

I S S N 0386—5878

土木研究所資料第3359号

日米科学技術協力協定に基づく
第2回日米IVHS合同分科会概要集

1995年3月



PROCEEDINGS OF THE 2ND U.S.-JAPAN IVHS GROUP MEETING
OF THE U.S.-JAPAN COOPERATION ON HIGHWAY SCIENCE & TECHNOLOGY

建設省 土木研究所

Copyright © (1995) by P.W.R.I.

All rights reserved. No part of this book may be reproduced by any means, nor transmitted, nor translated into a machine language without the written permission of the Director General of P.W.R.I.

この報告書は、土木研究所長の承認を得て刊行したものである。したがって、本報告書の全部又は一部の転載、複製は、土木研究所長の文書による承認を得ずしてこれを行ってはならない。

日米科学技術協力協定に基づく 第2回日米IVHS合同分科会概要集

要 旨：

本報告書は、1994年11月に米国のワシントンD.C.で開催された第2回日米IVHS合同分科会の概要をとりまとめたものである。合同分科会では、研究発表、日米共同研究に関する討議、スタディツアーが実施された。

キーワード：日米IVHS合同分科会、日米共同研究 IVHS

目 次

1. 合同分科会の概要	1
1.1 日程・場所	1
1.2 プログラム	2
1.3 参加者名簿	4
2. 日米共同研究及び次期合同分科会に関する討議	6
3. 発表の概要	11
3.1 オープニングセッション プレゼンテーション	11
3.1.1 「日本における I V H S の現状」	11
中村 亮（建設省土木研究所）	
3.1.2 「米国における I V H S の現状」	12
（アーキテクチャー、自動運転システム、実地テストを含む）	
John MacGowan (Turner Fairbank Highway Research Center, FHWA)	
3.2 セッション1 プレゼンテーション	13
3.2.1 「日本におけるナビゲーションシステムの現状」	13
野口好一（ITSアメリカ）	
3.2.2 「米国における自動料金収受システムの現状」	14
Michael Curtis (Turner Fairbank Highway Research Center, FHWA)	
3.3 セッション2 プレゼンテーション	15
3.3.1 「VICS プロジェクトの現状」	15
今長信浩（建設省土木研究所）	
柴田 潤（住友電気工業）	
3.3.2 「米国における地方部 I V H S の現状」	16
Mohsen Zarean (JHK & Associates, Inc.)	
3.4 セッション3 プレゼンテーション	17
3.4.1 「車間側方コントロールシステムに関する実験」	17
山田 豊（沖電気工業）	
3.4.2 「TravTek の最終評価結果」	18
Joseph Peters (Science Applications International Corporation)	

3.5 セッション4 プレゼンテーション	20
3.5.1 「道路走行模擬装置上での車載ディスプレイが運転に及ぼす影響」	20
木嶋 健 (建設省土木研究所)	
3.5.2 「『空間認識力と車内ナビゲーションシステム』に関する研究結果」	21
Kathryn Wochinger (Turner Fairbank Highway Research Center, FHWA)	
4. スタディツアー	22
別添資料: 発表関係原稿	29
・ Status of IVHS in Japan	31
・ Status of IVHS in the U.S. including Architecture, Automated Highway System, and Operational Field Tests	45
・ Status of Navigation Systems in Japan	59
・ Status of Electric Toll and Traffic Management Systems (ETTM) in the U.S. ...	69
・ Status of VICS Project	89
・ Status of Rural IVHS in the U.S.	105
・ Experience on the Headway and Lateral Control System	111
・ Effect of In-Vehicle Information Display on Driving by the Highway Driving Simulator	123

1. 合同分科会の概要

第2回日米IVHS合同分科会は米国において11月10日～11月17日まで開催され、日本からは中村土木研究所道路研究室長以下11名が参加した。

1.1 日程・場所

11月10日（木）午前：サンフランシスコに到着

午後：FHWAリージョン9表敬訪問

11月11日（金）PATHプログラム視察

午前：カリフォルニア大学バークレー校リッチモンド実験場において、PATHプログラムを視察

午後：カリフォルニア大学バークレー校において、PATHプログラムに関する意見交換

11月12日（土）午前：ワシントンD.C.へ移動

午後：ワシントンD.C.に到着

11月14日（月）ターナーフェアバンクで合同分科会を開催

11月15日（火）ターナーフェアバンクで合同分科会を開催

11月16日（水）午前：東京へ移動

11月17日（木）午後：東京に到着

1.2 合同分科会プログラム

11月14日(月)

9:00- 9:30 開会とメンバー紹介

「開会挨拶」

米国側 Robert Betsold

(Turner Fairbank Highway Research Center, FHWA)

日本側 中村 亮(建設省土木研究所)

9:30-10:30 オープニングセッション

「日本におけるIVHSの現状」

中村 亮(建設省土木研究所)

「米国におけるIVHSの現状」

(アーキテクチャー、自動運転システム、実車テストを含む)」

John MacGowan (Turner Fairbank Highway Research Center, FHWA)

10:30-11:00 (休憩)

11:00-12:30 セッション1

「日本におけるナビゲーションシステムの現状」

野口好一(ITSアメリカ)

「米国における自動料金収受システムの現状」

Michael Curtis (Turner Fairbank Highway Research Center, FHWA)

12:30-13:30 (昼食)

13:30-15:00 セッション2

「VICSプロジェクトの現状」

今長信浩(建設省土木研究所)

柴田 潤(住友電気工業株式会社)

「米国における地方部IVHSの現状」

Mohsen Zarean (JHK & Associates, Inc.)

15:00-15:30 (休憩)

15:30-17:00 セッション3

「車間側方コントロールシステムに関する実験」

山田 豊(沖電気工業株式会社)

「TravTekの最終評価結果」

Joseph Peters (Science Applications International Corporation)

18:00- ITSアメリカ訪問

(Director: James Constantino)

11月15日（火）

9:00-10:30 セッション4

「道路走行模擬装置上での車載ディスプレイが運転に及ぼす影響」

木嶋 健（建設省土木研究所）

「『空間認識力と車内ナビゲーションシステム』に関する研究結果」

Kathryn Wochinger (Turner Fairbank Highway Research Center, FHWA)

10:30-11:00 （休 憩）

11:00-12:00 クロージングセッション

「閉会挨拶」

日本側 中村 亮（建設省土木研究所）

米国側 Frank Mammano

(Turner Fairbank Highway Research Center, FHWA)

12:00-13:00 （昼 食）

13:00-15:00 ターナーフェアバンク実験施設を視察

15:00-17:00 日米共同研究及び次期合同分科会に関する討議

1.3 参加者名簿

1.3.1 参加者

a) 米国側

Robert Betsold	Turner Fairbank Highway Research Center, FHWA
John MacGowan	Turner Fairbank Highway Research Center, FHWA
Frank Mammano	Turner Fairbank Highway Research Center, FHWA
Samuel Tignor	Turner Fairbank Highway Research Center, FHWA
Michael Curtis	Turner Fairbank Highway Research Center, FHWA
Kathryn Wochinger	Turner Fairbank Highway Research Center, FHWA
Jim Arnold	Turner Fairbank Highway Research Center, FHWA
Charles Minehan	Turner Fairbank Highway Research Center, FHWA
Lyle Saxton	Turner Fairbank Highway Research Center, FHWA
Joseph Peters	Science Applications International Corporation
Mohsen Zarean	JHK & Associates, Inc.

b) 日本側

中村 亮	建設省土木研究所道路研究室
木嶋 健	建設省土木研究所道路研究室
今長 信浩	建設省土木研究所道路研究室
横田 敏幸	建設省土木研究所 (現コロンビア大学)
奥村 康博	建設省土木研究所 (現ペンシルバニア大学)
大庭 孝之	建設省道路局 (現ノースウエスタン大学)
野口 好一	I T S アメリカ
坂本堅太郎	I T S アメリカ
柴田 潤	住友電気工業株式会社
山田 豊	沖電気工業株式会社
倉見 邦彦	Nissan Research & Development, Inc.

1.3.2 住所

a) 米国側

- Turner Fairbank Highway Research Center,
Federal Highway Administration (FHWA)
6300 Georgetown Pike, McLean, Virginia 22101-2296
tel. +1-703-285-2027
fax. +1-703-285-2264
- Science Applications International Corporation
1710 Goodridge Drive, McLean, Virginia 22102
tel. +1-703-734-5861
fax. +1-703-556-9326

・ JHK & Associates, Inc.

Suite 600, 3500 Parkway Lane, N.W., Norcross, Georgia 30092-2832

tel. +1-404-447-6831

fax. +1-404-449-7268

・ Intelligent Transportation Society of America (ITS America)

400 Virginia Avenue, S.W., Suite 800, Washington DC 20024-2730

tel. +1-202-484-4134

fax. +1-202-484-3483

・ California PATH

University of California, Berkeley, Institute of Transportation Studies

Richmond Field Station, Building 452, 1357 S. 46th Street

Richmond CA 94804-4698

tel. +1-510-231-9541

fax. +1-510-231-9565

b) 日本側

・ 建設省土木研究所

茨城県つくば市大字旭 1 番地 〒305

tel. +81-298-64-2211

fax. +81-298-64-0178

・ 建設省道路局

千代田区霞ヶ関 2-1-3 〒100

tel. +81-3-3580-4311

fax. +81-3-5251-1949

2. 日米共同研究及び次期合同分科会に関する討議

(1) 次期合同分科会に対する開催予定

日本側は、第3回日米ITS合同分科会を1995年11月に開催することを提案した。11月9日～11日に横浜で第2回ITS世界会議が開催されることから、11月9日の前1週間を目途に合同分科会を開催することにした。

(2) ITSに関する日米共同研究

ITSに関する日米共同研究内容として、米国側は、「車内信号と標準信号に対する運転者の反応」、「車内情報システムが前方画面に及ぼす影響」、「交差点渋滞が運転者に及ぼす影響」、「ナビゲーション装置に対する概念表示の効果」の4つのテーマを提案した。日本側は、車載ディスプレイが運転に及ぼす影響について種々の実験を実施する、というテーマを提案した。討議の主な内容は、運転席周辺に設置した車載ディスプレイあるいはフロントガラスに表示するヘッドアップディスプレイを見て運転する場合に、運転者が事故を起こさないようにする方策に関するものであった。結局、日米共同研究のテーマは、米国提案の2番目のテーマである「車内情報システムが前方画面に及ぼす影響」に関する内容となった。詳細については、近い将来に決定する予定である。参考までに、米国側提案のテーマと日本側提案のテーマを記載する。

a) 米国側提案テーマ

b) 日本側提案テーマ

**Proposed Candidate Staff Research
for
Cooperative Japanese/United States
Human Factors-Highway Safety Research Program**

Driver Compliance with In-Vehicle Signing Versus Standard Signing

In-Vehicle Signing (IVS) is an infrastructure/vehicle system designed to provide accurate regulatory, warning and advisory information in a uniform manner to the driver at the right time, location, and for the right duration. Currently, there are human factors questions regarding the design of the IVS system relative to enhancing highway safety and improving driver performance.

A study is planned for the Department of Transportation/Federal Highway Administration Highway Driving Simulator (HYSIM) that will investigate the effects of IVS on driver compliance and performance. Independent variables will include sign location and driver age. Sign location values will include standard highway signing, in-vehicle signing, and in-vehicle signing with auditory alerting. Dependant variables will include compliance with speed limits, lateral placement during sign presentation, and driver preferences.

The Effect of In-Vehicle Information Systems on Useful Field Of View

The capacity to perceive and respond to visual stimuli in the peripheral field while focusing on tasks in the forward view (referred to as the Useful Field of View, or UFOV) degrades with age and under conditions of increased workload. An age-related decline in UFOV may contribute to the vulnerability of older drivers and partially explain their relatively high accident rates. The introduction of in-vehicle information systems raises the question of whether these systems might degrade UFOV.

A study is planned for the Department of Transportation/Federal Highway Administration Video Driving Simulator (VIDSIM) to assess the effects of in-vehicle information systems on UFOV. This study will use dash-mounted and head-up display modalities and include a variety of navigation tasks. In order to determine the extent of UFOV, the location of the peripheral targets will be systematically varied. Older and younger drivers will be included in this study.

Study of Intersection Cues Used by Drivers

Research and accident data have shown that intersection maneuvers, especially left turns, are particularly problematic for older drivers. Both specific intersection features and age-related declines in perceptual and cognitive abilities have been implicated in this issue. A clear understanding of the relative importance of specific perceptual and cognitive abilities in performing maneuvers at intersections will allow highway designers to select intersection features that maximize the strengths and minimize the weaknesses of older drivers.

A VIDSIM study is planned to examine the relationship between perceptual and cognitive abilities, and intersection "decisions-to-proceed" judgements as a function of intersection features. Perceptual and cognitive abilities to be evaluated include dynamic visual acuity, static visual acuity, selective attention, peripheral vision, Useful Field of View, and angular vision. Intersection features such as geometry and signing will be evaluated.

The Effectiveness of "Overview" Displays in Navigational Devices

Many navigational displays planned for in-vehicle use display information in a low level, turn-by-turn fashion. Although some displays allow the driver to select a high-level view that shows the entire route, many do not. The lack of an "overview" of a large portion of the circuit being traveled could lead some drivers to disregard or lose trust in navigation systems.

A HYSIM study is planned to investigate the effects of displaying low-level and high level information on the driver's mental representation of the geographical area being navigated; the driver's ability to follow a route; and the driver's ability to find his or her way when the system malfunctions. The interaction of display type with age and spatial ability of the driver will also be investigated.

Draft of the Joint Research Program

1. Objectives

The object of the work is to estimate the indicating method of information presented on the on-board display. To estimate this indicating method, we use driving performance, glance duration time, etc. as an indicator. To measure these indicators, the highway driving simulator is used as an experimental equipment. This year, to inspect the applicability of the highway driving simulator at Public Works Research Institute, we compare the experiment on the highway driving simulator with the experiment on the vehicle operating on the actual road.

2. Contents

To estimate the applicability of the highway driving simulator, we compare an experiment on the highway driving simulator with an experiment on the test course. For both experiments, we use the same test course at Public Works Research Institute. We also use the vehicle with the on-board information display.

(1) Experiment Condition

1) On-board Display

- We use characters as information presented on the on-board display. To estimate the driving performance according to the amount of information, we conduct an experiment in the case that the various number of characters are presented on the on-board display and no information is presented.
- To estimate the driving performance according to the size of the on-board display, we conduct an experiment for various size of the on-board display.
- To estimate the driving performance according to the position of the on-board display, we conduct an experiment for various position of the on-board display.
- To estimate the driving performance according to the operating method of the on-board display, we conduct an experiment for various operating methods.

2) Subject

- Aged people and un-aged people
- Men and women
- Persons with various driving history

3) Operating Velocity

- The range of the operating velocity is around 40~140km/h.

4) Weather Condition

- day and night
- fine and rain

(2) Measuring Items

1) Operating Performance

- Measuring the lateral position deviation from the operating center line.
- Measuring the velocity change while driving

2) Glance Duration Time

- Measuring the required time in the case of glancing the on-board information display.
- Measuring the eye movement while driving

3. 発表内容

3.1 オープニングセッション

3.1.1 「日本における I V H S の現状」

－中村 亮（建設省土木研究所）－

日本における I V H S 関係の研究の経緯及び内容について説明を行う。

日本における I V H S には、建設省、通産省、郵政省、運輸省、警察庁の 5 省庁が関連している。建設省は A R T S を、通産省は S S V S を、運輸省は A S V を、警察庁は U T M S を、郵政省は建設省や警察庁と共に V I C S を進めている。

5 省庁が別々のプロジェクトを推進すると弊害が出るため、統一した組織を作ることが望ましい。そのため、民間企業と学会とが中心となって、5 省庁が支援するという形で、V E R T I S という組織を形成した。この組織は、第 1 回 I T S 世界会議（パリ開催）の日本代表であり、第 2 回 I T S 世界会議（横浜開催）を主催する。

V I C S は、道路交通データを種々のメディアにより車両に提供するシステムであり、1996 年 6 月の供用開始を目指している。提供メディアとして、電波ビーコン（建設省）、光ビーコン（警察庁）、FM 多重放送（郵政省）がある。現在、全車両の 1 % にあたる 60 万台がデジタル道路地図を使用したナビゲーションシステムを利用している。A R T S 及び S S V S については、追突防止について一緒に進めようとしている。自動料金収受システムについては、民間との共同研究を進める予定で、現在民間企業参加のための公募手続きを行っている。

予算については、5 省庁の中で建設省が A R T S 関係で 1 億円の予算を所持している。なお、民間企業との共同研究も行っているなのでその額を含めるとかなりの数字になる。他省庁関係については、民間企業がその指導による開発を進めているため、研究開発に関する費用は不明である。

質疑応答

Q：自動料金収受システムに関して、いかなる企業も入札に参加できるのか。

A：日本政府が入札の基準を作成することになる。自動料金収受システムとして、おそらく色々なシステムが出てくるであろうが、唯一のシステムに決めようとは思っていない。

Q：日本では、I V H S の研究活動の予算はいくら位なのか。

A：日本では主として建設省だけが I V H S の研究活動に対する予算を持っており、土木研究所道路研究室に 1 億円の予算がある。研究内容が多岐にわたるため、民間企業との共同研究が必要とされている。

3.1.2 「米国におけるIVHSの現状」

(アーキテクチャー、自動運転システム、実地テストを含む)」

—John MacGowan (TFHRC, FHWA) —

米国におけるIVHSの研究開発は、IVHSプロジェクト全体の一部である。IVHSの研究開発には、長期的、世界的な専門家との協調、ユーザーニーズに合致、広範囲にわたるプログラム等の特徴がある。

主な研究開発プログラムの分野は、ATMS (先進的交通管理システム)、ATIS (先進的旅行情報システム)、AHS (自動運転システム)、ARTS (先進的地下鉄輸送システム)、APTS (先進的公共輸送システム)、CVO (貨物車操縦)、AVCS (先進的車両衝突システム) がある。

研究開発プログラムの範囲は、主なシステム開発 (交通管理、車内信号、自動運転システム等)、将来可能な研究 (コミュニケーション技術、ヒューマンファクター等)、プログラム支援のための研究等にわたる。

自動運転システムは、米国の車両・道路システムを向上させる次世代システムの基盤を与えることを目標としている。本システムのメリットとして、安全性の向上、交通容量の増大、大気汚染の低減、快適性の向上、天候に対する順応性、利便性の向上等があげられる。本システムは、ユーザーにとって望ましいもの、自動運転にならない道路との整合性、高い信頼性、乗用車、バス、トラックにとっての利用し易さ、他の交通機関との整合性等を主たる目標に置いている。

プログラムには以下のフェイズが設定されている。

①事前解析フェイズ

②システム解析フェイズ

③稼働/評価フェイズ

IVHSアーキテクチャーとは、IVHSアメリカ (現ITSアメリカ) と連邦DOTが、IVHSについて、米国内の互換性、ユーザーサービスの統合、規格標準化、公開性等のフレームワークを設定するものである。これまでに、独立した4つのチームが4つのコンセプトの下でシステム案を作成してきた。現在第一フェイズが終了し、1995年1月より第二フェイズが始まる予定である。

さらに、米国におけるIVHSの実地テスト箇所の紹介を行った。

質疑応答

なし

3.2 セッション1 プレゼンテーション

3.2.1 「日本におけるナビゲーションシステムの現状」

－野口好一（ITSアメリカ）－

米国と日本における道路と交通の現状を比較した後、ラジオ通信による交通情報サービス、道路混雑情報表示板、行先案内表示板等、車載ディスプレイ以外の手段による道路交通情報提供の現状について説明を行った。

ナビゲーションシステムについて、現在及び将来の販売台数、現在までの発達経緯について説明を行った。さらに、日本におけるナビゲーションシステムの例を、写真を用いて紹介した。また、ニューエレクトロマルチビジョン機能に関して、ナビゲーション、テレビ、オーディオ制御、エアコンデーション制御、セルラーホーン制御、CD変換器の説明を行った。さらに、ニューナビゲーションシステムに関連して、高品質のルートガイダンス機能、単純な交差点表示、目的地へのルートガイダンス、運転中の再ルート検索等の特徴を説明した。

ナビゲーションに関して、現在位置の計算、現在位置から目的地へのルート計算・表示、運転中のルートガイダンス等の機能、表示形態、マップデータベースについての説明を行った。

質疑応答

Q：都心での利用率は

A：詳細はわからないが、都心での利用率が高いことは確かである。

Q：車載装置はどの会社のもを使用しても良いのか。

A：トヨタ車で最初から装備される機器はソニー、住友等に限られている。（後付けは自由）

Q：利用料金は利用時間別に設定されるのか。

A：現在のところ均一料金である。4月からは利用時間によって設定する。

Q：VICISについて、適用地域を増やすことは考えているのか。

A：現在のところ東京地域だけだが、他の地域についても実施する予定である。

3.2.2 「米国における自動料金収受システムの現状」

—Michael Curtis (TFHRC, FHWA) —

現状のシステムは、近視眼的に作成されており、互換性がない状態にある。

車両から路側へのコミュニケーション技術の発達により、自動料金収受システム、道路維持管理、貨物輸送管理等が可能となっている。

I V H Sに関する基準を作成する場合には、利用者は旧式の技術を使いたがらない、メーカーは一度投資してしまうと長期に使えるものを求める等の点を考慮する必要がある。

