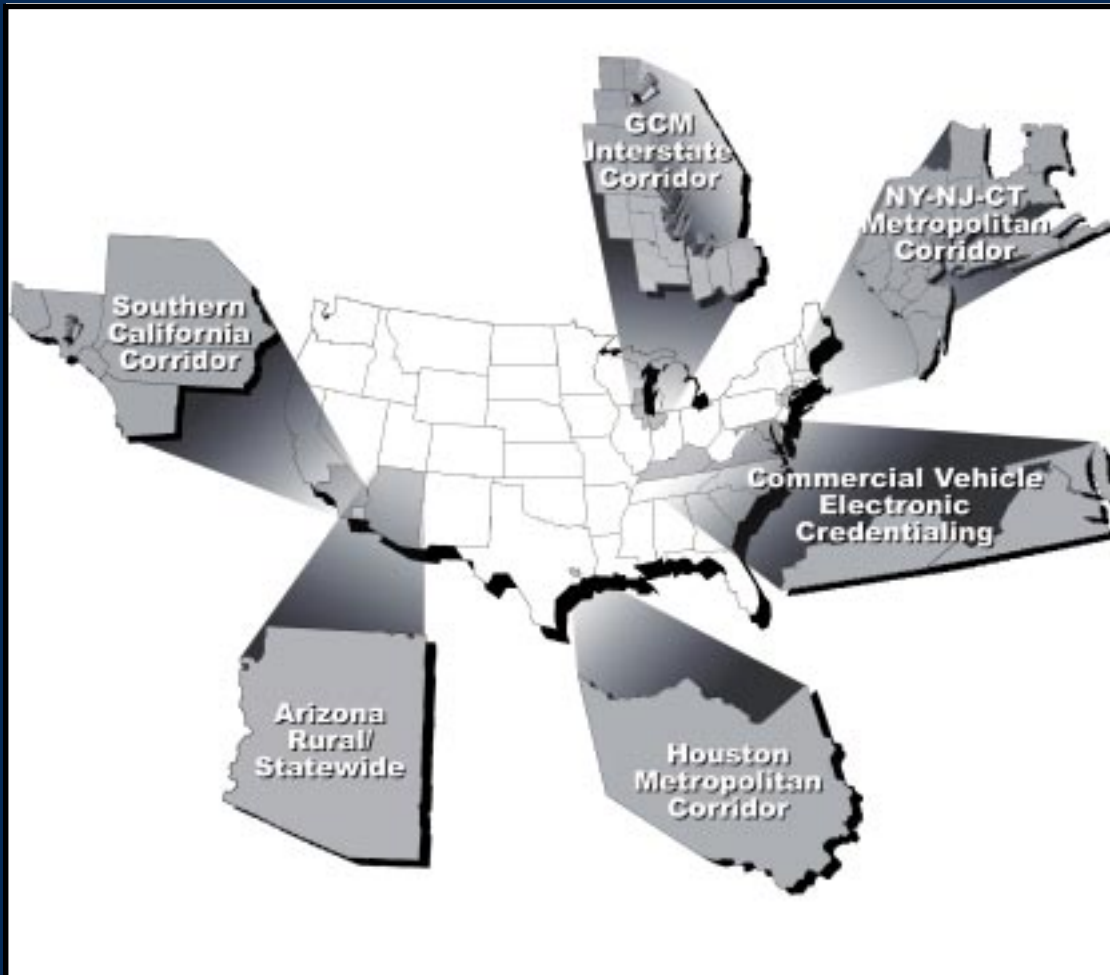# Developing a Regional ITS Architecture

A Cross–Cutting Study

Building a Framework for Regional ITS Integration

September 1999

Foreword

Dear Reader,

We have scanned the country and brought together the collective wisdom and expertise of transportation professionals implementing Intelligent Transportation Systems (ITS) projects across the United States. This information will prove helpful as you set out to plan, design, and deploy ITS in your communities.

This document is one in a series of products designed to help you provide ITS solutions that meet your local and regional transportation needs. We have developed a variety of formats to communicate with people at various levels within your organization and among your community stakeholders:

- **Benefits Brochures** let experienced community leaders explain in their own words how specific ITS technologies have benefited their areas;

- **Cross-Cutting Studies** examine various ITS approaches that can be taken to meet your community's goals;

- **Case Studies** provide in-depth coverage of specific approaches taken in real-life communities across the United States; and

- **Implementation Guides** serve as "how to" manuals to assist your project staff in the technical details of implementing ITS.

