purchase tickets for travel, dining, entertainment and parking (optional) **d.** Distribute traveler services information to users
Transit Information Distribution Equlpment	**a.** Tailor traveler services information to a transit user's specific request **b.** Maintain comprehensive traveler services information relative to areas around transit stops **d.** Distribute traveler services information to transit users

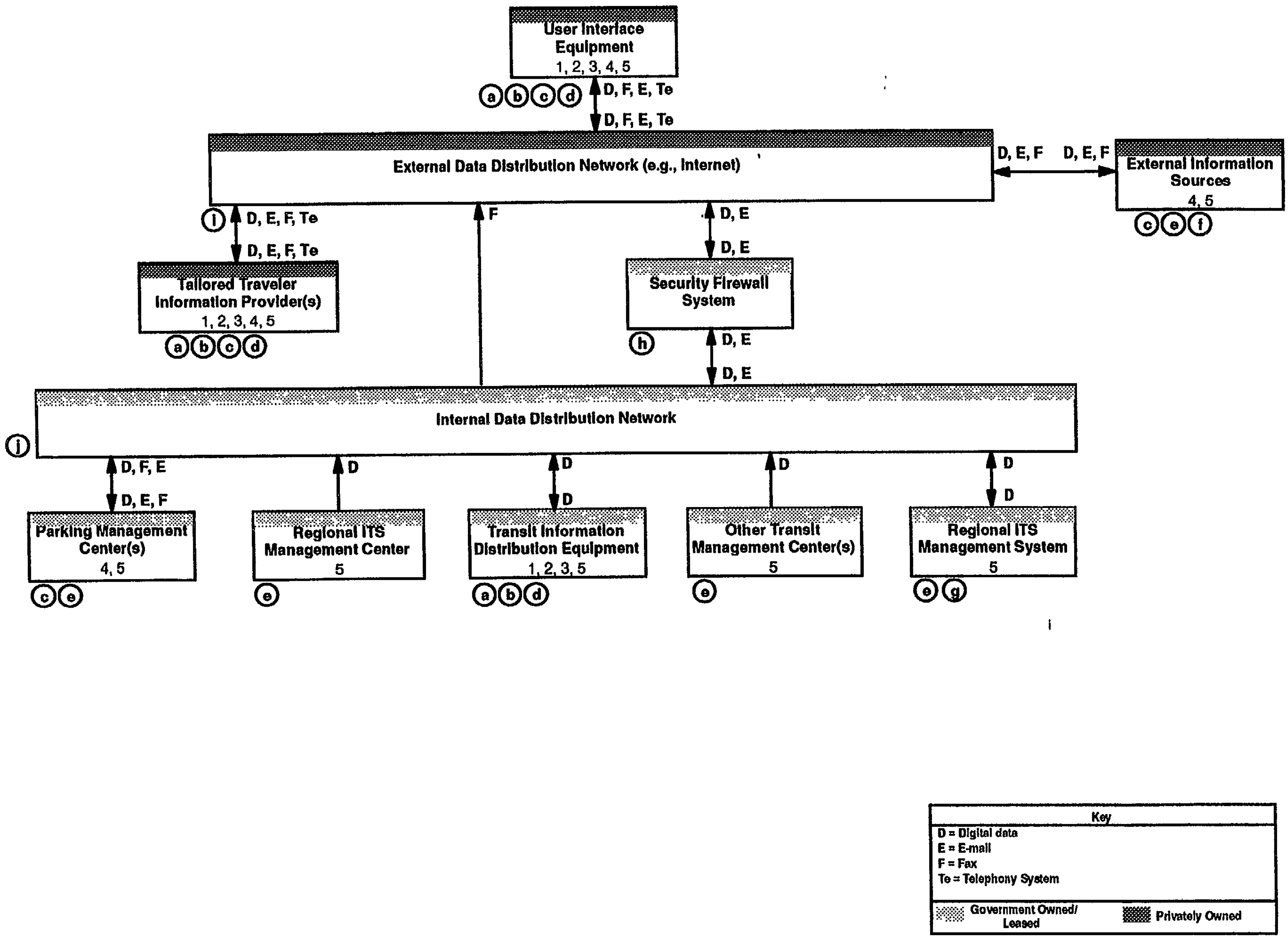
Traveler Services Information Service Architecture Approach Summary

	Recommended Architecture
Security Firewall System	**h.** Provide secure firewall for two way data exchange between government owned/leased and privately owned networks
External Data Distribution Network	**i.** Provide public access, statewide ITS communication network
Iuternal Data Dlstrlbutlon Network	**j.** Provide limited access, regional public agency ITS network

Approach Topic Codes

a. = Tailor traveler services information
b. = Traveler services information management
c. = Reservations/ticket purchase capability
d. = Distribute traveler services information
e. = Distribute traveler services source data
f. = Provide transportation network model
g. = Interface management
h. = Security firewall
i. = External data access
j. = Internal data access