基準について F H W A が求める主な分野は下記の通りである。

- 1) 自動料金収受システム (Vehicle to Roadside Communication)
- 2) 周波数
- 3) データの頻度
- 4) 信頼性

車両から道路へ通信するシステムには、短期的に見ると一長一短があり、どのシステムが良いかについての回答を出すことはできない。このため、短期的に、各システムが F H W A の I V H S の中で変更することはない。長期的には I T S アメリカの基準に従うことになるだろうが、そのためにも、ユーザー、メーカー、政府機関等との共同作業が必要となる。I T S アメリカは、自動料金収受システムの基準作りを進めることとなった。

この作業には3つのフェイズがあり、

- ・フェイズ1： システムに対する要望の草案作り
- ・フェイズ2： 草案のレビューとリファイン
- ・フェイズ3： ユーザーの要望最終案の作成

を州交通省、有料道路公社、メーカー等の意見を順次取り入れながら進める。

さらに、自動料金収受システムで用いられる技術であるタグとリーダーについて説明を行った。

質疑応答

Q：発表では車載装置に重点が置かれているようだが、インフラサイドではどうなっているのか。

A：このプロジェクトは現在進行中のものであり、政策になったものではない。F H W A 以外のグループがインフラサイドで検討を行う可能性はある。

Q：自由市場が決定するという原則について

A：米国では、政府が先導することは嫌われる。民間の市場原理に基づくことが好まれる。

Q：タグの正確さはどの位か。

A：99.995%である。但し、これは政策的に決められた数字である

Q：料金はどのようにして支払うのか。

A：例えば、V I S A カードによって口座から料金を引き出す方法を考えている。

Q：コストの分担はどのようにして行うのか。

A：インフラのコストは事業者が、車載装置のタグについてはユーザーが分担することになる。初期投資はかかるが、リーダーにより料金徴収の人件費は削減できる。

3.3 セッション2 プレゼンテーション

3.3.1 「VICSプロジェクトの現状」

ー今長信浩（建設省土木研究所）ー

ー柴田 潤（住友電気工業）ー

VICSの目的、現状、利益と費用について説明を行った。

VICSの目的については、VICSの背景、日本の交通現況のトレンド、VICSの目標、情報システムの改善、VICS実現化の方策及びVICS推進委員会の歴史（委員会の設立、目的、推進策、組織）について説明を行った。

VICSの現状については、VICSの一般概念、VICSの実用化に関する重要点、情報表示イメージ、VICSメディア方式、VICS公開実験及び実験システムの概要について説明が行われた。

VICSの利益と費用については、利益、費用及び将来計画（今後10年間）について説明を行った。

質疑応答

Q：便益／費用は10なのか。

A：その通りである。情報は道路情報センターに一元的に収集され、費用は参加企業で分割されて最小化する。関係200社がこのシステムの導入に賛成している。

Q：光ビーコンの媒体として何を使用しているのか。

A：赤外線を使用している。

3.3.2 「米国における地方部 I V H S の現状」

—Mohsen Zarean (JHK & Associates, Inc.) —

膨大な延長を有する地方部の道路において、既存施設のみで交通情報提供等の交通管理を行うことは難しい。A T I Sを個々の車に搭載することで、旅行時間情報提供等のサービスを供給できるようになり、地方における自動車交通の利便性が向上する。地方部 A T I S プロジェクトは、地方における A T I S 開発方策の検討を目的とするものである。

実施主体は F H W A、予算は 1,373,501米ドルである。米国における地方部の特徴としては、人口が全体の25%、道路延長が全体の80%、自動車走行台キロが全体の40%、交通事故が全体の30%となっている。

道路交通面から見ると、追越しができない、野生生物が多いために動物との事故が増大している、工事による遅れが生じる、天候の影響を受けやすい、商業用トラックの占める割合が高い、距離があるため緊急活動に多くの時間を要する等の特徴がある。また、地方部における道路の全長 3,116,555 マイルの内50%が舗装道路となっている。

情報に対するニーズは利用主体によって異なる。地元住民や通勤等通過交通者については、事前の行程策定のための情報、運転中の情報、事故発生時の情報が必要となる。トラック、バス等については、安全性に関わる情報、迂回交通情報や迂回道路の制限内容（高さ、重量等）、前後のトラックからの情報が必要となる。提供者（トラベル情報提供者等）については、リアルタイムな事故情報、リアルタイムで正確な情報、緊急時、安全対策に関する情報、情報多寡とまらない配慮、旅行者に便利な情報が必要となる。カウンティについては、安全・メンテナンスに関する情報が必要となる。

技術面での課題として、道路の面的整備よりも車載機器の整備が重要となる。さらに、コミュニケーション技術の開発と共に既存技術の活用が必要となる。また、実行にあたっては、官民が協力して行っていく必要がある。

その他、システム、今後の発展可能性について説明を行った。

質疑応答

Q：費用面での検討は行っているのか。

A：市場調査も費用計算も行っていない。

Q：環境センサーとは何か。

A：霧、路面状況、温度、湿度である。

Q：このプロジェクトは州間道路を含んでいるのか。

A：含んでいる。

3.4 セッション3 プレゼンテーション

3.4.1 「車間側方コントロールシステムに関する実験」

－山田 豊（沖電気工業）－

車間側方コントロールシステムに関する実験計画の説明を行った。

実験システムの概要が説明された後、建設省土木研究所内に設置予定の車間側方コントロール実験施設について説明を行った。車間側方コントロールシステムの実験は3段階に分離される。すなわち、①情報提供・警告レベル、②運転支援レベル、③自動運転レベル、の3つである。現在のレベルは、①の情報提供・警告レベルの段階であり、この段階に関する実験を実施することを計画している。

さらに、実験で用いられるデータ形式、通信フォーマットについての説明も行った。

質疑応答

Q：LCXとは何か。使用する周波数はどの位か。

A：LCXは「Leakage Coaxial cable（漏洩同軸ケーブル）」の略である。使用する周波数は、2.6GHzである。

Q：500m区間内の車両の方向認識をどのようにして行うのか。

A：車載センサーで判定した車両位置情報と「エアフォーマット」の情報を用いて車両の方向認識を行う。

3.4.2 「TravTekの最終評価結果」

—Joseph Peters (Science Applications International Corporation) —

米国におけるITS関係のプロジェクトで開発中のTravTek(TRAvel TECHnology)と言われる双方向通信システムの紹介。これは日本のナビゲーションシステムにリアルタイムの交通情報による最適経路案内や買い物、食事等の店先案内等の機能を加えた高機能ナビゲーションシステムである。

トラブテックに参加した研究団体は、AAA、DOT、GM、オーランド市、フロリダDOTである。ナビゲーションシステムの基本的な機能として、ルートプランニング、地図表示、ターンバイターンガイダンスがあるが、これにリアルタイムな交通情報、都市情報、リアルタイムな再ルート検索の機能を付加したものである。評価実験は、100台の車両、4000人の被験者を対象に実施された。

1) トラブテックは機能したか。

市内の道路等では使用が困難であったが、高速道路では機能した。また、情報が正確で信頼度が高いとの評価であった。

2) 効率は上がったか。

45%の時間節約効果、20%のルート短縮効果があった、地元利用者の評判も良く、ビジネスにも活用でき、売り上げが40%伸びた。ナビゲーションタイムについては、交通情報等を付加したナビゲーションを利用した者が渋滞を早く回避できるという結果が得られた。

3) 便利だったか。

役に立ち使いやすかった。ナビゲーションについては運転の40%で使用した。交通情報等を付加したナビゲーションについては運転の80%で使用した。

4) ボイスアナウンス(音声誘導)は有効か。

過去に自動車業界はシートベルト等のボイスガイドに失敗しているが、トラブテックに関してはボイスアナウンスは有効だった。ボイスアナウンスは画面視認時間を減少させる効果があった。

5) 安全だったか。

危険であるという結果はアンケートからも事故データからも得られなかった。唯一3個の事故は、私道内、横から追突されたもの、バスとの接触であった。ドライブの負担が軽くなり安全につながると共に、ニアミスが少なくなった。ネットワーク効果により、渋滞回避による安全性の向上と共に時間短縮による事故遭遇率の低減が得られた。また、ボイスアナウンスが安全性を高めた。

6) 非搭載車へのメリットはあったか

トラブテック使用による渋滞削減効果が、円滑な交通の確保、ひいては燃料節約、環境保全効果につながった。

7) 買うかどうか

1000米ドルまでであれば購入、28米ドル/月であれば借り入れるという結果であった。情報ニーズの優先度は、ルートナビゲーション、リアルタイム情報、レストラン等の順であった。

質疑応答

Q：シカゴにおいて実施される次の実験に向けた改良点は。

A：旅行者だけでなく、ビジネスマン、通勤者にも広げ、台数も拡大することである。

Q：コスト（整備、維持管理）の検討はしたのか。

A：今回は機能の検討が目的でありコストは度外視した。ただし、端末についてはGMがオーディオ機器の高級品程度の値段でいけると言っている。

Q：旅行者を対象とした理由は何か。

A：地理に不案内であること、距離利用すること、一度にたくさんの車両に端末をつけることが可能かつ維持管理がしやすいこと。（この100台はAVISレンタカーの協力を得て搭載した）

参考文献

J.I. Peters and F.J. Mammano ;

"Results of the TRAVTEK System Evaluation"

Proceedings of the 1st World Congress on Applications of Transport Telematics
and Intelligent Vehicle-Highway Systems, pp.839-846

3.5 セッション4 プレゼンテーション

3.5.1 「道路走行模擬装置を用いた場合の車載ディスプレイが運転に及ぼす影響」

－木嶋 健（建設省土木研究所）－

本研究の研究目的及び研究方法の説明を最初に行った。

本実験で用いた土木研究所所有の道路走行模擬装置の説明後、首都高速3号線を対象に、車載ディスプレイを視認した時の車両追従走行シミュレーション実験の概要を説明した。本実験においては、首都高速3号線で前車に追従しながら、車載ディスプレイに表示された情報を視認する場合に、運転挙動や車両挙動がどのように変化するかを計測した。また、画像の他に文字情報を視認させ、両者の実験結果を比較することにより、画像の定量的な表現方法を提案した。

本実験では、道路走行模擬装置の適用性について言及していなかったため、将来的に実車実験と道路走行模擬装置の比較によって、道路走行模擬装置の適用性を検討する必要がある旨説明を行った。

質疑応答

Q：不安定な挙動の測定は交通安全と関係があるのか。

A：その通りである。

Q：不安定な挙動と交通事故との関係を実際に測定したことがあるのか。

A：測定をしたことはない。

3.5.2 「『空間認識力と車内ナビゲーションシステム』に関する研究結果」

—Kathryn Wochinger (TFHRC, FHWA) —

米国では、高齢化に対応した高齢者の快適な走行を支援するためには、ナビゲーションシステムの普及が考えられている。本発表では、簡単な道路走行模擬装置を用いて、どのようなナビゲーションエイドが走行を支援するのかを評価した実験が説明された。

ナビゲーションエイドとして、紙地図、文字（ディスプレイ）、記号（ディスプレイ）を用いた。被験者は56人であり、65歳～75歳の層と30歳～45歳の層、男女別に分類した。本実験では、反応時間と正確性をナビゲーションエイドの種類を変化させた場合に計測したものである。

解析結果は以下の通り。男性と女性の間での変化は殆ど現れない。加齢と反応時間の間には関係がある。全てのナビゲーションエイドに対して、空間認識力・感知スピードと反応時間・正確性の間に関係が見られた。文字やターンバイターンによる説明用紙を用いた場合に、言語能力と反応時間・正確性の間にも関係が見られた。

ナビゲーションエイドは空間認識力が欠如している高齢者に必要とされるものである。従って、ナビゲーションエイドとして、空間認識力を求めないターンバイターンを使用することが望ましい。

質疑応答

Q：どの位の時間、被験者は道路走行模擬装置上を走行するのか。

A：約5分間である。

Q：実験はあらゆる道路網に対して行われたのか。

A：1ケースについて行ったのみである。

Q：モニターにおいて地図を見やすくする方法を採用したのか（例えば、進行方向を真上にする）。

A：実験では拡大された地図のみをモニター上に表示している。

Q：現在位置を表示することは重要であると思われる。ボイスアナウンスによってルートガイダンスを行うことが効果的と思われる。

A：実験では実施していない。

Q：日本ではどのようなナビゲーションシステムが売られているのか。

A：走行ルートは、走行中の地図表示によって行われる。交差点の近くでは、ボイスアナウンスや矢印によって案内される。

4. スタディ・ツアー

4.1 カリフォルニア P A T H プログラム (写真-1、2)

日本のメンバーは、11月11日にカリフォルニア大学バークレー校を訪問した。バークレー校のリッチモンド実験場において、自動車両制御システム (A V C S) の公開実験が行われた。自動車両制御システムはカリフォルニア P A T H プログラムの1つであり、自動車に車間制御機能と車線制御機能とを持たせて追従車群走行を行わせるものである。これは、運転負荷の軽減、交通容量の増大、車両空気抵抗の低減を目指している。自動車両制御システムには2つの技術要素を用いられている。1つは車間制御技術である。車間制御については、車両前方に設置している超音波発信板より超音波を発信させることにより行う。2つめの技術要素は、舗装の中に磁気ネールを埋め込んで車線制御を行うやり方である。磁気ネールと車両にとりつけられた磁気センサーにより車両の横方向の挙動を制御するものである。ここでの自動車両制御システムは1997年に実施される予定となっている。

4.2 ターナーフェアバンク道路研究所 (写真-3、4、5、6)

日本のメンバーは、11月15日にターナーフェアバンク道路研究所を訪問した。4つの実験施設と1つのデモンストレーションを見学した。衝突実験施設、電子技術実験施設、照明実験施設、道路走行模擬装置、トラブテックの公開実験である。

a) 衝突実験施設

この施設は防護柵のような道路付属施設の強度を調査するためのものである。重量のある振り子を時速30マイルのスピードで防護柵に衝突させる。防護柵の強度は衝突後の状況を調査することにより認識できる。

b) 電子技術実験施設

G P S によるナビゲーションシステムを搭載した車両が製作されていた。実験車に搭載されたナビゲーションシステムは、デジタル地図が研究段階のものであった。

c) 照明実験施設

この施設は、種々の光源に対する道路付属施設の見え方を調査するものである。実験には、種々の色の光源が使用される。どのような色の光源を用いると、運転者にとって道路付属施設が見易いのかを調査する。種々の色の照明による物の見えやすさについて、模型によるデモ実験が行われた。

d) 道路走行模擬装置

道路走行模擬装置が実験施設に設置されている。これは、モーション装置が付設されていない点等、建設省土木研究所の道路走行模擬装置とほぼ同程度のものである。自動車交通事故や種々のナビゲーションエイドに対するヒューマンファクターに関して、評価実験が行われている。

e) トラブテック公開実験

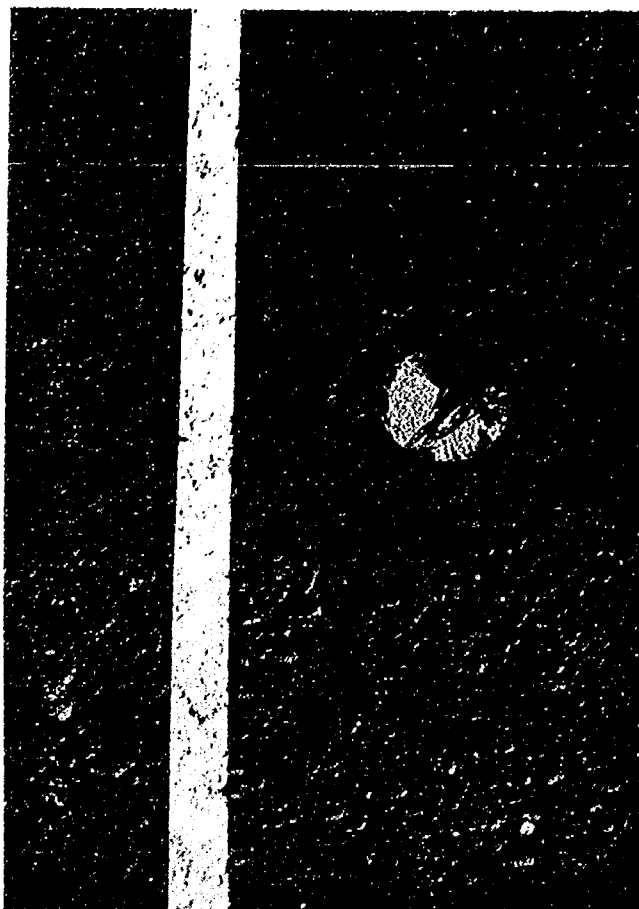
パソコン画面上でトラブテックの公開実験が行われた。



写真－１（a） 車両前面の超音波送受信装置



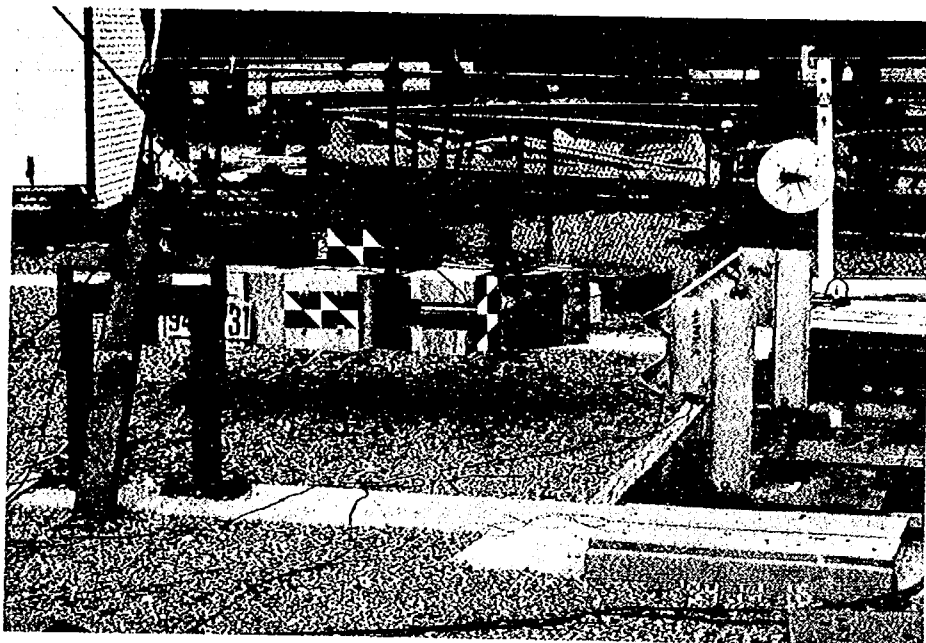
写真－１（b） 車両前面の超音波送受信装置



写真－２（a） 舗装に埋め込まれた磁気ネイル



写真－２（b） 車両に取り付けられた磁気ネイルセンサー



写真－3 衝突実験施設



写真－4 照明実験施設



写真－５ 道路走行シミュレータ



写真－６ トラブテックのデモ実験

おわりに

次世代道路交通分野のリーディングカントリーである米国では、カリフォルニア大学バークレー校のような大学においても I V H S の研究が相当に進んでいる。産業界、官界、学界がそれぞれの役割を果たしながら、I V H S プロジェクトを推進している。二日間にわたるプレゼンテーションでは、日米の I V H S の現状、個々のシステムの研究開発の動向が示された。このようなシステム開発では、高度な情報通信技術がベースとなっており、土木技術、交通技術の他に、車両技術、電気通信技術の協力が必要である。

このような中で、第 2 回日米 I V H S 合同分科会が開催されたことは、次世代道路交通技術に関する理解を深める上で非常に有意義であった。今後、I V H S に関する理解が深められ、道路交通の革新的発展が行われることを祈念するものである。

別 添 資 料

- Status of IVHS in Japan
- Status of IVHS in the U.S. including Architecture, Automated Highway System, and Operational Field Tests
- Status of Navigation Systems in Japan
- Status of Electric Toll and Traffic Management Systems (ETTM) in the U.S.
- Status of VICS Project
- Status of Rural IVHS in the U.S.
- Experience on the Headway and Lateral Control System
- Effect of In-Vehicle Information Display on Driving by the Highway Driving Simulator

Status of IVHS in Japan

Overview: The Status of IVHS in Japan

Makoto Nakamura

Public Works Research Institute
of the Ministry of Construction,
Chief of Traffic Engineering
Division

1. Introduction

The ITS development efforts in Japan are led by five government administrative organizations, the Ministry of Construction (MOC), the Ministry of International Trade and Industry (MITI), THE Ministry of Posts and Telecommunications (MPT), The Ministry of Transport (MOT) and the National Police Agency (NPA). Each of these five organizations is headed by the Parliament Cabinet Minister who participate the Cabinet meetings regularly. There are 20 Parliament ministers excluding the Prime Minister, this means a large portion of Government organizations are engaged in the ITS developments.

2. Japanese Projects

The major projects currently being developed by Government Administrative Organizations are: the ARTS led by MOC playing a major role as the Roadway Administrator, the SSVS led by MITI stimulating the machine industry development, MOT is involved in the ASV to establish the vehicle's type standards and the safety standards, NPA promotes the development of the UTMS in terms of the public security and the traffic accident prevention. MPT, playing a leading role in radio wave control and broadcasting administration, promotes the VICS in cooperation with MOC and NPA.