ITS has matured to the point that you don't have to go it alone. We have gained experience and are committed to providing our state and local partners with the knowledge they need to lead their communities into the next century.

The inside back cover contains details on the documents in this series, as well as sources to obtain additional information. We hope you find these documents useful tools for making important transportation infrastructure decisions.

Christine M. Johnson
Program Manager, Operations
Director, ITS Joint Program Office
Federal Highway Administration

Edward L. Thomas
Associate Administrator for
Research, Demonstration and
Innovation
Federal Transit Administration

This is one of seven studies exploring processes for developing ITS architectures for regional, statewide, or commercial vehicle applications. Four case studies examine metropolitan corridor sites: the New York, New Jersey, and Connecticut (NY-NJ-CT) region; Gary-Chicago-Milwaukee (GCM); Southern California; and Houston. The fifth case study details Arizona's process for developing a rural/statewide ITS architecture. This particular study highlights the cross-cutting findings and perspectives of the five case studies. The seventh study in the series is a cross-cutting examination of electronic credentialing for commercial vehicle operations in Kentucky, Maryland, and Virginia.

This study was prepared for a broad-based, non-technical audience. Readership is anticipated to include mid-level managers of transportation planning and operations organizations who have an interest in learning from the experiences of others currently working through ITS architecture development issues.

Purpose

Contents

Overview

A regional intelligent transportation systems (ITS) architecture provides states and localities with a framework for sharing information and a structure for integrating new ITS projects with existing systems. Sharing information helps to maximize the ability of agencies to meet specific transportation management needs. A basis for addressing these needs has been established through such initiatives as the National ITS Architecture and special incentive funding. These initiatives, along with a growing understanding of the value of sound systems engineering practices, are making a strong case for regional and statewide ITS integration.

This report highlights cross-cutting findings and perspectives gleaned from a series of case studies that examined the development processes of regional and statewide ITS architectures. In selected instances, relevant findings from the commercial vehicle cross-cutting study of electronic credentialing in Kentucky, Virginia, and Maryland also are included in this report.

Five of the six studies were conducted by the U.S. Department of Transportation's (U.S. DOT) Volpe National Transportation Systems Center, under the sponsorship of U.S. DOT's ITS Joint Program Office, and in coordination with the Federal Highway Administration and the Federal Transit Administration. The Houston study was conducted by Mitretek Systems, with support from the Volpe Center. Credit and appreciation goes to stakeholders at each site who took the time necessary to tell the story of their site's regional ITS architecture development process.

Each of the cases is unique. What is compelling about them is the way in which each site dealt with the main issues inherent in the regional ITS architecture development process. Generally, these issues can be grouped around steps toward regional ITS architecture development: laying a foundation, gathering stakeholders, organization and governance, outreach and education, resources, and implementation and maintenance. Cross-cutting findings specific to these topics are discussed in the following pages.

"The need for a framework or architecture helped to unify the Corridor—to link our data together."
— **John Corbin,**
 Freeway Operations
 Engineer,
 Wisconsin DOT

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Laying a Foundation: Getting Started

While the approach or process for developing a regional ITS architecture is bound to be different for each region or state, one thing is clear: the process includes much more than producing a systems architecture design document. Preparing Early Deployment Plans (EDPs) and corridor program plans, gathering a wide range of stakeholders to assess what is needed and to explore options for electronic data exchange, building interjurisdictional partnerships, and identifying the interfaces necessary to ensure that systems can communicate with each other—all these and more are part of a broad-based, dynamic process of often concurrent activities. What this suggests is that developing a regional ITS architecture is both incidental to such activities, and purposeful—in large part to gain regional benefits that are otherwise elusive.

Deploying compatible transportation management systems to improve traffic and transit operations provides a strong motivation to strive toward regional ITS integration. The following are important factors that can help agencies get started.

- *Strengthen Existing Partnerships:* Existing partnerships for sharing information to improve traffic and transit operations and management also help in laying a foundation. For example, specific to the Gary-Chicago-Milwaukee (GCM) Corridor, the Illinois, Indiana, and Wisconsin state DOTs (as well as other transportation agencies) have formally and informally coordinated information sharing for many years.