Traveler Services Information Recommended Architecture



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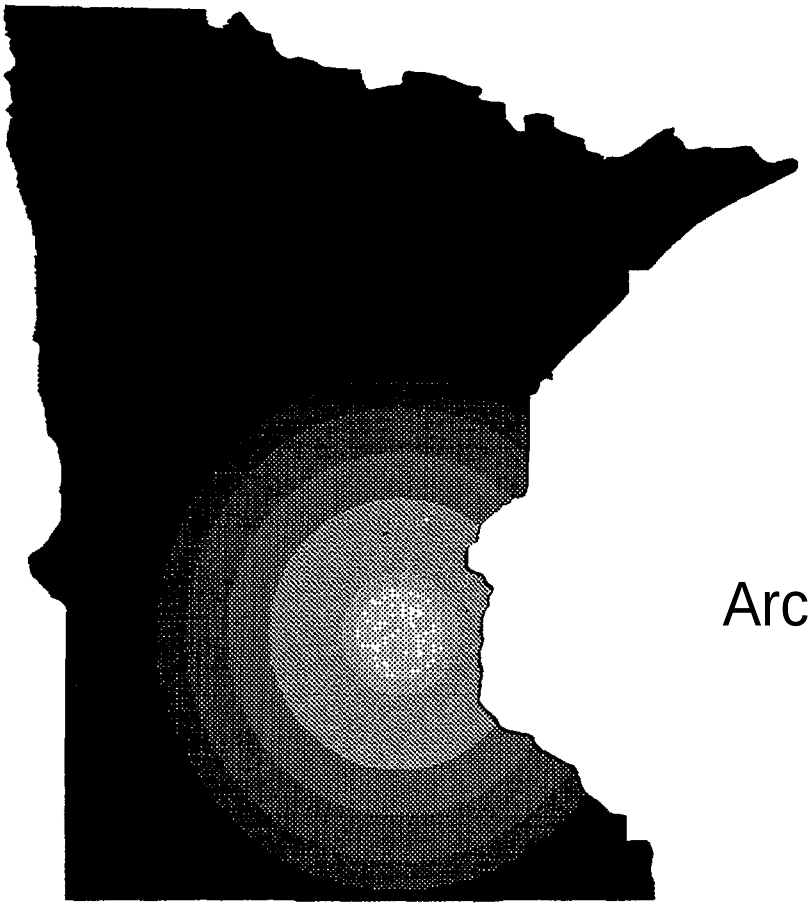

Polaris

Architecture Trade-Off Details

Trip Planning & Directions

Function Descriptions

Trip Planning and Directions (TPD) Service

1. Determine Route (DR)

- store all geographic points of reference for the transportation network model (e.g. roadways, bus routes, etc.)
- calculate the best path or detour route between origin and destination point(s) using user-specified parameters and travel conditions information
- can be based on single or multiple modes

2. Compute Directions (CD)

- provide step by step instructions for a user to get from an origin point to a destination point

3. Build Trip Itinerary (BTI)

- assemble and package all information about a user-specified trip including, route (w/map), directions, schedule (and date) information (if needed), information about destination point(s) and information about points of interest along the route

4. Distribute Trip Plans and Directions (DTPD)

- accept requests for routes, schedules, directions and trip itineraries
- distribute routing, directions and trip itinerary information
- support multiple delivery devices: phone, computer, fax, e-mail, in-vehicle devices...

Trip Planning and Directions Service Architecture Approach Summary

	Recommended Architecture
Regional ITS Management Center and Other Transit Management Center(s)	**a**. Calculate best transit route between origin and destination points for transit users and calculate detour routes for transit drivers **b**. Compute transit directions for transit users **c**. Distribute transit trip itinerary information to transit users **i**. Maintain transit route, schedule and fare information for own transit agency **j**. Distribute transit route, schedule and fare information to Regional ITS Management System
Demand Responsive Transit Center(s) and Transit Service Provider(s)	**a**. Calculate detour routes for transit drives **i**. Maintain transit route, schedule and fare information for own transit agency
Inter-jurisdictional Transit System	**a.** Calculate best inter-jurisdictional transit route between origin and destination points **b.** Compute inter-jurisdictional transit directions
Regional ITS Management System	**h.** Centralized management of private agency interfaces i. Maintain transit route, schedule and fare information of all public transit agencies **j.** Distribute public transit route, schedule and fare information to private agencies
Tailored Traveler Information Provider(s) and Information Provider(s)	**a.** Calculate best single or multiple mode route between origin and destination points for travelers **b.** Compute single or multiple mode directions for travelers **c**. Distribute trip itinerary information to travelers **i.** Maintain transit route, schedule and fare information of all public transit agencies **J.** Distribute public transit route, schedule and fare information to travelers
Parking Management Center(s)	**k.** Distribute parking fee information to the Regional ITS Management System
Toil Authority Center(s)	1. Distribute roadway toll information to the Regional ITS Management System

Recommended Architecture

Trip Planning and Directions Service

Advantages

- Centralized transit trip planning and directions operations are more efficient from a people and resource perspective
- Metro Mobility and other Demand Responsive Centers are network connected for increased data access and sharing

Disadvantages

- Centralized trip planning and directions is a single point of failure

Issues

- Will current policy force recommended migration of transit operations to a Regional ITS Management Center