However, the way in which each Government Administrative Organization separately takes an initiative and promotes each project independently sometimes causes an inconvenience to each other. The idea of setting up an integrated organization was forged unanimously to eliminate such inconvenience and adverse effects, enabling them to work smoothly toward the opening of the planned ITS World Congress.

3. VERTIS

Under these circumstances, the organization, referred to as VERTIS was established in January,

1994 with the participation of academia and industries, and backed up by the five related government administrative organizations.

The VERTIS will represent Japan at the first World Congress in Paris of this year and will take a major role in the following 2nd ITS World Congress in November, to take place in 1995 in Yokohama.

Shoichiro Toyota, Chairman of Toyota Motor Corporation presides over the VERTIS.

4. VICS

A brief synopsis of the cooperation among the projects and the relations between government administrative organizations is presented here. The VICS, is the project developed by MOC, NPA and MPT. The Ministry of Construction and the National Police Agency will cooperate with each other to gather the traffic data into the VICS Center which will be established later but they distribute traffic information from this data source using different information media. The user can receive the information from the radio wave beacons installed by MOC and from optical beacons installed by NPA. The information through FM multiplex broadcasting is distributed by the FM multiples radio station conducted by MPT.

Because the MOC and NPA promote the beacon system, this causes confusions on the user side. The organizations have made an agreement that NPA installs the optical beacons to provide their information along the ordinary road and the radio wave beacons are installed by MOC on the expressway and the ordinary road where NPA will not install.

The coordinations are arranged between related organizations toward embarking the fullfledged VICS project in spring, 1996.

In Japan, currently six hundred thousand roving automobiles and trucks, which is equivalent to 1% of the total number of vehicles, are equipped with Navigation Systems with digital road map. When the VICS system is introduced, it will enables them to receive not only the static information but the dynamic information so that the system will become pervasive.

5. ARTS & SSVS

The ARTS project, which will be presented later in detail is one of the functions provided in interministries cooperative system.

Regarding the joint study on the collision prevention function with the related entities of the SSVS which is led by MITI, regular meetings are held to identify the possible joint working items in this function.

6. Electronic Toll System

The research and development for the Electronic Toll System are the unique efforts which MOC is currently involved in. The toll roadway system was introduced more than 30 years ago in Japan.

Japan Highway Public Corporation now manages a total mileage of 6,000km of toll highways. About five million vehicles utilize these highways in a day and the earnings out of this is one trillion 600 billion yen on an annual basis.

The target total mileage to be achieved is 14,000km, according to national plan.

Metropolitan Expressway Public Corporation's total operational mileage is 230km and about one million 100 thousand vehicles use the highways per day.

The annual earnings out of the toll roadways is 220 billion yen, and the target mileage to be extended is 300km.

Hanshin Expressway Public Corporation manages a total mileage of 200km and expects to enlarge to 250km. The current total earnings on the annual basis is 120 billion yen, obtaining 800 thousand vehicles in a day.

There are some other highways which are managed by Road Corporations under the control of each prefectural and municipal government body.

Total earnings for all the toll road bodies are around 2 trillion yen a year.

Now a day, all toll collection on these roadways are manually conducted but the introduction of Electronic Tolling Collection System is a move towards more practical operation. The system is supposed to provide both users and roadway administrators with the advantages that can eliminate a halt and save manpower.

The research and development for this system is planned to carry out on the public and industry cooperation basis. We are now appealing for the industries to join in this R&D.

On the existing operational roadways of the forementioned Public Corporations, the vehicle classifications and whether the tolling system is based on the mileage or the flat tolling vary with what Public Corporation manages. The concrete system architecture remains to be further studied but the concept for it is to allow the system to enable every roadway administrator to conduct Electronic Tolling via radio wave across the country.

7. Budget

Among the discussed five projects, only the ARTS project is invested 100 million yen for R&D as the National Budget by the Government and also investment is made by the 24 industries,

forming a joint research and development group. The total investment amount is boosted by several million yen. Each total investment amount other than the ARTS is not known, as industries involved in the projects are taking the initiative in the R&D, receiving advice from the government organizations concerned.

8. Postscript

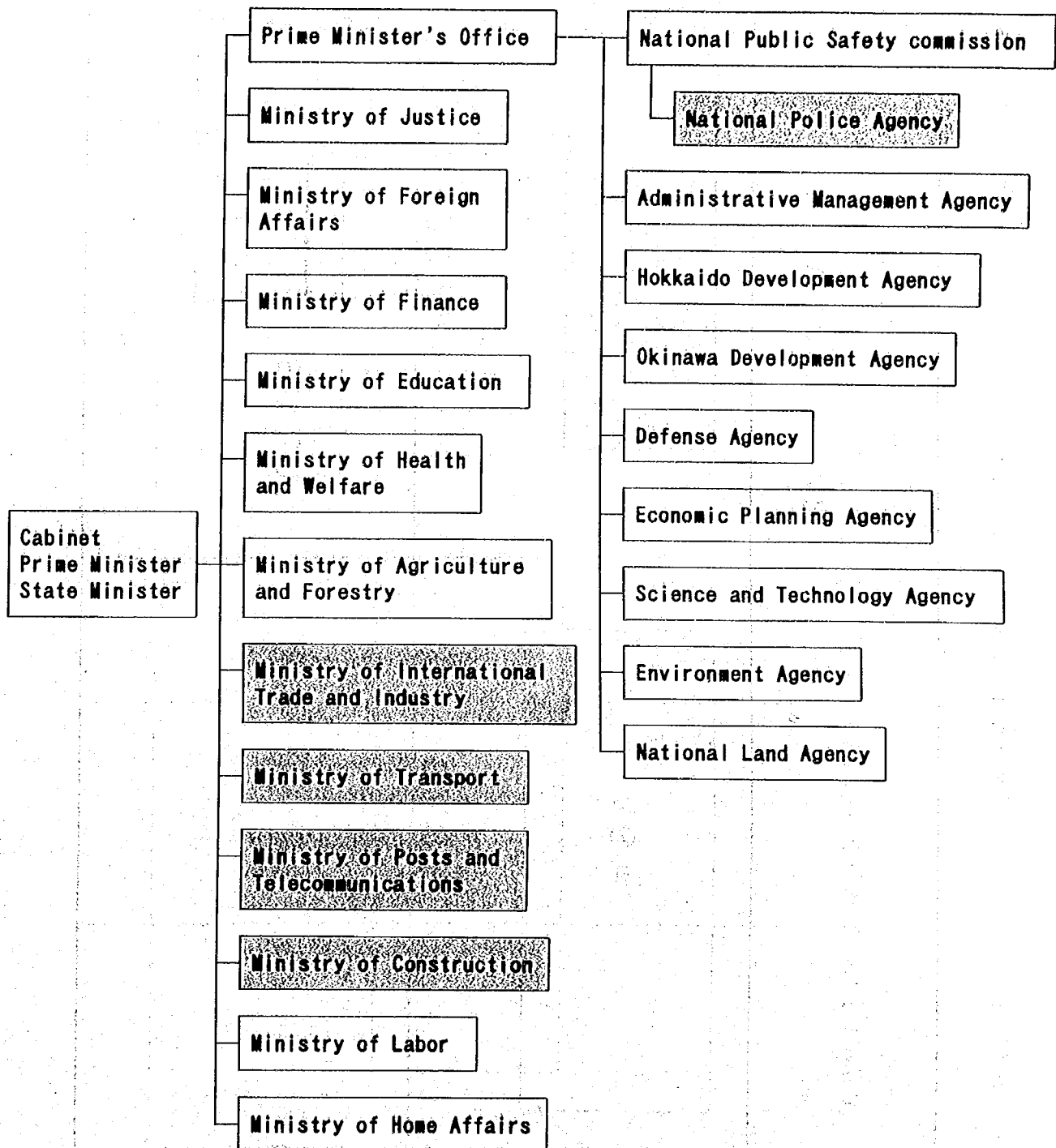
Lastly, I would like to explain Japan's international cooperation in ITS field. We hope to make international contribution and cooperation on every possible occasion. On this principle, we have participated in almost all subcommittees under ISO, TC204, as well as PIARC, OECD and so on through cooperative activities in international conferences. The bilateral cooperation with foreign countries such as the U.S., Canada and Germany is underway in parallel.

I hope my speech has brought you up-to-date on the status quo of ITS in Japan.

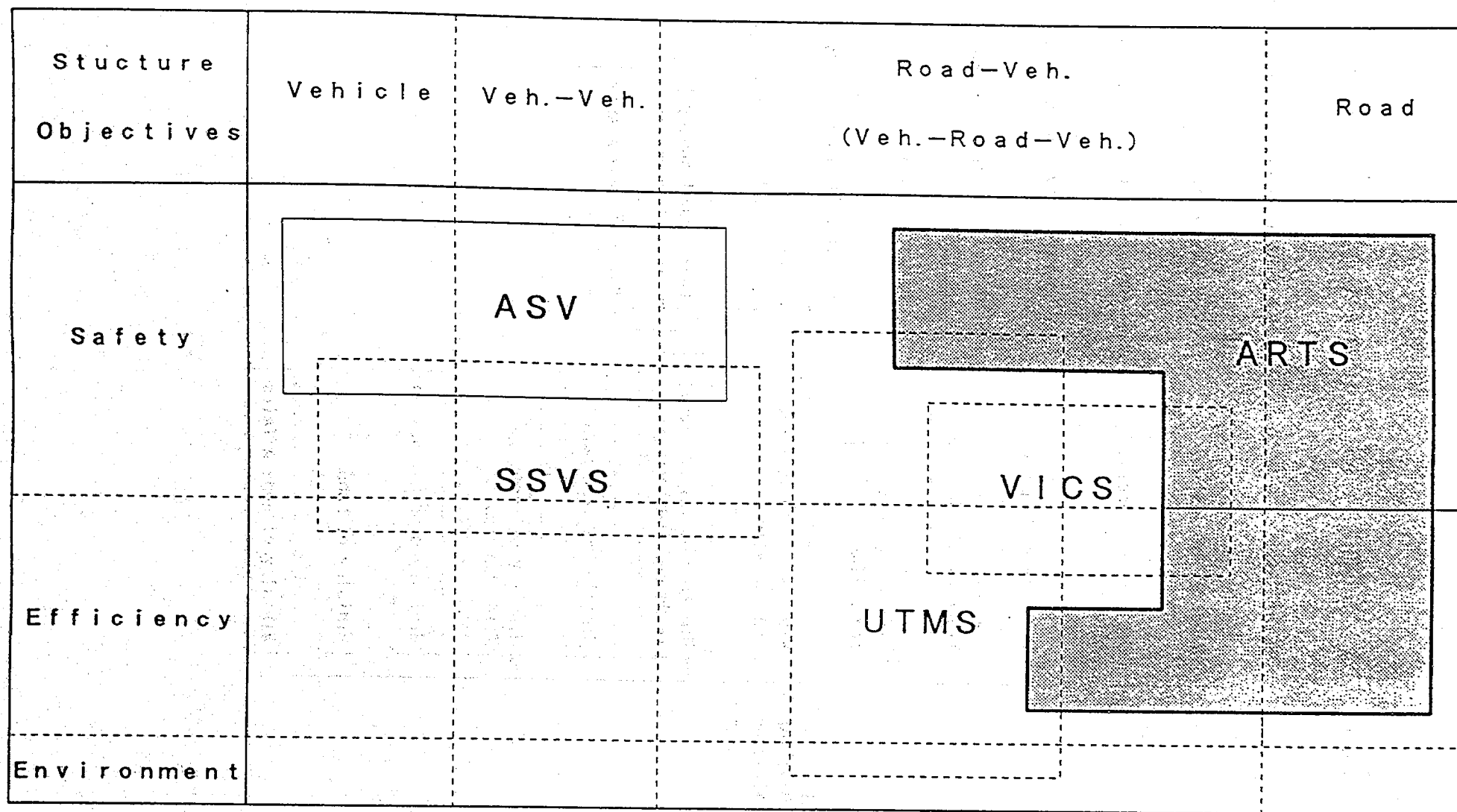
May I conclude by expressing my hope that through international cooperation such as information exchanges, joint study, exchange visitors etc., we can continue to make contributions to the worldwide development of ITS.

Japan will continue the role as a one of the leading countries in the study and development of ITS, now and in the future.

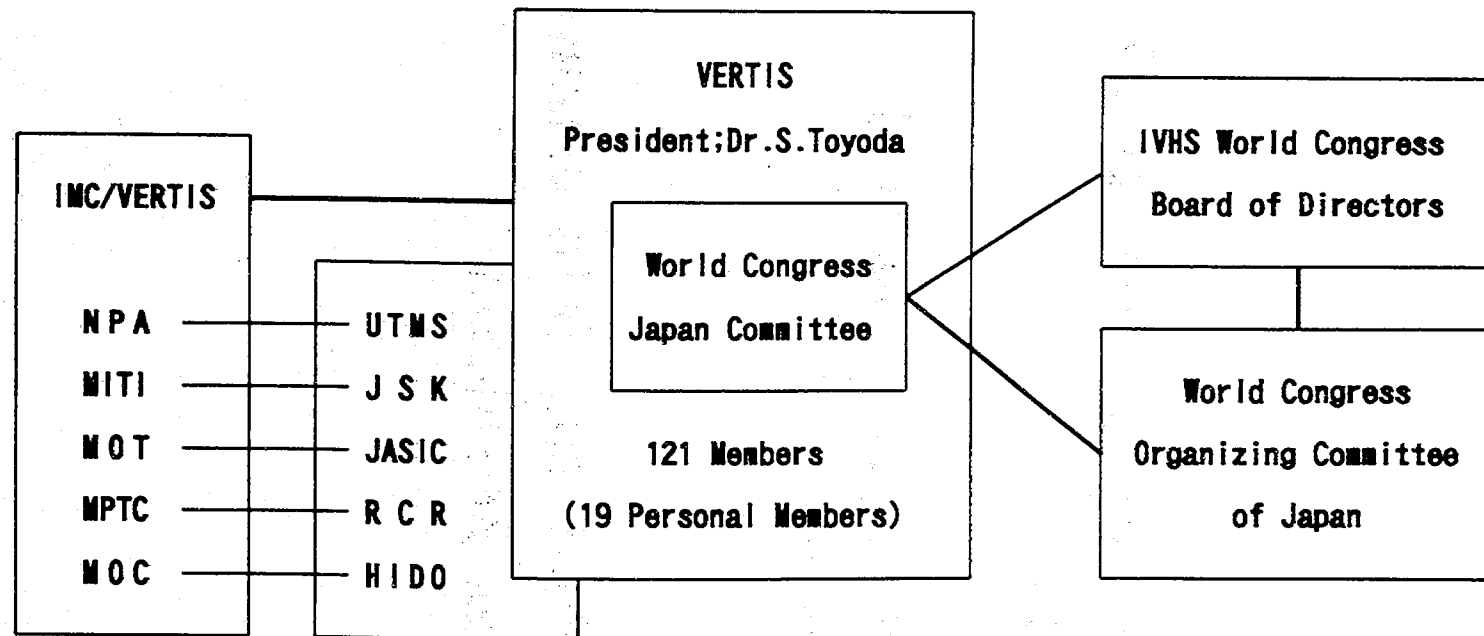
Chart of Administrative Organizations



Classification of IVHS in Japan by system objectives and structure



VERTIS & Other Related Organizations



UTMS; Universal Traffic Management Society of Japan

JSK ; Association of Electronic Technology for Automobile Traffic and Driving

JASIC; Japan Automobile Standards Internationalization Center

RCR ; Research & Development Center for Radio Systems

HIDO; Highway Industry Development Organization

V I C S

**M O C (Ministry of Construction)
Radio Beacon**

**N P A (National Police Agency)
Optical Beacon**

**M P T C
(Ministry of Post and Telecommunications)
FM Multiplex Broadcast**

ETC

Electronic Toll Collection

Schedule (draft)

1st Nov.' 9 4 Start of Application

28th Feb.' 9 5 Dead line of Application

1st Jun.' 9 5 Joint Research start

Date on Japan Highway Public Corporation

Length of road in service (as of Mar.31,1994) (unit:km)	express ways 5574.3 ordinary toll roads 652.8 total 6227.1
Length of road under construction (as of Mar.31,1994) (unit:km)	express ways 2312.7 ordinary toll roads 203.4 total 2516.1
Average daily Traffic volume (as the end of 1993 F.Y) (unit:thousand vehicles)	express ways 3,400 ordinary toll roads 1,788 total 5,188
Average daily toll revenue (at the end of 1993 F.Y) (unit:million yen)	express ways 4,020 ordinary toll roads 460 total 4,480
Number of toll gate (as of Mar.31,1993)	637
Number of traffic lane at toll gate (as of Mar.31,1993)	4144

Date on Metropolitan Expressway Public Corporation
(in Tokyo area)

Length of road in service (as of Mar.31,1994) (unit:km)	231.4
Length of road under construction (as of Mar.31,1994) (unit:km)	94.8
Average daily Traffic volume (as the end of 1993 F.Y) (unit:thousand vehicles)	1,114
Average daily toll revenue (at the end of 1993 F.Y) (unit:million yen)	6,200
Number of toll gate (as of Mar.31,1993)	135
Number of traffic lane at toll gate (as of Mar.31,1993)	328

Date on Hanshin Expressway Public Corporation
(in Osaka area)

Length of road in service (as of Apr.28,1994) (unit:km)	200.0
Length of road under construction (as of Apr.28,1994) (unit:km)	88.2
Average daily Traffic volume (as the end of 1993 F.Y) (unit:thousand vehicles)	830
Average daily toll revenue (at the end of 1993 F.Y) (unit:million yen)	340
Number of toll gate (as of Apr.28,1993)	121
Number of traffic lane at toll gate (as of Apr.28,1993)	297

Status of IVHS in the U.S.

including Architecture, Automated Highway System, and Operational Field Tests

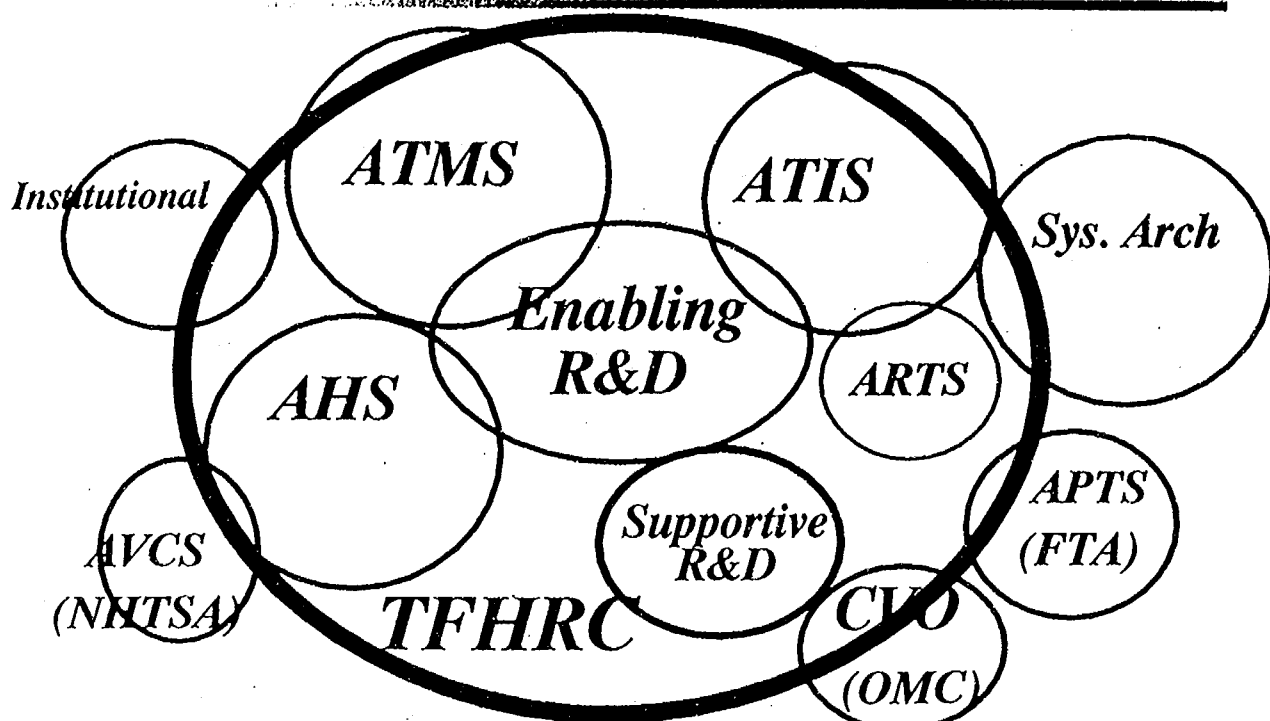
THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF CHEMISTRY
5708 S. UNIVERSITY AVE. CHICAGO, ILL. 60637

The ITS R&D Program at TFHRC...