- *Look to Neighboring Jurisdictions*: One agency's decisions can alleviate or confound transportation problems in neighboring jurisdictions. A concern in Southern California and the New York-New Jersey-Connecticut region was that deployment of incompatible systems would make traffic management increasingly more difficult.

- *Build on Deployment Successes:* Once a history of traffic management successes emerges, the demand increases for additional ITS deployment. For example, after the 1984 Summer Olympics in Southern California, the early use—and success—of ITS services prompted interest in more ITS deployment. Other events from which enhanced ITS coordination and integration opportunities emerged include the Northridge earthquake in Southern California, and winter highway closures in Arizona.

- *Share Information:* Information sharing often precedes the use of ITS technologies to improve traffic and transit operations. The regional ITS architecture development process in turn provides opportunities to build on information sharing arrangements through electronic information exchange to a broader base of interested stakeholders. For instance, those states that are participating in a special ITS commercial vehicle program, known as the Comercial Vehicle Information Systems and Networks (CVISN), will be able to exchange safety and credentialing information from roadside inspection sites to state information systems.

"An impetus for coordination was concern that deployment of incompatible systems would make transportation problems worse rather than better."
—**Rob Hess,**
   Senior Manager, Transit Projects, Capital Program Budgets, New York Metropolitan Transportation Authority

"It's hard to imagine diverse communication coordination and electronic data exchange without the GCM (Corridor) or National Architecture."
— **Ken Glassman, Coordinator of Engineering Services, Illinois State Toll Highway Authority**

Laying a Foundation: Getting Started

ITS SERVICES ADDRESSED IN REGIONAL ITS ARCHITECTURE (TO DATE)

	So.Cal.	GCM	NY-NJ-CT	Houston	Arizona	CVO
ATMS	X	X	X	X		
ATIS	X	X	X	X	X	
CVO	x	x	X		x	X
APTS	x	X	X	X		
ARTS					X	
Incident Mgmt.	X	X	X	X	X	

X Priority ITS Services
X Services Also Addressed
x Services Planned

(ATMS=traffic management, ATIS=traveler information, CVO=commercial vehicles, APTS=advanced transit, ARTS= rural ITS)

This chart illustrates how regions tend to develop ITS architectures in an incremental, evolutionary way.

Gathering Stakeholders

"For a first project, pick one large enough to have data flowing to or from most of the stakeholders. Using this as an example in an early meeting will bring more people into the process."
— **Susan Beaty**
   Senior Project Manager,
   Houston TranStar,
   METRO

It is crucial that a wide range of stakeholders participate in the development process, to ensure consideration of the broadest range of integration opportunities and legitimacy in the effort's outcome. Beyond the essential traditional transportation agencies, the range of organizations with a stake in improved transportation system management and operations includes police, fire, and other safety-related agencies; planning organizations; even agencies charged with promoting tourism. While an entity's purpose or mission is often a determining factor in its participation, other considerations apply, such as the availability of staff and resources—or even an individual's particular interest in ITS. Case study interviewees provided additional insights regarding:

- *ITS Champions:* "Champions" are a crucial ingredient in the successful development of a regional ITS architecture. They are leaders and advocates that bridge institutional gaps, educate and inform others, and help cultivate additional resources. In the case of electronic credentialing for commercial vehicle operations, champions in each state sought to keep stakeholders "on the same page" as the program moved forward.

- *Range of Organizations:* Broadening stakeholder involvement is important because the value of the information disseminated through the systems (connected by way of the regional ITS architecture) is progressively enhanced as it is used more. Of course, the purpose and scope of the regional ITS architecture greatly determines which stakeholders are motivated to participate.

Gathering Stakeholders

- *Role of Transit Agencies:* Transit's role in identifying integrated solutions to improved management of the transportation system varies. The Metropolitan Transit Authority of Harris County (METRO) has taken a leadership role in ITS in Houston and has worked closely with others through their transportation coordination organization (TranStar). Several transit agencies have been actively involved in the (NY-NJ-CT) region's efforts, while transit's role is still emerging in Southern California.