Overview

- Major R&D: a part of ITS
- Long-term involvement
- World class experts and corporate memory
- Design and perform R&D program for customer needs
- Broad program scope

Major R&D Program Areas



Program Areas

■ Major System Advances

- *Traffic management*
- *In-vehicle signing*
- *AHS*

■ Enabling Research

- *Communications technology*
- *Traffic management lab*
- *Human factors*

■ Mission Supporting Research

- *IDEA's*
- *RCE's*
- *Operational test evaluations*

AHS PROGRAM GOALS:

TO PROVIDE THE BASIS FOR, AND
TRANSITION TO, THE NEXT MAJOR
PERFORMANCE UPGRADE TO U.S
VEHICLE HIGHWAY SYSTEM

POTENTIAL PERFORMANCE GAINS

- ENHANCE SAFETY
- INCREASED CAPACITY
- REDUCED POLLUTION
- IMPROVED TRIP QUALITY & MOBILITY
- INCLEMENT WEATHER OPERATION
- INCREASED USER COMFORT/CONVENIENCE

KEY TARGET SYSTEMS CHARACTERISTICS

AFFORDABILITY

USER DESIRABILITY

CONSISTENT WITH OPERATION OF NON-AHS ROADS

DUAL MODE VEHICLE INSTRUMENTATION

HIGHLY RELIABLE, MODULAR SYSTEM TECHNOLOGY

EVOLVABLE FROM TODAY'S VEHICLE/HIGHWAY
SYSTEMS

USEABLE BY CARS, BUSES, & TRUCKS

FREEWAY-TYPE ROADWAYS

CONVENIENT WITH OTHER TRANSPORTATION
MODES

THREE PHASE AHS PROGRAM:

1. ANALYSIS PHASE -

15 PRECURSOR SYSTEM ANALYSES, \$14M

1 AHS HUMAN FACTOR STUDY \$5M

NHTSA COLLISION AVOIDANCE ANALYSES

2. SYSTEM DEFINITION PHASE -

WILL:

A. ESTABLISH AHS PERFORMANCE OBJECTIVES

B. IDENTIFY/EVALUATE ALTERNATIVE AHS CONCEPTS

C. PROVIDE A DEMONSTRATION IN 1997

D. SELECT A PREFERRED SYSTEM APPROACH

E. DEMONSTRATE/TEST/EVALUATE PREFERRED SYSTEM

F. DOCUMENT PREFERRED AHS SYSTEM

3. OPERATIONAL EVALUATION PHASE -

1 OR MORE PREFERRED AHS SYSTEM

INSTALLATION AT SELECTED U.S. LOCATIONS

*PRECURSOR SYSTEMS ANALYSES
OF
AUTOMATED HIGHWAY SYSTEMS
(AHS)*

NATIONAL AHS CONSORTIUM

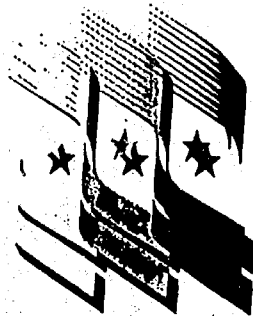
ADVERTISED: DEC. 15, 1993

**PURPOSE: TO FORM A COOPERATIVE
RELATIONSHIP BETWEEN THE U.S. DOT AND
PRIVATE ENTERPRISE, STATES, ACADEMIA,
AND OTHERS TO PROVIDE MANAGEMENT
AND TECHNICAL SKILLS TO CONDUCT THE
SYSTEMS DEFINITION PHASE FOR AHS**

THE AHS CONSORTIUM WILL:

1. PROVIDE LEADERSHIP AND FOCUS
2. REPRESENT THE MAJOR PARTICIPANTS WHO WOULD DESIGN, BUILD, DEPLOY, & OPERATE AN AHS
3. PURSUE THE VISION, GOALS & COOPERATIVE EFFORTS OF THE PROGRAM
4. MANAGE THE NATIONAL EFFORT

IVHS ARCHITECTURE DEVELOPMENT



INTERIM STATUS

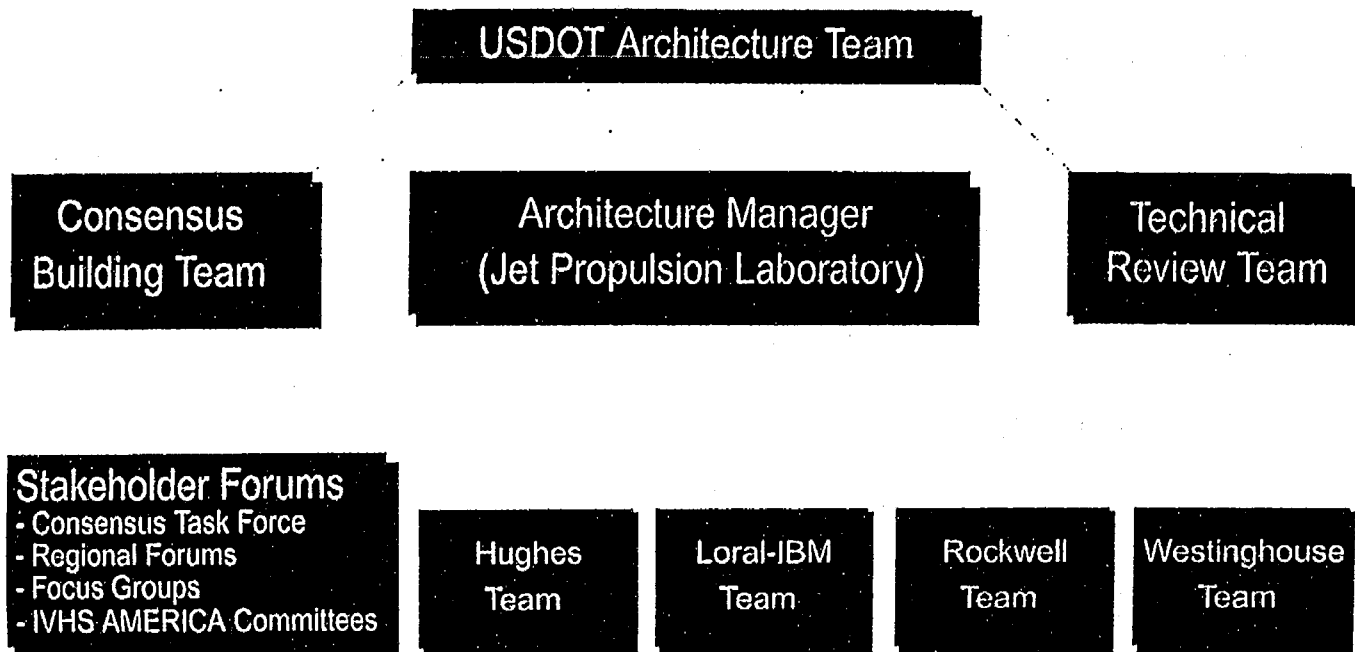
IVHS ARCHITECTURE

- **NATIONAL COMPATIBILITY**
- **SERVICE INTEGRATION**
- **ACCOMMODATIVE**
 - ▶ **SERVICE OPTIONS**
 - ▶ **GROWTH**
 - ▶ **MODERNIZATION**
- **OPEN**

ARCHITECTURE DEVELOPMENT

- **RECOMMENDED BY IVHS AMERICA**
- **MULTIPLE TEAMS, MULTIPLE CONCEPTS**
- **TECHNICAL REVIEW**
- **STAKEHOLDER INVOLVEMENT**
- **34 MONTHS - SEPTEMBER 1993 - JUNE 1996**
- **TWO PHASES**

PROGRAM STRUCTURE



SCHEDULE

PHASE I

INTERIM REVIEW	MARCH 1994
FINAL REVIEW	OCTOBER 1994
DOWN-SELECT	DECEMBER 1994

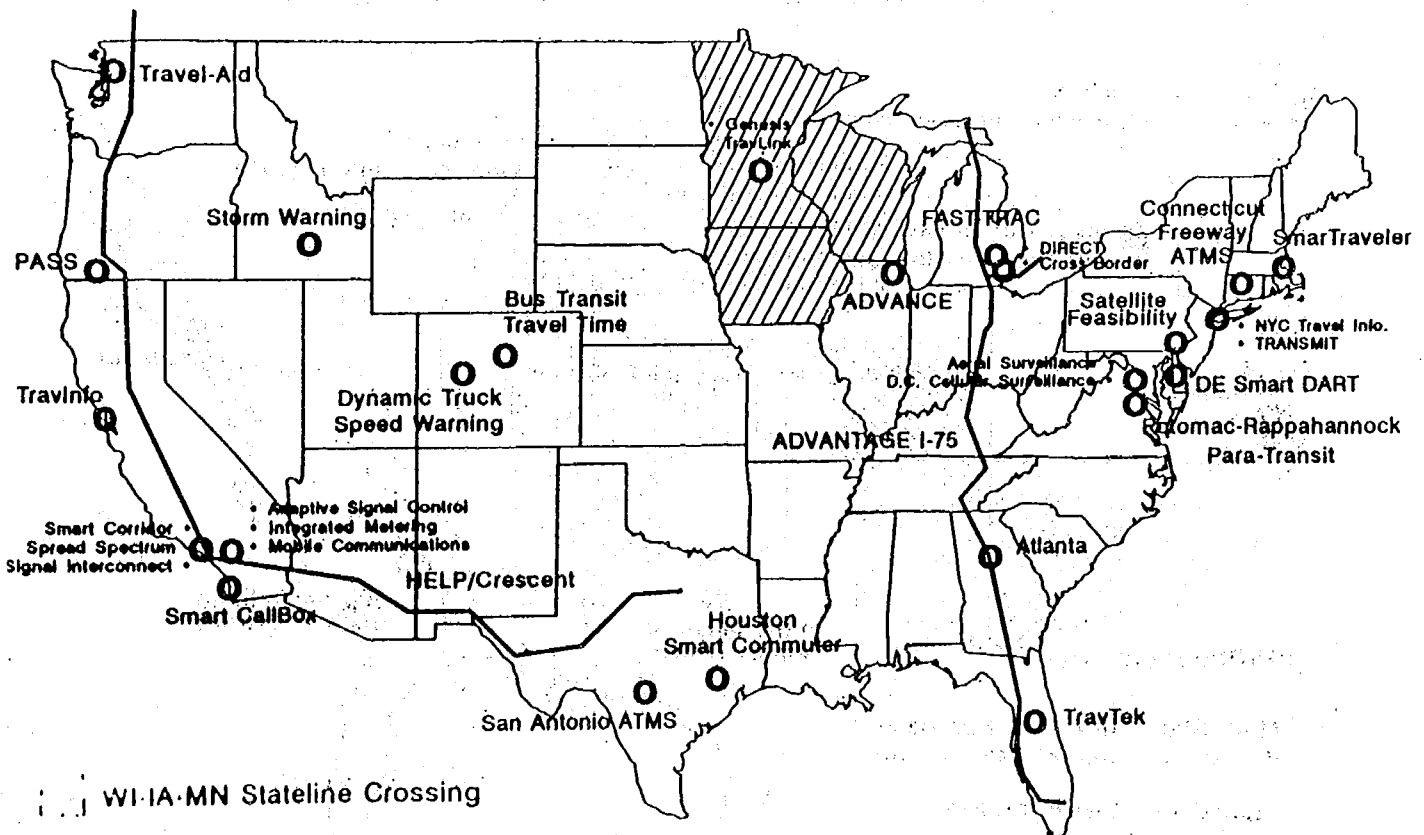
PHASE II

JANUARY 1995-
JUNE 1996

Operational Tests

- **Purpose:**
Demonstrate new technologies, concepts, institutional and/or real-world financial arrangements transportation environment
- **Implementation:**
Public/Private Partnerships
- **Delivery:**
 - Solicitation
 - Corridor Studies

EXISTING IVHS OPERATIONAL TESTS

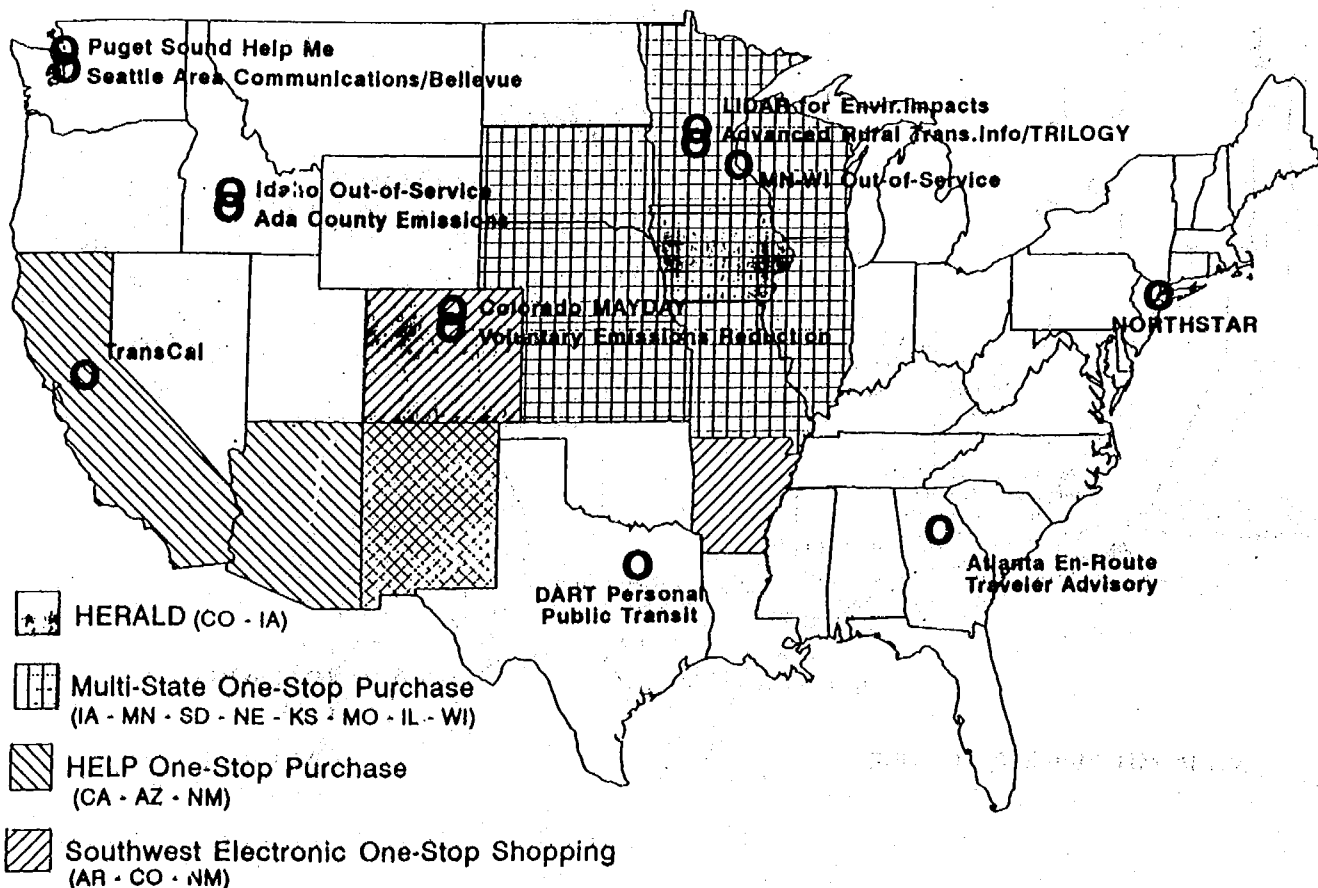


RESPONSE TO SOLICITATION

- 63 Offers Received

- 17 Sites Selected for Operational Tests

1994 IVHS OPERATIONAL TESTS



USER SERVICE AREAS

- ❖ **Commercial Vehicle Administrative Processes, and Automated Roadside Safety Inspection**
- ❖ **Personalized Public Transit**
- ❖ **En-route Traveler Advisory and Traveler Services Information**
- ❖ **Emergency Notification and Personal Security**
- ❖ **Travel Demand Management**

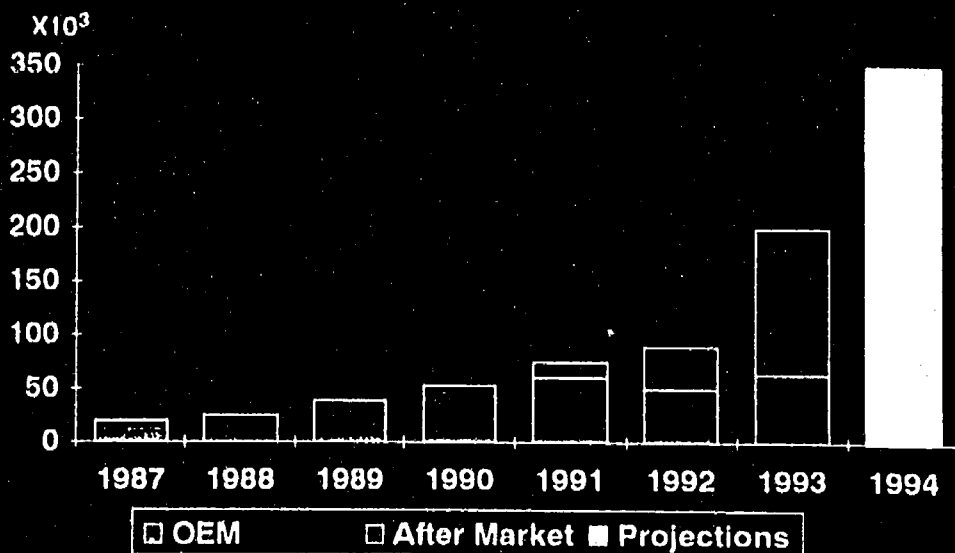
Status of Navigation Systems in Japan

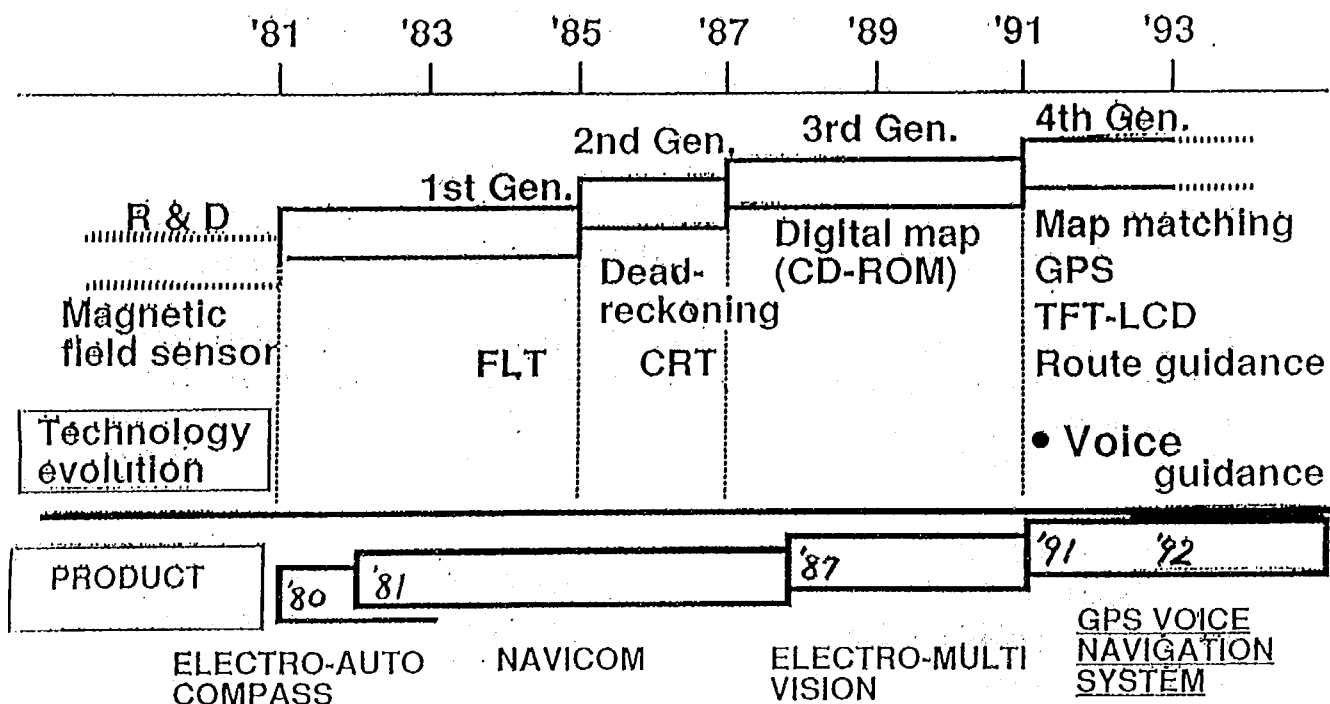
Comparison of Road & Traffic Between US and Japan

	<u>United States</u>	<u>Japan</u>
Population	258,000,000	124,000,000
Land Area (km2)	9,373,000	378,000
Licensed Driver	173,000,000	62,000,000
Registered Vehicles	190,000,000	65,000,000
Expressway (Km)	72,000	6,000
Traffic Fatalities	39,200	10,900
Intersections		
Signalized	250,000	*135,000
Computerized	25,000	* 43,000
Traffic Centers	25	161

as of 1993, * as of 1991

Automobile Navigation System Sold in Japan



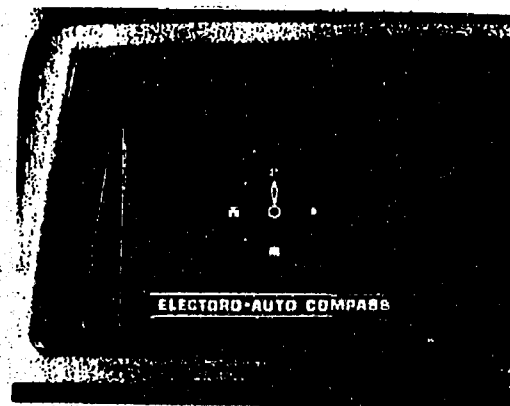
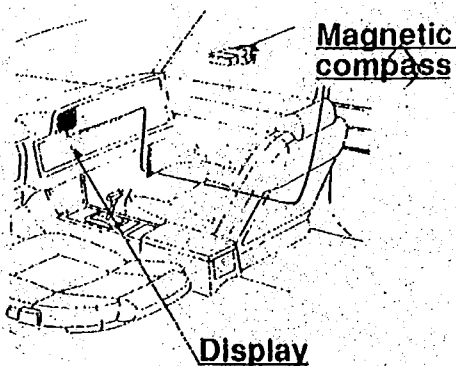


ELECTRO-AUTO COMPASS

1980, Installed in TOYOTA CROWN

FUNCTION

Display of car direction



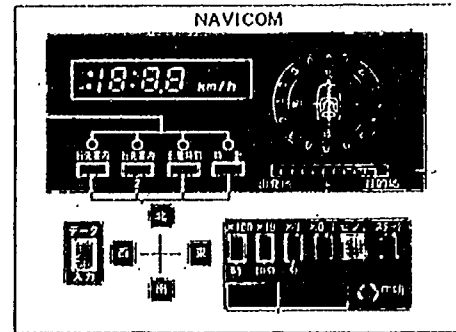
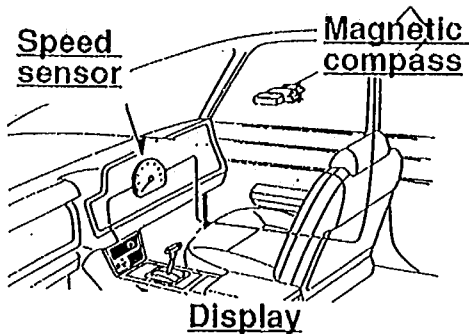
Display

NAVI-COM

1981, Installed in TOYOTA CROWN

FUNCTION

Current car direction
Direction to the destination
Distance to the destination (km,%)
Estimated arrival time

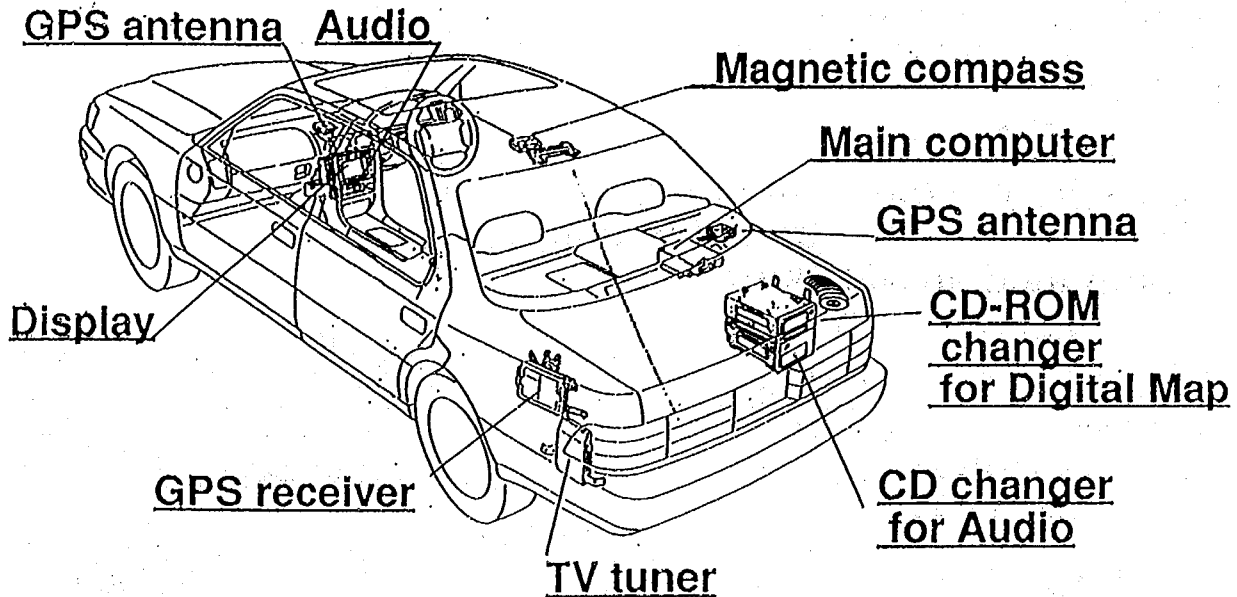


Display

Function of New Electro-Multivision

- 1) Navigation
- 2) Television
- 3) Audio control
- 4) Air-condition control
- 5) Cellular Phone control
- 6) CD-Craft (multi-media soft) Interpreter
- 7) Diagnosis
- 8) Various mode Display, e.g., maintenance

Component Allocation



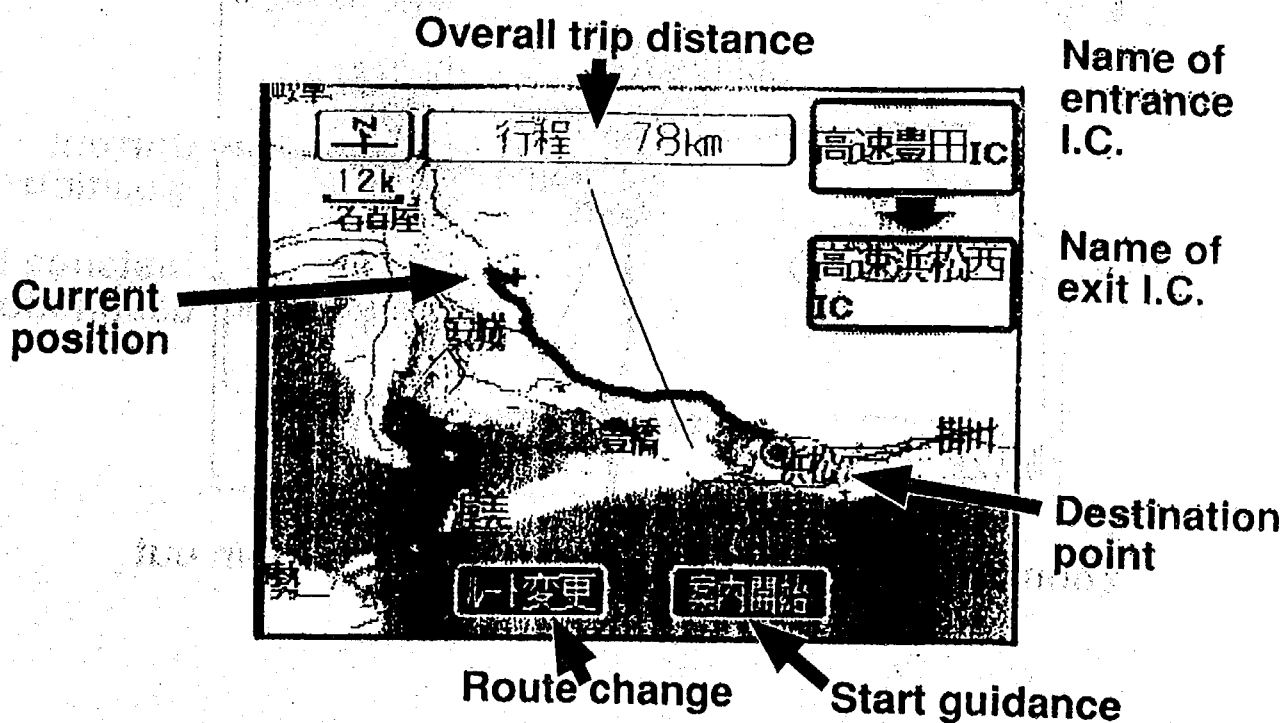
FEATURES of New Navigation System

- 1) Route guidance in high-quality voice, using proper nouns, such as the names of intersections and roads etc.
- 2) Intersection sketches to permit simple identification of intersection and car direction
- 3) Route Guidance to the vicinity of the destination based on phone numbers
- 4) Route re-search via simple one-touch key operation while driving

NAVIGATION FUNCTION

- 1) Calculation of current car location
- 2) Map retrieval and destination setting by phone number and name of the place
- 3) Calculation and display of routes from current location to the destination vicinity
- 4) Route guidance during driving
 - Map display presenting the desired route and current location
 - Displaying intersection diagram
 - Issuing route guidance voice

OVERALL GUIDANCE ROUTE DISPLAY



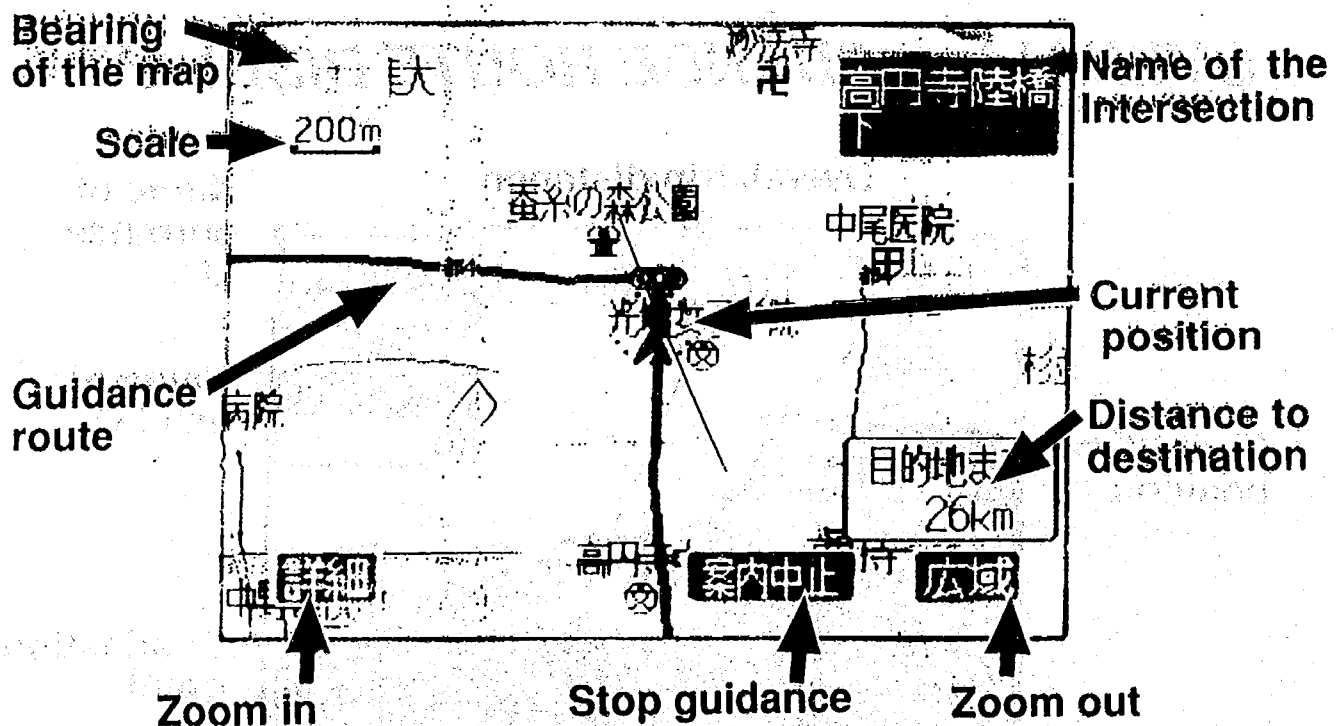
ENTRY OF DESTINATION

Specified by 24 parameters

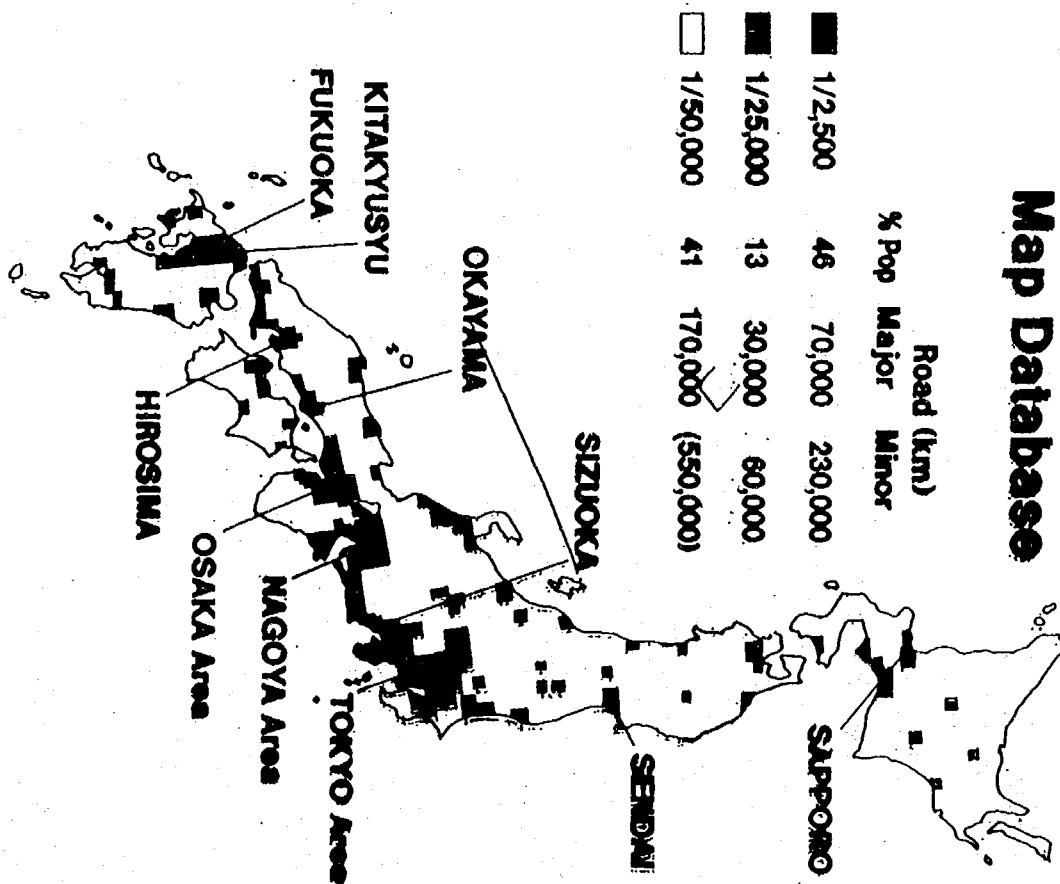
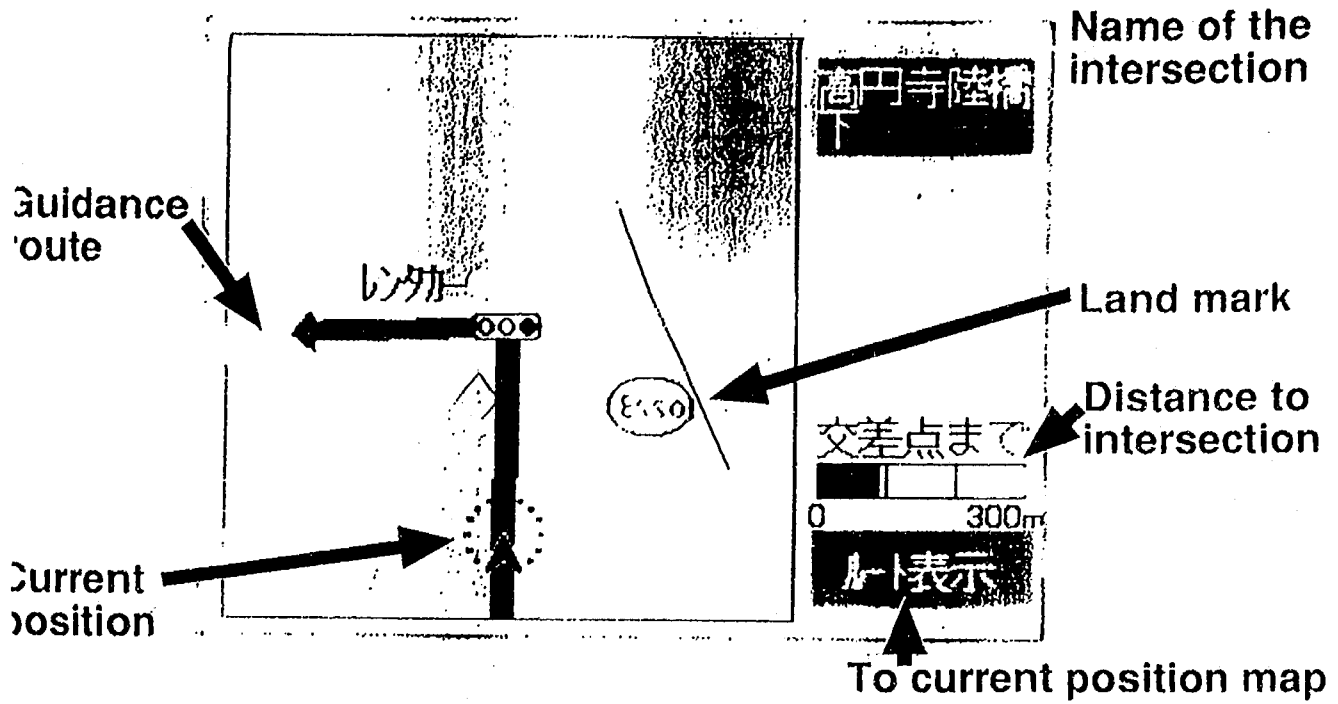
- | | |
|----------------|-------------------|
| ■ Phone Number | ■ Park |
| ■ Address | ■ Police station |
| ■ Interchange | ■ Public office |
| ■ Golf link | ■ Railway station |
| ■ Airport | ■ Hotel |
- etc.

13

CURRENT POSITION MAP



INTERSECTION DIAGRAM



Status of Electric Toll and Traffic Management Systems(ETTM) in the U.S.