ITS STAKEHOLDER AGENCY PARTICIPATION AT EACH SITE*

	So.Cal.	GCM	NY-NJ-CT	Houston	Arizona	CVO
State DOT	X	X	X	X	X	X
Fed. Agency	X	X	X	X	X	X
MPO	X	X	X	X		
Transit	x	X	X	X		
Other State Ag.	X	X	X			X
Reg. Authority	x	X	X			
County Ag.	X	x		X		
City Agency	X	X	X	X	X	
Private Firm (Incl. consultant)	X	X	X	x	X	x

X Champion

X Active Participant

x Participant

*Designation is representative of the given stakeholder category as a whole. However, if one agency in a category is considered a champion, the entire category is listed as "champion".

- *Various Levels of Participation:* Not all organizations that could be involved in the ITS architecture development process will be involved equally. Keeping all organizations informed, regardless of their level of commitment, can help overcome those institutional, resource, or other factors that make active or sustained participation problematic.

- *Multiple Interests:* Stakeholders have different operational and organizational uses for ITS data. A major benefit of having a regional ITS architecture is that it facilitates the flow of information. Stakeholder participation will help identify what information is needed and ensure its eventual availability. Metropolitan planning organizations along the GCM Corridor and in New York are (or plan to) use ITS-generated data to improve transportation modeling.

Organization and Governance

Development of a regional ITS architecture requires coordination with, and the cooperation of, multiple organizations. This often takes the shape of a coordinating committee. Generally, these committees rely on the sharing of member-agency resources, as is the case for the GCM Corridor and Southern California. Notably, Southern California is considering establishing a more formal governing body with dedicated funding and staff similar to the I-95 Corridor Coalition, one of the other priority corridors. Larger issues of governance, such as the relationship between state and local agencies, coordination of activities across state lines, and participation by agencies not usually involved in traditional transportation planning and decision-making all affect the regional ITS development process. Suggestions from study sites include:

- *Designate a Lead Agency:* Progress is more likely if one (or more) agency agrees to lead activities. Within the coordinating committee environment, different approaches reflect regional realities. For example, the chief working-level GCM Corridor committee is chaired by one of the three state DOT ITS program managers, by annual rotation.

- *Build on Existing Methods for Regional Cooperation:* Developing a regional ITS architecture is a cooperative effort that assumes existing regional cooperation. Using an existing organization that has worked to develop regional solutions to regional problems is a good starting point. That structure can be adapted for regional ITS architecture development purposes, or a new structure can be developed from that base. This is true in many cases. Southern California sought to work within a working environment already established by the two key metropolitan planning organizations in the region. NY-NJ-CT built on the regional operations foundation set previously. The GCM Corridor capitalized on existing informal relationships, especially among the tri-state DOTs. And, Houston has adapted and expanded from the innovative, interagency coordination of TranStar.

- *Establish Governance Agreements and Understandings:* A Memorandum of Understanding, letter of agreement, or other formal mechanism is usually required when participation includes sharing resources. These agreements are not the only way to structure cooperative efforts. Informal arrangements, such as staff-to-staff contact, sometimes can be as effective as formal relationships. An important exception to this observation, however, relates to funding and financial arrangements.

- *Create a Committee Structure:* Committees established to address specific elements of the regional ITS architecture and to ensure participation by a wide variety of stakeholders are useful in the development process. The regional ITS architecture development effort in Southern California and the GCM Corridor used sub-committees to bring stakeholders from a wide variety of organizations together, often focused within affinity groups (such as commercial vehicles, transit, etc.).

"The (GCM) architecture is taking interagency coordination to another level. The technology is helping to break down jurisdictional obstacles."
— **Jeff Hochmuth,**
  ITS Program Manager,
  Illinois DOT

Organization and Governance

- *Agree on the Role of Consultants:* Consultants can play an important role in this process, especially in supporting the system integration effort. That role should be agreed to by agencies involved in the development process. Issues to consider include separation from design, implementation experience in architecture development, and systems integration and configuration management. In addition, Houston has demonstrated that it is possible for a group of stakeholders to work through many of the technical architecture design activities often tasked to consultants.

- *Be Prepared for the Impact of External Events:* Outside political events can influence the development process. Political change can affect the level of participation by agencies and organizations. The structure of government and organization of agencies in a region requires adapting a development process that suits the region.