MICHAEL CURTIS

Program Manager
Research and Development
FHWA IVHS Division
November 1994

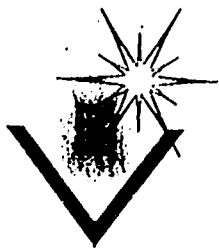
Phone: (703) 285-2991

Fax: 2264



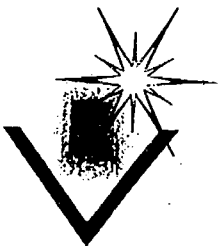
OVERVIEW

- ◆ Impressive
 - ◆ TRAVTEK
 - ◆ Electronic Clearance
- ◆ Short Sighted
 - ◆ Projects supporting only some national goals
- ◆ Patch Work
 - ◆ Mosaic of incompatible systems
 - ◆ I-75
 - ◆ Help



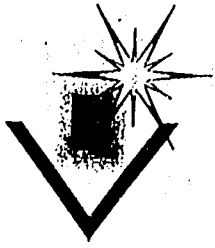
EVOLUTION

- ◆ Vehicle to Roadside Comm (VRC)
 - ◆ ETTM (Electronic Toll&Traffic Mgmt)
 - ◆ Toll
 - ◆ Traffic Management
 - ◆ Electronic Clearance
 - ◆ Vehicle Data
 - ◆ Maintenance
 - ◆ Freight Management



SYNERGY

- ◆ Single Projects are good
 - ◆ Sell IVHS
 - ◆ Advance State-of-the-art
- ◆ Real Benefits come from synergy
 - ◆ Toll with Commercial Vehicle Ops (CVO)
 - ◆ Allows electronic clearance without tag
 - ◆ Traffic info from toll and CVO
 - ◆ Reader installed at key commuter routes



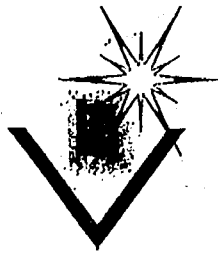
CREATION TO ORGANIZATION

- ◆ IVHS is no longer a concept to be proved
 - ◆ Project from drawing board to roadway
 - ◆ IVHS no longer transportation sector term
 - ◆ Articles in newspapers and magazines common
 - ◆ National political leaders refer to smart highways



Systematic and Orderly Manner

- ◆ Principles to follow
 - ◆ Project requirements supplied by users
 - ◆ User/supplier partnership designs system
 - ◆ FHWA leadership accelerates development
 - ◆ Free market makes final selection



KEY COMPONENTS ARE BEING IDENTIFIED

- ◆ In-Vehicle Systems

- ◆ Information

- ◆ Content

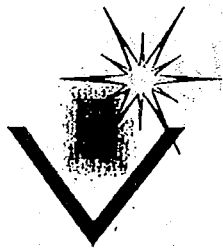
- ◆ Format

- ◆ Communication

- ◆ Wide area (FM subcarrier)

- ◆ Medium area two-way (cellular, PCS)

- ◆ Short range two-way high data (VRC)



STANDARDS ARE REQUIRED

- ◆ Participation by user requires them

- ◆ Users don't want to invest in obsolete technology

- ◆ Those invested resist change

- ◆ Won't accept multiple redundant systems

- ◆ Lights

- ◆ Sounds



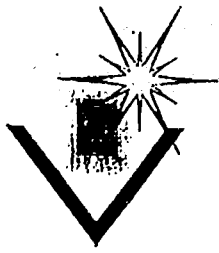
FHWA is pursuing standards in these key areas

- ◆ VRC (ETTM)
 - ◆ Performed analysis
 - ◆ Natl Institute of Standards and Technology - -- NIST
 - ◆ Lawrence Livermore Natl Laboratory - LLNL
 - ◆ Frequency Agility
 - ◆ Data Rate
 - ◆ Mounting
 - ◆ Dependability and Reliability



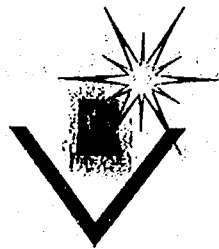
Short Range Vehicle to Roadside Communication (VRC)

- ◆ Evaluated the Leading Alternatives
 - ◆ No Common Tag
 - ◆ Caltrans (Own Spec, Back-Scatter)
 - ◆ Interagency (Mark IV, Active)
 - ◆ FL (IVHS America, Active 2.4GHz)
 - ◆ Dulles (Saab, 2.4GHz)
 - ◆ Illinois (AT COM, 9.6kb)



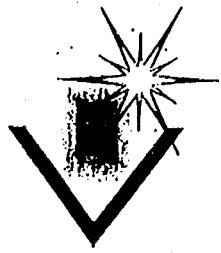
No Clear Winner

- ◆ No Reason to Change Existing Technologies
- ◆ Different Tags are superior in different applications
 - ◆ Backscatter provided frequency agility
 - ◆ Actively powered for wide-area



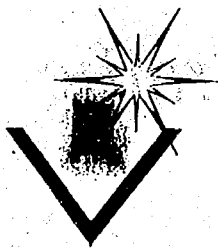
No Clear Winner

- ◆ Toll uses active and backscatter
- ◆ Active Tags are Being Used for CVO Electronic Clearance
 - ◆ Probably Continue for Several Years
 - ◆ No Short-Term Effort to Change in FHWA IVHS
 - ◆ Long Term Solution Being Addressed



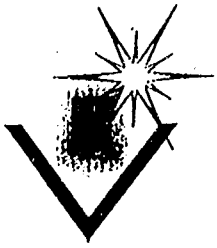
Long Term Solutions

- ◆ Supporting IVHS America Standardization
- ◆ Working with Several Organizations
 - ◆ Users (Toll, CVO)
 - ◆ Standards Organizations (IEEE, SAE, ISO, ASTM)
 - ◆ Vendors
 - ◆ Government Agencies (FCC, NTIA)



Course of Action

- ◆ ITS America selected to develop requirements
 - ◆ Institution designed to support ITS in the United States
 - ◆ Public/Private partnership
 - ◆ International membership
 - ◆ Utilized Federal Advisory Committee to US DOT



ITS America

- ◆ Board of Directors included:
 - ◆ California DOT (Caltrans)
 - ◆ Florida DOT
 - ◆ New Jersey DOT
- ◆ Lack of standards a major deterrent to wide-scale ETTM deployment
- ◆ Prompt development of ETTM standards



Electronic Toll & Traffic Management

- ◆ Strong need for ETTM
- ◆ Early winner
- ◆ Installed on a fairly limited geographic basis
- ◆ Characterized by several different technologies, most proprietary and not interoperable with each other



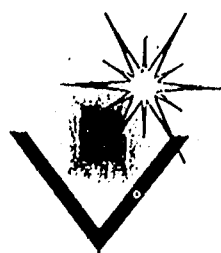
Future National Interoperability

- ◆ Users must jointly define common requirements for next generation technologies
- ◆ Development of ETTM specifications must allow transition period for agencies with existing technology



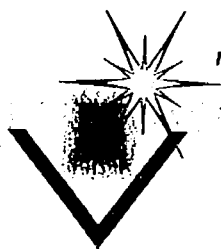
Importance of Interoperability

- ◆ The National ITS Program Plan requires
 - ◆ Initial infrastructure
 - ◆ Support other ITS applications
- ◆ Commercial Vehicle Operations (CVO)
 - ◆ Increased mobility
 - ◆ Reduced downtime



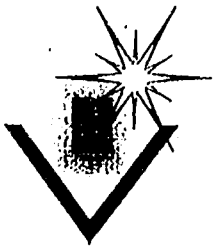
CVO Applications of ETTM Technologies

- ◆ Electronic payment of tolls
- ◆ Electronic credentials and clearance
- ◆ Weigh-in-motion (WIM)
- ◆ Owners monitor and manage fleet
 - ◆ Real-time status and schedule information
 - ◆ Vehicle and container diagnostics



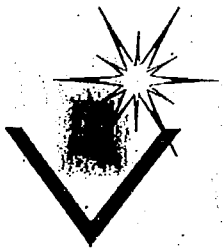
Timely Establishment of User Requirements

- ◆ Allows the market to respond
- ◆ Provides time for developing, testing, and providing next generation technologies
- ◆ Limit proliferation of non-interoperable technologies
- ◆ Will result in a far broader market and economies of scale in manufacturing



Multi-Phase Process

- ◆ Phase I - Core Group
 - ◆ Develop initial requirements draft
- ◆ Phase II - Toll Agencies/DOT's
 - ◆ Review and refine initial draft
- ◆ Phase III - ETTM Industry Commentary
 - ◆ Finalize user requirements



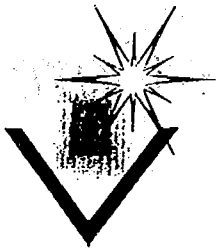
Phase I Participation - Core Group

- ◆ Large, geographically diverse, multi-jurisdictional public agencies:
 - Caltrans NJTA PTC
 - FDOT NYSTA TBTA
 - NJHA PANYNJ
- ◆ Each addressing interoperability on a regional basis
- ◆ FHWA supplying expertise



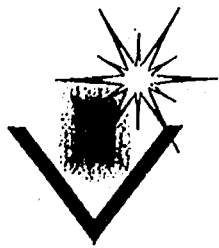
Common User Requirements

- ◆ Frequency Allocation
- ◆ Data Rate(s)
- ◆ Minimum Capture Rate
- ◆ Error Rates
- ◆ Data Security/Encryption
- ◆ Technology
- ◆ RF Characteristics
- ◆ Protocol
- ◆ Tags
- ◆ Reader



Phase II Participation - Toll Agencies/DOTs

- ◆ Core Group expanded to include other toll agencies and DOTs:
 - ◆ Georgia DOT
 - ◆ Massachusetts Turnpike
 - ◆ Massachusetts Highway Department
 - ◆ Texas Turnpike Authority]
 - ◆ Transportation Corridor Agencies



ETTM Steering Committee

- ◆ ITS AMERICA
- ◆ Thirteen governmental agencies
- ◆ Eight states represented
- ◆ Applied Physics Lab, Johns Hopkins University



Additional Phase II Support

- ◆ State DOTs:
 - Colorado Maryland N. Carolina Utah
 - Maine Mississippi Wisconsin Texas
- ◆ Oklahoma Turnpike Authority
- ◆ Ontario Ministry of Transportation
- ◆ ENTERPRISE
- ◆ Rural IVHS issues



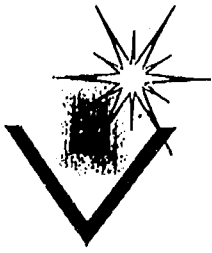
Phase III - ETTM Industry Commentary

- ◆ Draft requirements distributed to ETTM industry-at-large for comment
- ◆ Obtain ETTM Steering Committee consensus
- ◆ Deliver user requirements to standards developing organization(s)



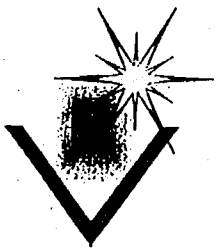
Industry Commentary

- | | |
|---------------------------|------------------------|
| ◆ Amtech | ◆ Lockheed IMS |
| ◆ Delco Electronics | ◆ Mark IV |
| ◆ Hughes | ◆ MITRE |
| ◆ Intellitag
Products | ◆ Texas
Instruments |
| ◆ Kimley-Horn &
Assoc. | ◆ WELCO |



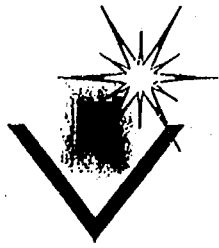
ETTM Technologies

- ◆ User support for ETTM standards shows demand
- ◆ Vending/Manufacturing community paying attention
- ◆ Evolving off-the-shelf technology capable of deployment today
- ◆ Future interoperability requirements soon supported
 - ◆ Florida DOT and other will procure



Tags

- ◆ Memory
 - ◆ Read-Only data
 - ◆ 256 bits minimum to identify tag, vehicle, and sensitive application specific information
 - ◆ Read-Write data
 - ◆ 1 Kb minimum of RAM with partitioning capability for general application and error and diagnostic information



Tags (continued)

◆ Field of View

- ◆ The tag antenna's field-of-view shall be a 90 degree conical cone pointed 45 degrees upwards and parallel with the roadway

◆ Size

◆ Windshield mounted interior

- ◆ Thickness shall not exceed 15mm
- ◆ Length plus width not to exceed 15cm



Tags (continued)

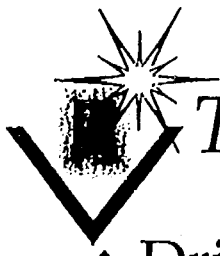
◆ Size (continued)

◆ Dashboard mounted (Above steering column)

- ◆ Width shall not exceed 10cm
- ◆ Height shall not exceed 5cm
- ◆ Depth shall not exceed 5cm

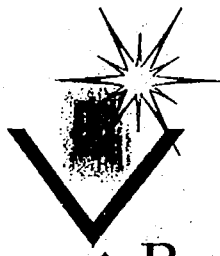
◆ Exterior tags may conform to license plate mounting

◆ Centerline mounting - behind rear-view mirror



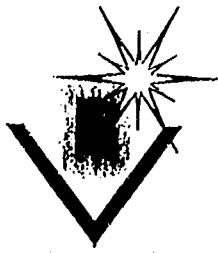
Tags (continued)

- ◆ Driver Interface - Data displays, status lights, and audible signals are optional
 - ◆ May develop recommended practices
- ◆ Security such as data encryption and password protection is being addressed
- ◆ Digital Interface is RS-485 4 pin to on-vehicle devices



Reader

- ◆ Reader
 - ◆ Antenna position must accommodate all tag mounting locations
 - ◆ Frequency assigned by FCC; minimum co-primary status
 - ◆ All message packets for toll and CVO defined
 - ◆ Reads multiple tag types



Conclusion

- ◆ National Interoperability will likely evolve around joint IEEE, ASTM standards based on ITS AMERICA generated requirements.
- ◆ A reader that reads multiple technology tags
- ◆ FCC has not ruled on frequency authorization; Large scale deployment is continuing in 902 - 928 MHz band

Status of VICS Project

CURRENT STATUS of VICS PROJECT

Second USA-JAPAN ITS Workshop

November 14 & 15, 1994

NOBUHIRO IMACHO

Traffic Engineering Division
Public Works Research Institute
Ministry of Construction

JUN SHIBATA

Intelligent Transport Systems R&D Dept.
Vehicular Technology Laboratories
Sumitomo Electric Industries, LTD.

1

VICS

Current Status of VICS Project

VICS: Vehicle Information & Communication System

I. Purposes of VICS

1. Background of VICS
2. Goals of VICS
3. Direction for Realization of VICS
4. History of the VICS Promotion Council

II. Current Status of VICS

1. General Concept of VICS
2. Important Points Concerning the Practical Use of VICS
3. Information Service Items
4. Service Images
5. Overview of VICS Media
6. VICS Demonstration

III. Benefits and Costs of VICS

IV. Future Plan (10 years)

I. Purposes of VICS

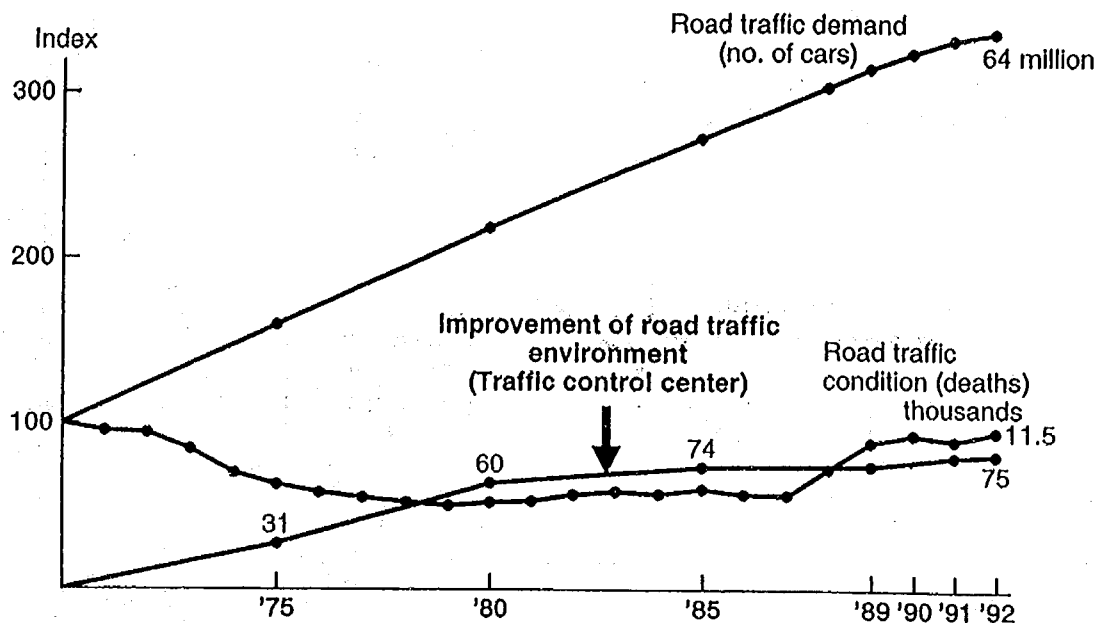
1. Background of VICS

- (1) Road traffic demand has increased very rapidly
- (2) It has been getting harder to improve road traffic environment
- (3) Road traffic conditions have been getting worse

4

VICS

• Trend of Traffic Status in Japan



5

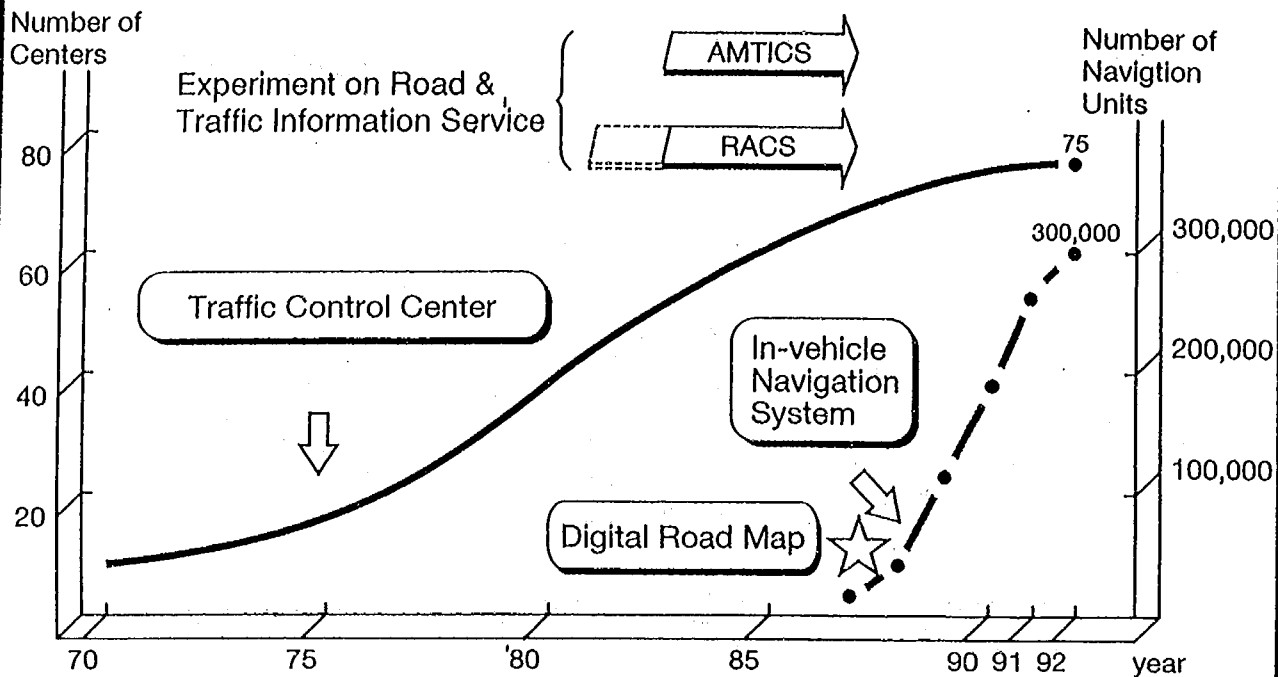
VICS

2. Goals of VICS

Accurately and appropriately utilize information

- Decentralize traffic
 - ➔ Mitigate or eliminate traffic jams
- Reduce the likelihood of becoming lost or taking the wrong route
 - ➔ Reduce the amount of traffic
- Stabilize driver psychology
 - ➔ Prevent accidents

• Improvement of Information System



3. Direction for Realization of VICS

(1) Information services which correspond to drivers' needs

- Realization of inexpensive systems which are easy to use

- 1 Integrated management of information
- 2 Systematizing information service media

(2) Harmony with public policy

- 1 Harmony with the radio wave policy
(Effective use of radio waves)
- 2 Harmony with the road and traffic policy

(3) Unification of efforts by private enterprises

4. History of the VICS Promotion Council

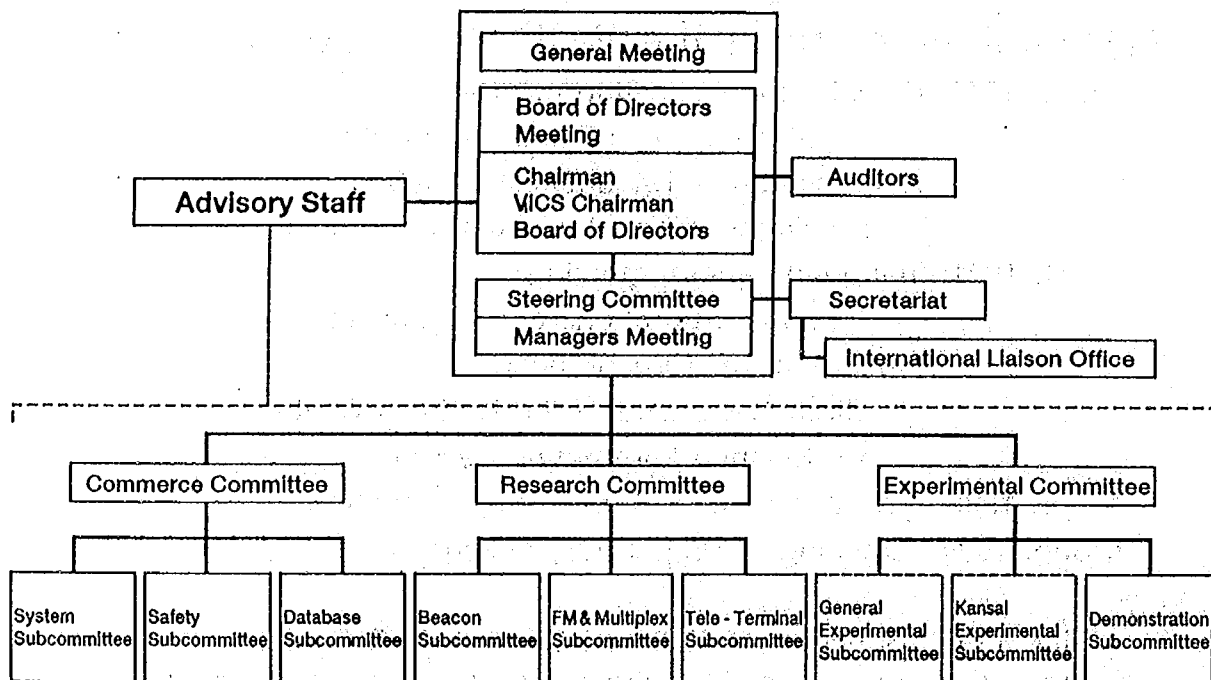
(1) Establishment of the VICS Promotion Council

- Sep. 1991: Establishment meeting of promoters
10 corporations and organizations
Representative: Dr. Shoichiro Toyoda
President of Toyota Motor Corporation
- Oct. 1991: Inaugural general meeting
201 corporations and organizations
Chairman: Dr. Hiroshi Inose
Director General of the National Center
for Science Information Systems
- Apr. 1993 Created Optical Beacon Subcommittee
- Sep. 1994 Opening of Preparatory Office
- Mar. 1995 Schedule of Establishment of VICS Center
- Mar. 1996 Start of Service (All media; in Kanto, Aichi, Osaka)

(2) Objectives and Operation Plans of the Council

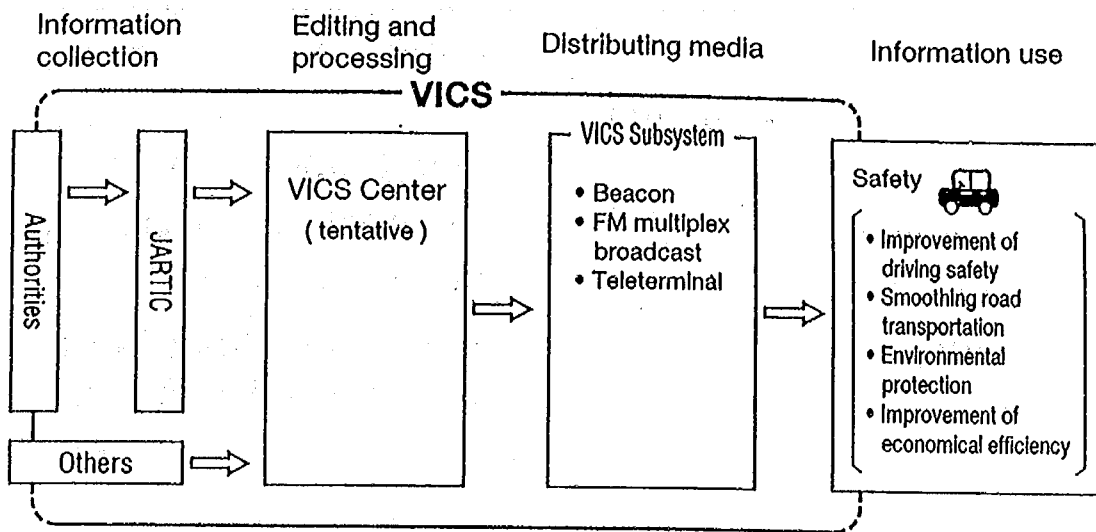
- [1] Objectives: To promote the adoption of VICS
into practical use within a
reasonably short period of time
- [2] Operation plans:
 - a) Conducting investigations, research and
development aimed at putting VICS into
practical use
 - b) Activities to spread the use of VICS
 - c) Other activities necessary to achieve the
purpose of the organization

(3) Organization



II. Current Status of VICS

1. General Concept of VICS



2. Important Points Concerning the Practical Use of VICS

- (1) Careful consideration to safety
- (2) Social infrastructure of the future
- (3) The structure of the organization to spread the use of VICS

3. Information Service Items (Tentative)

- (1) Traffic congestion : Area and level of congestion
- (2) Temporary regulation : Area, time, and causes under control
- (3) Traveling time : Traveling time between two points
- (4) Parking : Parking locations and their availabilities, etc.