"Bringing together existing institutions rather than creating brand new ones was a major reason for the success of the development effort."
— **George Smith,**
 New Technology and
 Research Program
 Manager,
 California DOT

Outreach and Education

Having deployed ITS projects and established information sharing arrangements, both agencies and staff in the areas studied were knowledgeable about the benefits of ITS and of information sharing. However, this knowledge was not consistent across job functions or across, and within, agencies. Developing a regional ITS architecture requires broad participation and resource sharing; education and outreach can help.

- *Focus on Outreach and Inreach:* Outreach to non-traditional stakeholders and the public should focus in large part on "demystifying" ITS architecture efforts. Limiting the technical terminology and jargon, and emphasizing regional integration, are crucial. "Inreach," education within an organization, is crucial to get both decision-makers and other staff educated, involved, and interested in the development process.

- *Target Materials:* Educational materials and information should be tailored for specific audiences. High-level information is most appropriate for decision-makers, while technical information is needed for operations staff. Agency public/community affairs staff can play a crucial role in this, as was the case in Arizona, where ADOT's public affairs office played a leading role in the highly successful statewide ITS architecture outreach activities across the state.

- *Undertake Cross-Agency and Cross-Jurisdictional Outreach:* Cross-agency and cross-jurisdictional sharing of information is necessary to develop, deploy, and maintain a regional ITS architecture. In Arizona, broad stakeholder participation ensured that weather and traffic data would be shared among ADOT district offices and other interested parties, such as the Department of Public Safety, the regional railroads, and area weather forecasting stations.

- *Demonstrate Benefits:* Successful deployments can be the best way to convince decision-makers of the benefits of participating in this process. The "E-ZPass" (automated toll collection) program in the NY-NJ-CT Region gave solid evidence of the advantages of both ITS and interagency coordination to decision-makers and the public throughout the region.

> **Anticipated Institutional Benefits of a Regional ITS Architecture**
>
> - Roadmap of ITS services
> - Legacy systems inventory
> - Framework for integration
> - Basis for funding
> - Improved agency coordination
> - Enhanced access to information
> - Guide for future expansion

- *Keep Partners Informed:* Regular information sharing with a broad range of individuals and organizations is important. Those actively involved in the process must keep those less involved informed. Newsletters are an often-used and effective tool in accomplishing this goal.

Federal funding provided resources to the case study areas for regional ITS architecture development. That funding alone, however, was not sufficient to make these efforts successful. State and local resources were also necessary. Resources included funds, facilities, and junior level to senior management staff. Sharing resources and work products from Early Deployment Plan (EDP) efforts and similar projects added resources, and some complexity, to the regional ITS architecture development process in several areas.

- *Federal Participation is a Motivation:* Federal guidelines and funds provide motivation to develop an ITS architecture but are not sufficient to move areas forward. An understanding of the benefits is needed for organizations to commit to a regional ITS architecture effort.

- *Using the National ITS Architecture Can Save Time:* The National ITS Architecture identifies major elements that should be included in a regional ITS architecture, and therefore provides a starting point for developing a regional ITS architecture. In study areas where regional ITS architecture development efforts preceded completion of the National ITS Architecture, the National ITS Architecture proved to be a valuable check on agency efforts. Using the National ITS Architecture can also save considerable development time. The Arizona DOT estimated that adapting the National ITS Architecture to their unique needs cut development time in half.

- *EDPs Add Resources and Complexity:* EDP resources were important in the areas included in this study. An EDP can lead to the development of a regional ITS architecture or can come out of the regional ITS development process. Coordinating regional ITS architecture development with EDP efforts can add complexity to both efforts, but will also ensure that local and regional systems can be integrated with one another.

- *Consultants Can Reduce Design and Development Time:* It is certainly possible to perform regional ITS architecture design work without the support of system integration consultants, though of the sites studied, Houston was the only site that attempted this. Consultants represent an additional cost "up front," but they can reduce the amount of time needed for ITS architecture development.

- *Cost and Time Will Vary:* These two factors vary widely depending on the size and population of the area, and the level of ITS services that are in operation, under development, or planned. Costs specifically tied to the development of a regional ITS architecture are commensurate with the scale of efforts. In addition, these are "up front" costs that, theoretically, will easily be recovered over time as a result of more efficient system design and implementation. Regional ITS architecture development time ranged from 12 to 24 months.