4. Service Images

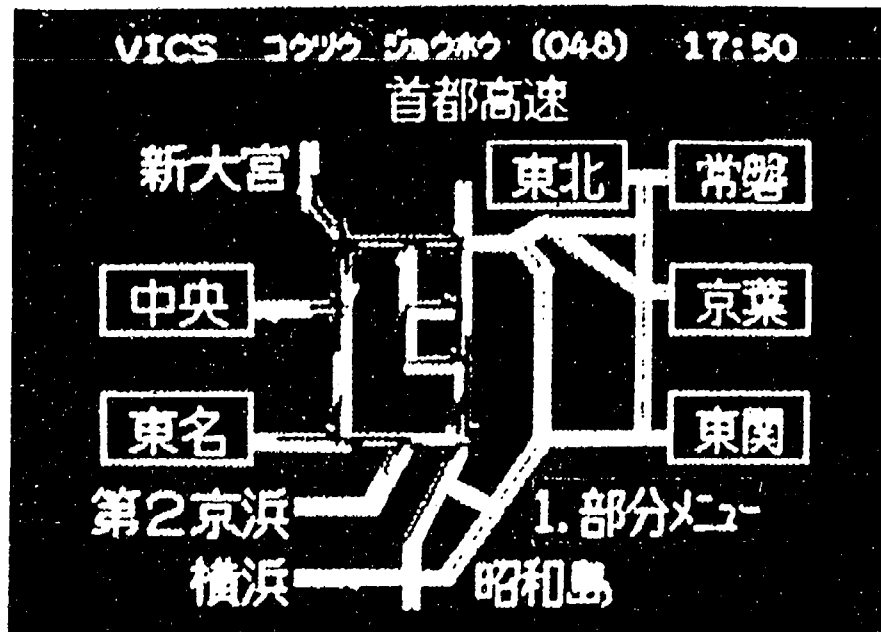
(1) Map display



16

VICS

(2) Simplified Map Display



17

VICS

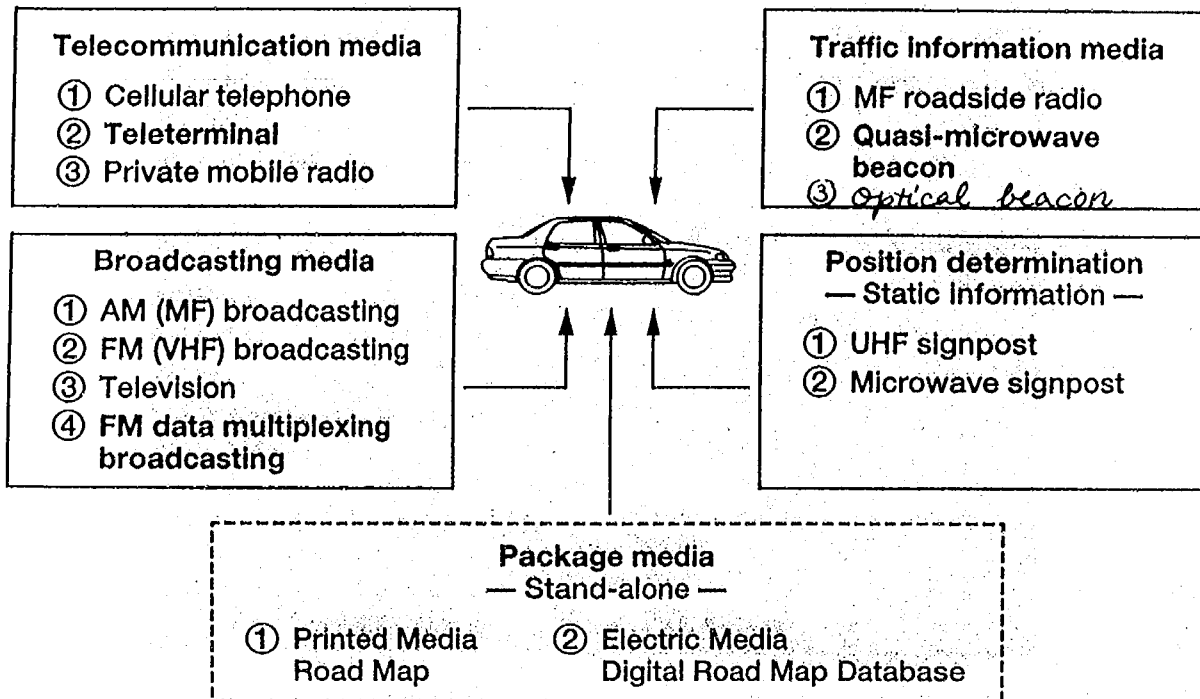
(3) Character Display

VICS コケツク ジョウホウ (032) 17:50

山手通り 外回り

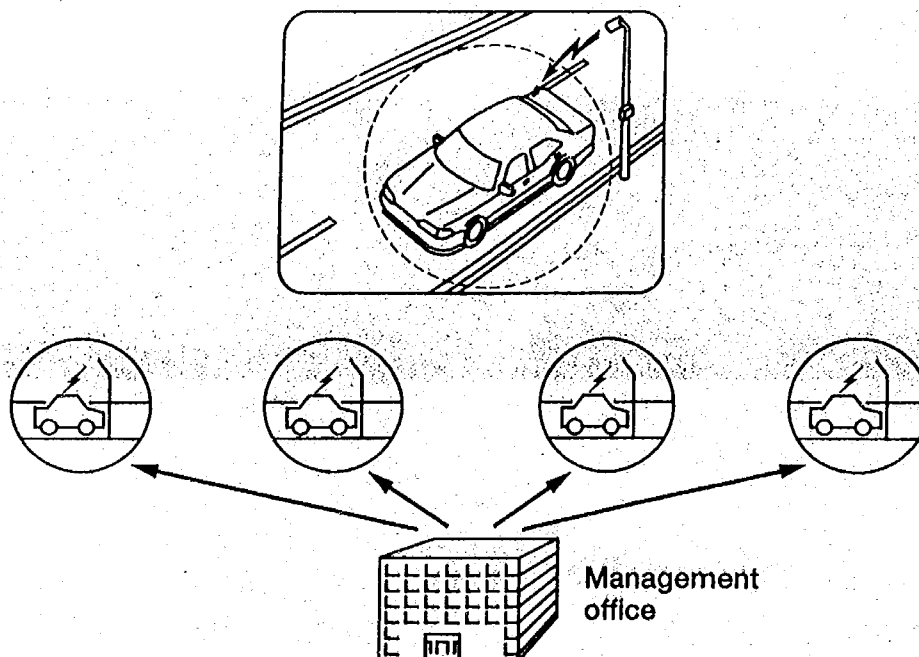
中野坂上→要町一 渋滞 4.5km

5. Overview of VICS Media



(1) Quasi-microwave beacon

◆ 64 Kbps, approx. 70m/1 zone

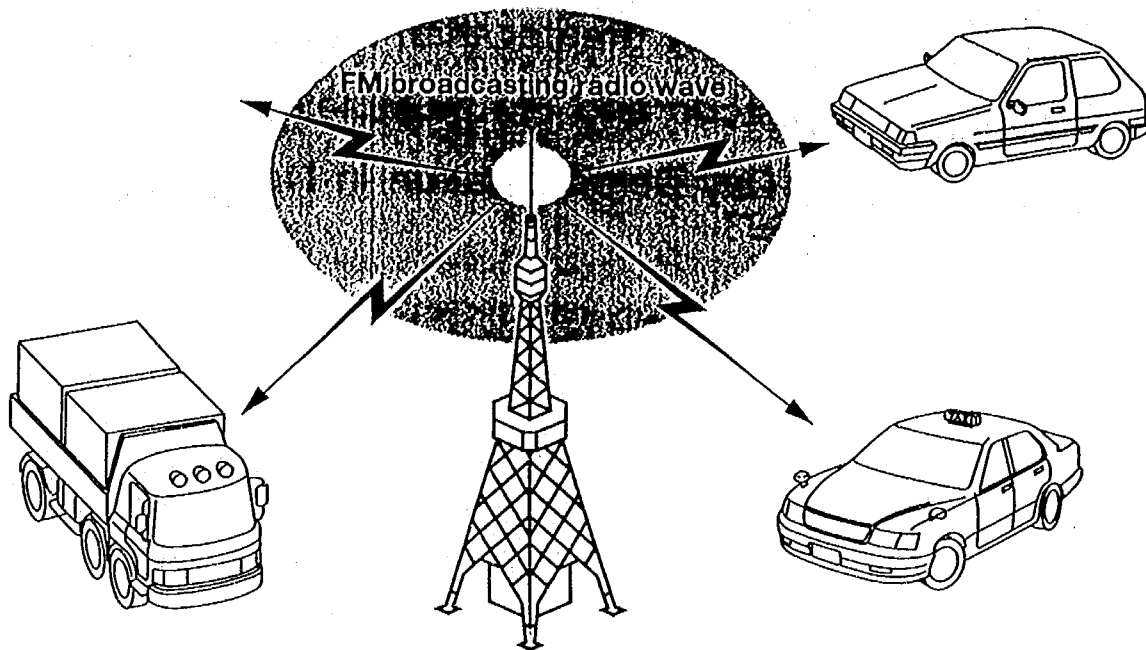


20

VICS

(2) FM Data Multiplex Broadcasting

◆ 16 Kbps, 10 – 50km Radius/1 zone

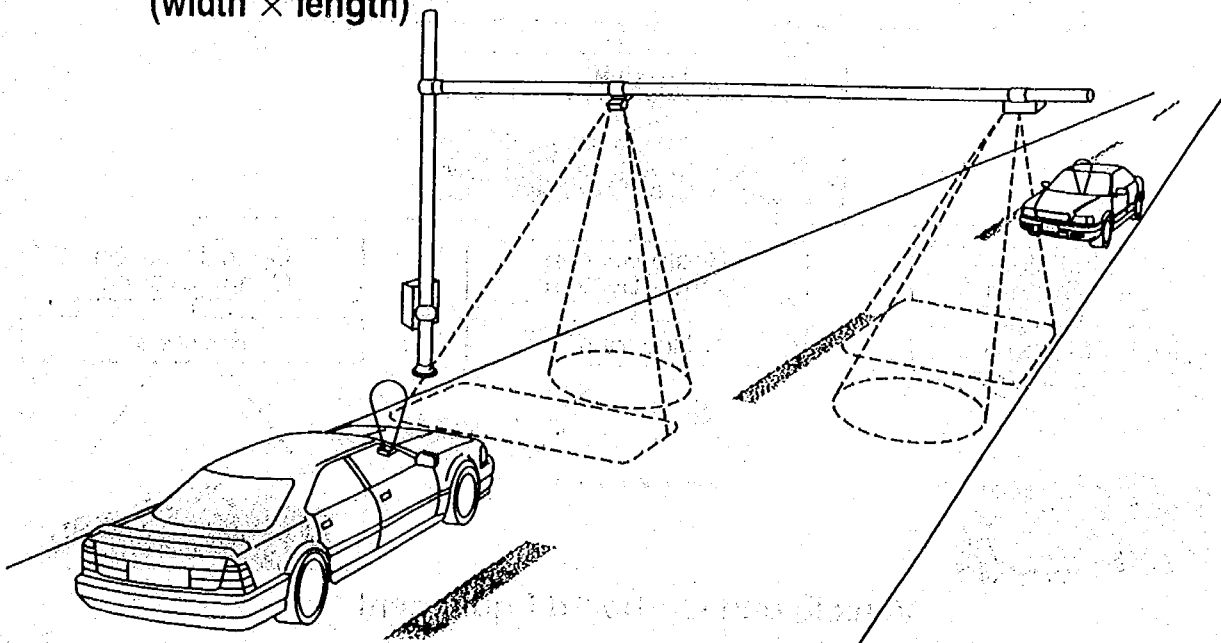


21

VICS

(3) Optical Beacon

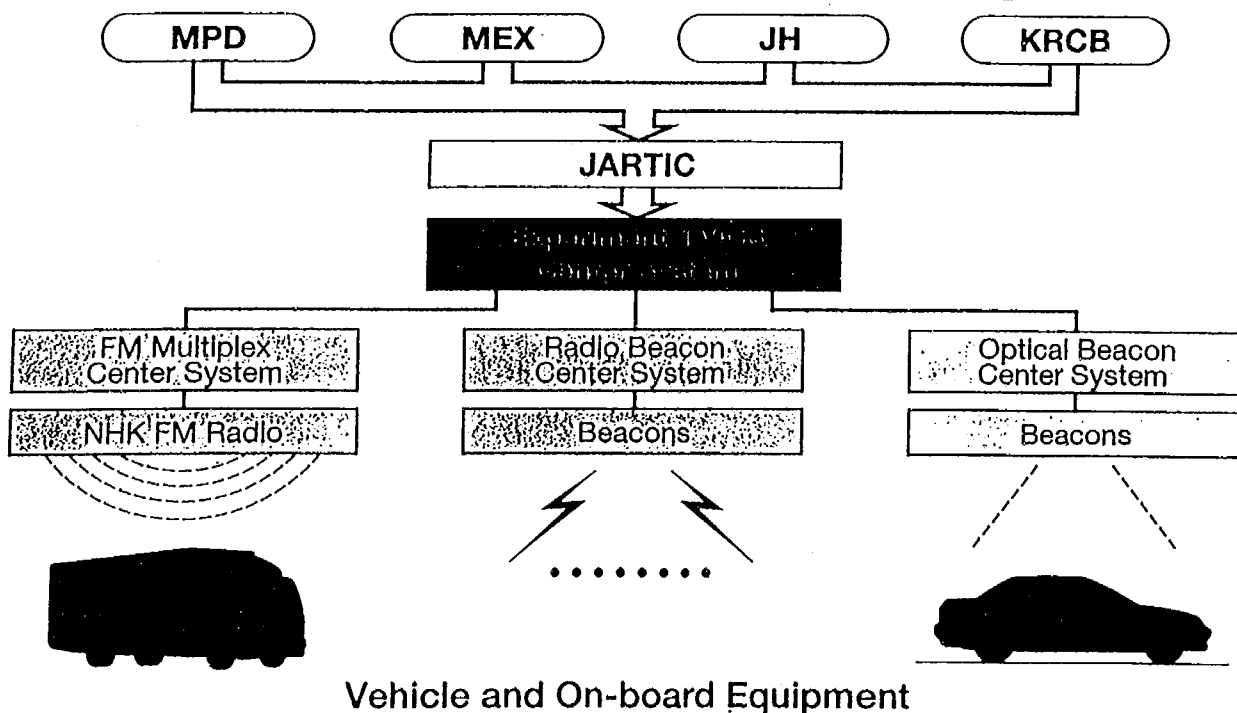
◆ 1Mbps (downlink) 64Kbps (uplink); approx. size 3.5m × 3.5m (width × length)



6. VICS Demonstration

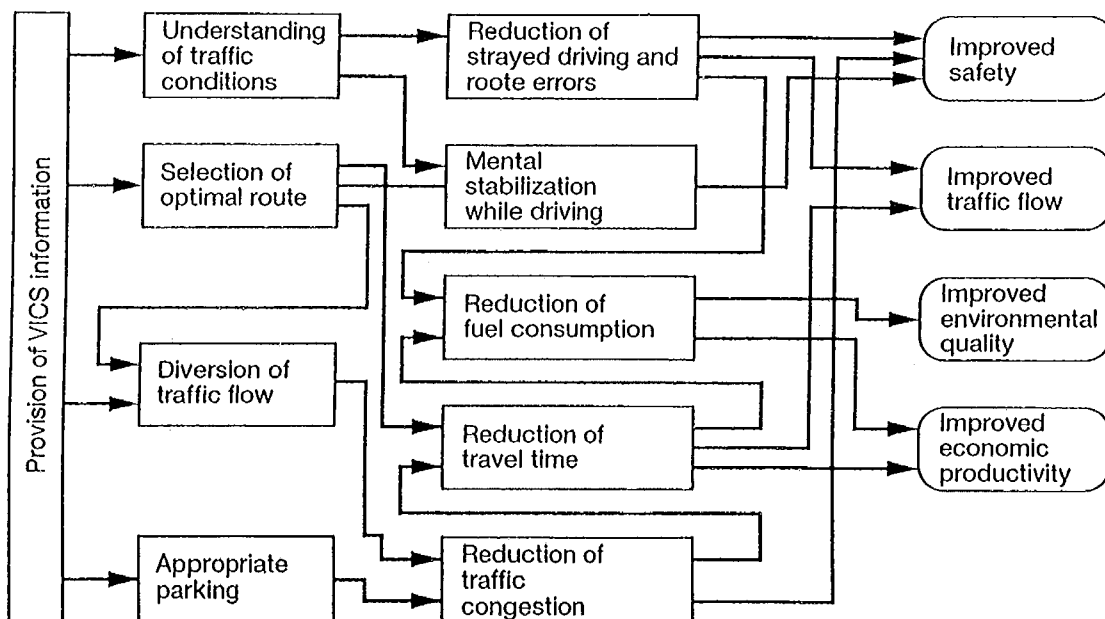
- Area : Tokyo area
(Slightly greater than 20Km × 20Km)
- Media : Beacon and FM multiplexing
- Schedule : 2-Day Demonstration in December
1993 *November*

Outline of the Experimental System



III. Benefits and Costs of VICS

Benefits of VICS



Costs of VICS

- Information collection: -- (existing)
- Information processing and editing: ¥30 billion
- Information provision: ¥370 billion (shared)
- Information utilization: ¥900 billion (purchasers of on-board equipment)

Required operating expenses : 1.3 trillion
(10 years) ⇒ VICS Center : ¥30 billion



Benefits : 5 trillion (10 years)

- Reduced driving hours: ¥4.7 trillion (all drivers/society)
- Reduced fuel consumption: ¥0.3 trillion (all drivers/society)
- Improved safety: fewer and less serious accidents (society)
- Environmental protection: reduced exhaust emissions (society)
- Other benefits: expansion in domestic demand/technological development etc. (society)

IV. Future Plan (10 years)

	Sep. 1993	Feb. 1994
<i>ten thousand</i> Equipment sold (million units)	1,805	433
Operating expenses (billion yen)	30	8.5
Benefit (trillion yen)	5.0	0.9
Number of prefectures (10th year)	48 ※	12

※ whole country

Status of Rural IVHS in the U.S.