"The largest benefit of a unified Regional Architecture will be cost savings to the agencies that operate Southern California's transportation network. This is particularly true because the Showcase architecture is flexible enough to allow the subscription of legacy systems without having to go back and redesign old ITS or reinvest in new versions of the old systems."
— **Ali Zaghari, Showcase Project Manager, California DOT**

"I would estimate that using the National ITS Architecture cut our development time in half. All you have to do is take the National ITS Architecture and throw out what doesn't apply—what's left is the basis for your architecture."
— **Timothy Wolfe, Assistant State Engineer and ITS Projects Manager, Arizona DOT**

Implementation and Maintenance of the Regional ITS Architecture

Completion of a regional ITS architecture is an important step in establishing a structure for ITS planning, deployment, and decision-making. But, to ensure flexibility to adapt to changing transportation—and political—needs and demands, maintenance of the regional ITS architecture is crucial. The ITS architecture will need to be used as advanced transportation management technologies are deployed and maintained, as new opportunities for sharing information are identified, and as regional approaches to integrated transportation system management and operations evolve.

"People are more cognizant now that their individual projects need to coordinate and work together. Projects can't be isolated. The National ITS Architecture helps raise awareness of the need to integrate."
— **Gilmer Gaston,**
   Agency Manager
   Houston TranStar,
   City of Houston

- *Mainstreaming ITS:* All of the areas studied have received federal funds designated for ITS projects and regional ITS architecture development. These areas are now looking at how to mainstream both ITS deployment and their regional ITS architectures. Mainstreaming is also the focus of a formalized program for ITS commercial vehicle operations.

- *Competing for Resources:* A major challenge identified in most areas is that as special ITS corridor program funding expires, ITS projects have to compete for resources with other transportation projects. With the development of strategic deployment plans, regional ITS architectures, and the participation of key metropolitan or state planning organizations, areas are confident that ITS projects will compete favorably. In Southern California, the Metropolitan Planning Organizations in the Los Angeles and San Diego areas have been incorporating ITS projects into their long range transportation plans and improvement programs in keeping with the corridor planning and ITS architecture development processes.

- *Maintaining the Regional ITS Architecture:* Responsibility for long-term maintenance of a regional ITS architecture has been firmly identified in some areas, and less firmly in others. The organization instituted for the development process is usually viewed as the most suitable structure for maintaining the regional ITS architecture.

- *Developing Maintenance Plans:* All areas included in this study have identified maintenance as a long-term issue. Some have adopted long-term ITS plans that specifically address this issue; others are only beginning to look at long-term ITS architecture maintenance.

- *Determining Design and Standards:* Development of a regional ITS architecture is crucial for identifying those standards necessary to ensure compatibility among systems and their interfaces at the local level. Southern California, largely because of the progress already gained in developing a regional ITS architecture, is giving much attention to those ITS standards deemed essential to ensure that systems will be able to communicate and exchange data smoothly.

Concluding Thoughts

Finally, the following points are included to stimulate continuing thought regarding the development of a regional ITS architecture. These items represent both points of emphasis and additional considerations.

- A regional ITS architecture is a means, not an end. It is crucial that any regional ITS architecture development process be based on addressing real needs, identified from EDPs, corridor program plans, special commercial vehicle project plans, or other similar planning initiatives.

- The development process itself can yield as much benefit as the product, especially for nontraditional stakeholders. For example, through the Arizona statewide ITS architecture development process, the National Weather Service became an active stakeholder, sharing weather data essential to reliable, up-to-date traveler information.

- The importance of agency inreach, as well as outreach and education, cannot be overstated in supporting a successful development process.

- A regional ITS architecture is the most effective means of providing for regional ITS integration. Moreover, the National ITS Architecture is a valuable and versatile tool with which to make smart decisions throughout the regional ITS architecture development process.

"The regional architecture set the stage for long-term plans and projects that we have ongoing in Orange County, in particular, and also in the Southern California region. (It) sets the framework for us to make better investment decisions and ensures that projects are compatible across jurisdictions."
— **Dean Delgado, Principal Transportation Analyst, Orange County Transportation Authority**

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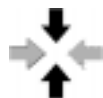## Additional Transportation Stakeholders

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