June 1994

A 30 Month National Study Sponsored by the
Federal Highway Administration

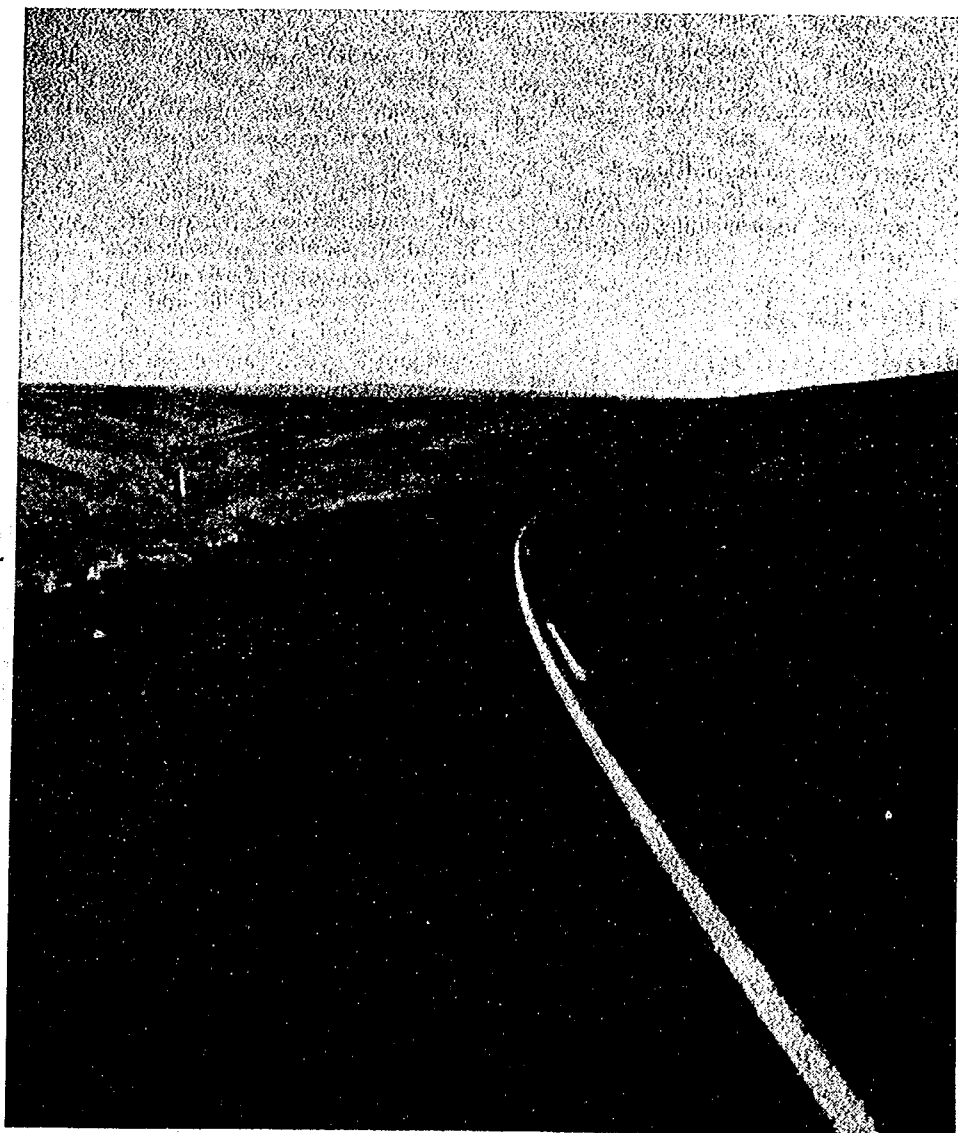
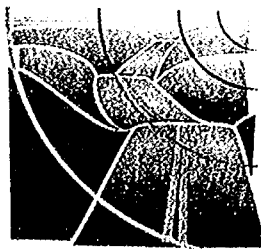
FHWA's Rural ATIS Study

Interim Findings: User Needs and Technologies

Most Intelligent Vehicle/Highway System (IVHS) investments to date have been concentrated in major urban areas, where congestion is most severe and population densities are highest. IVHS technology, however, also offers substantial potential benefits to both highway users and operators in rural and small urban areas.

In early 1993, the U.S. Federal Highway Administration (FHWA) began a 30 month study of rural applications of Advanced Traveler Information Systems (ATIS). This pamphlet describes some of the preliminary results of that project.

Rural ATIS



This study is being conducted by a research team led by JHK & Associates, with assistance from Virginia Tech, Hughes Aircraft, and Bell Atlantic.



JHK & Associates
An SAIC Company

Scope of Study

The study covers seven major topics:

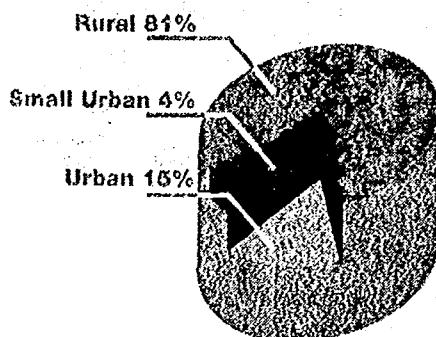
- 1) a detailed assessment of user needs;
- 2) a review of relevant technology both in existence and under development;
- 3) an evaluation of the national significance of rural problems which might be addressed by ATIS technology;
- 4) the development of a range of rural ATIS concepts;
- 5) selection of a sample of promising concepts and preparation of detailed system specifications;
- 6) implementation of field tests of these systems; and
- 7) documentation of guidelines for use by state and local government agencies in implementing rural ATIS systems.

The Rural Environment

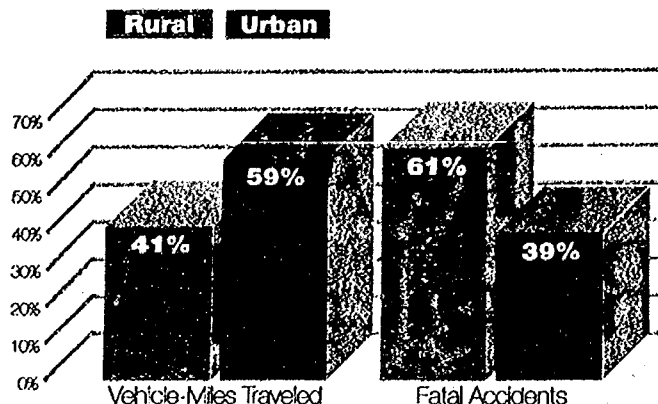
The rural environment presents significantly different challenges to IVHS deployment than does the typical urban area:

- distances are longer and traffic volumes lower;
- safety is a major issue;
- congestion is primarily non-recurrent;
- alternate routes are fewer;
- many travelers are unfamiliar with their surroundings;
- rural highways frequently traverse rugged terrain in remote areas;

Public Road and Street Mileage By Area Type



Vehicle Miles Traveled vs. Fatal Accidents



- climate conditions are often extreme;
- emergency medical services (EMS) take longer to respond to rural incidents;
- the lack of existing surveillance and communication infrastructure in sparsely populated areas make the implementation of cost effective systems more difficult; and
- there are significant multijurisdictional issues involved.

User Needs

Survey Program

An extensive series of surveys were undertaken to identify the top priorities placed by travelers, highway agencies, police departments, and other organizations on the availability of travel related information in rural areas. For purposes of definition, the term "rural" was assumed to include parts of the U.S. outside urban areas of 50,000 population or more.

The surveys were national in scope, including:

- eighteen focus group sessions with 15 - 20 members of the general public;
- a national telephone survey of 525 households;
- three focus group sessions with representative highway officials and toll authorities;
- eight focus group sessions with fleet operators, dispatchers, EMS providers, and law enforcement officials;
- sixty-one one-on-one interviews with senior highway, police, EMS, tourist, commercial operator, and travel organization executives.

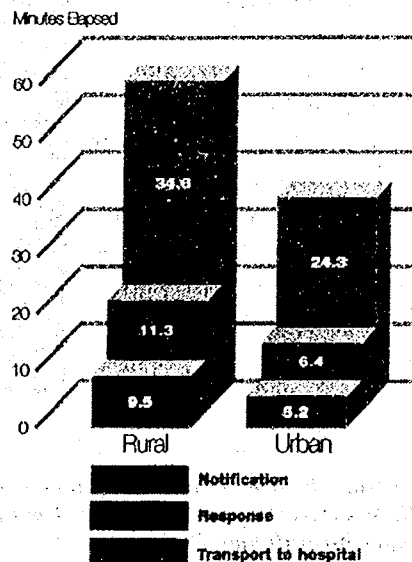
Major Findings

General Travelers Survey respondents were asked to consider the types of information they needed in each of three stages of a trip:

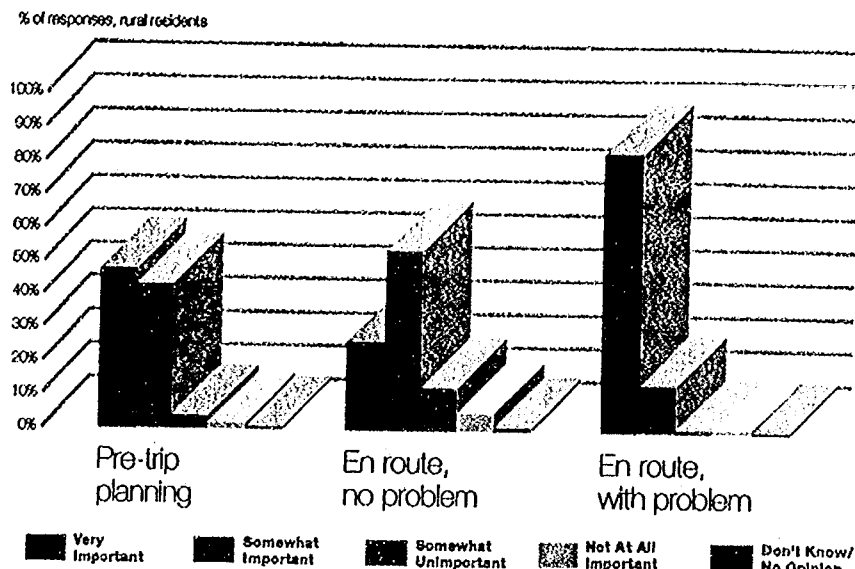
- 1) Pre-trip planning, before setting out;
- 2) En-route (no problem), while traveling and everything is okay; and
- 3) En-route (with problem), while traveling and a problem has arisen.

Two national telephone surveys were conducted to verify the quantitative results of focus group discussions with general travelers. The first national telephone survey interviewed a sample of 525 urban and rural

Average EMS Elapsed Times: Rural vs. Urban Fatal Crashes



Importance of Information



residents regarding their long distance travel (more than 150 miles) information needs. The second national telephone survey of 500 respondents addressed only local rural travel information needs.

The bar chart above summarizes the survey respondents' priorities for long distance travel with respect to these three categories of information.

Not surprisingly, by far the highest priority was placed on information relating to problems encountered while traveling. Second was pre-trip planning. General "en-route" information placed a distant third.

This chart relates to rural residents. Virtually identical findings were discovered for urban residents when considering rural travel.

When the respondents' answers were analyzed in more detail it became clear that the top priority information need was related to safety. The three most important issues were all related to safety problems encountered en-route:

- the ability to call for help in an emergency (Mayday);
- warning of rapidly approaching hazards immediately ahead; and
- a signal to "wake-up" a drowsy driver.

Of secondary importance were two other warning messages, related respectively to road closure ahead and an advance warning of a hazardous situation.

Information regarding trip routing, road and weather conditions, and travel time was considered particularly important to pre-trip planning, but of substantially less importance than the safety-related information described above. Similarly, general information was considered useful while en-route but became of concern only when a problem arose.

The results of the "local rural travel" telephone interview supported the findings of the "long distance travel" telephone interview. The only exception was that local travelers placed lower priority on the information regarding alternate routes, en-route facilities, and construction and

Trip Stages



maintenance. This was anticipated, as local travelers are usually familiar with local roadways and facilities.

Other Users Other users surveyed regarding the types of information they needed when traveling in rural areas included truck drivers, truck fleet managers, school bus fleet operators, and paratransit managers. Key findings include:

- the primary need of weather and road condition information;
- safety as a concern;
- concern for road regulations and obstacles when rerouting; and
- sensitivity to the cost versus benefit of ATIS technologies.

Service Providers Service providers include highway agencies and toll authorities, EMS providers, economic development and tourism departments, National Park Service, county and public works officials, law enforcement officials, and various other groups.

The perspectives of these providers on traveler information needs and technologies were collected through both focus groups and one-on-one interviews:

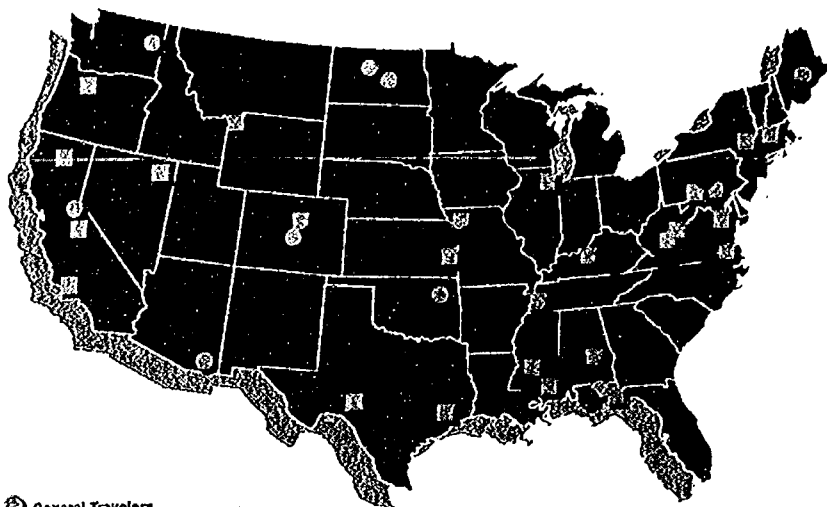
- highway agencies consider emergency, safety, and warning information as most important;
- EMS providers are concerned with reducing accident notification and response time;
- ATIS systems are seen as instruments to promote tourism and, hence, economic development;
- at the county level, major concern is highway safety; and
- there is concern for traffic management during highway construction, accidents, and adverse weather conditions.

It was stressed that the information disseminated through ATIS systems be timely, accurate, relevant, and reliable. Providers also voiced concerns regarding driver information overload.

Technology

An extensive investigation was conducted to identify technologies that are likely to support rural ATIS applications. Several major conclusions were drawn from this investigation:

(continued on back page)



- General Travelers
- Fleet Operators, Dispatchers, EMS, Law Enforcement Officials
- Highways Officials and Toll Authorities
- Other Interest Groups

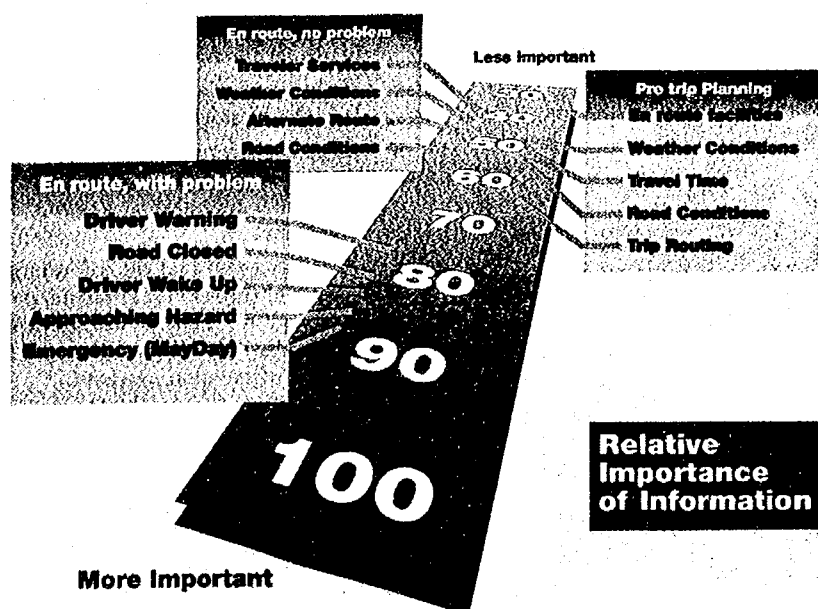
Locations of Focus Groups and Interviews

- substantial proven technology is available to support basic rural ATIS applications;
- significant potential for piggybacking rural ATIS applications on other, non-transportation related investments exists;
- infrastructure costs and the nature of user priorities make in-vehicle and targeted roadside systems a high priority;
- communication is a major challenge;

- non-safety/non-emergency applications must be commercially viable; and
- legal liability is a key concern.

Next Steps

A series of 20 rural ATIS concepts are under development. These will be evaluated and a lesser number will be selected for detailed development. In parallel with this analysis, the project team is compiling a list of potential test sites. If you or your organization are interested in participating, please let us know.



To **ENQUIRE** about potential public or private involvement in the testing and deployment of rural ATIS applications, or for more information regarding rural ATIS, contact:

Mac Zarean, Ph.D., P.E.
JHK & Associates
 3500 Parkway Lane, Suite 600
 Norcross, GA 30092
 404/447-6831
 FAX 404/449-7268

Davey Warren
FHWA
 HER-10
 6400 Georgetown Pike
 McLean, VA 22101-2296
 703/285-2426
 FAX 703/285-2264

Expert Panel

- **Joe Armijo**, Montana State University
- **Gene Bergoffen**, National Private Truck Council
- **Douglas Bovin**, National Association of County Officials
- **Paul Cunningham**, East Carolina University Medical Center
- **David Gehr**, Virginia DOT
- **Frank Horne**, Motorist Information Services Association
- **Mary Ingels**, National Park Service
- **John Kiljan**, Colorado DOT/ENTERPRISE
- **James McLary**, Community Transportation Association of America
- **Susan Pikrallidas**, AAA
- **Annett Sandberg**, Washington State Patrol
- **Mike Sobelewski**, Minnesota GuideStar
- **John West**, Caltrans



JHK & Associates
 An SANC Company

Experience on the Headway and Lateral Control System

Experimental System on the Headway and Lateral Control Systems

Yutaka Yamada

Advanced Road Transportation Systems Research Committee

1. Overview

The series of radio wave propagation experiments using leakage coaxial cable(LCX) and quasi-microwaves have been conducted through the year 1993 and the satisfactory results for a use as communication media of the Headway and Lateral Control Systems have been obtained.

To check and verify the functions in the Headway and Lateral Control Systems, the experimental system is planning to be installed on the test course set up in the Public Works Research Institute of the Ministry of Construction.

A brief synopsis is discussed.

2. Outline of the Experimental System

The entire length of the test course in the Public Works Research Institute is approximately 6.2 km and the Experimental System will be installed on along 4.5 km of the course. The system installed test course is divided into nine sections. Each section is 500m in length. The leakage coaxial cables are laid in the sections to create the area where consecutive communication can be implemented. The length of the leakage coaxial cable for each section is assigned on the basis of the experiment results with the propagation features.

In each section, a radio transmitter / receiver and a local processor is connected with a leakage coaxial cable. The roles of the local processor are: communication with vehicles moving in the section where the leakage coaxial cable is connected with the local processor, relay of the data which is received from vehicles and is transmitted to other vehicles, communication with other local processors, communication with the central processor and so on.

The local processors are linked with communication lines so that they can

communicate with the vehicles while passing information of the moving vehicles to the other local processors located in rear and front sections. The local processors glean information detected by sensors installed on the roadside and distributes it to the vehicles and other local processors in ongoing direction.

The central processor supervises the local processors in a way that the central processor monitors information detected in the each LCX sections, implements forced information intervention, controls the local processors and so on.

The unusual conditions on the test roadway are detected by the video camera image processor installed on the test course.

3. The contents of experiments

The Headway and Lateral Control System is classified into three levels in its development: the Warning and Information Dissemination Level, the Driving Assisting level, the Automatic Driving Level. Currently, the development efforts are mainly focused on the very basic level, the Warning and Information Dissemination, and the experiments are planing regarding the following three items:

- Warning and information dissemination function which allow the motorist to identify an incident before that comes into his visible field.
- Information display function on the vehicles in the vicinity of the ego-vehicle, e.g. information on too small daylight between the rear vehicle and sudden deceleration of a front vehicle.
- Collision prevention function which identify an appropriate daylight between a front vehicle. when the daylight becomes too small, warning is generated and braking control is implemented, if necessitated.

The schedules of the experiments are as follows:

- 1995 Check and verification of basic communication functions.
 - Check and verification of functions using a single vehicle.
 - Check and verification of functions using plural number of vehicles.
 - Check and verification of performance on the LCX boundary areas.
 - To inform the location of other vehicles to the test vehicle.
 - To inform the intention regarding driving tasks to the roadside.
 - The vehicle location identification and drive tracking by an on-board sensor(a radar and so on) and an infrastructure sensor.
- 1996 Man-machine interface for information display .
- 1997 Check and verification according to the roadway structure types.
 - Check and verification of the warning and vehicle location display function.
- 1998 Revise and set up the system functions and component specifications.

4. Data Format Example

The System is configured on the assumption that the maximum of 36 vehicles exist in a single LCX section. This maximum number of vehicle is acquired under the condition that each vehicle is moving at 100km/h and passing by at intervals of 1.5 second through a 500m section. Three lanes are assumed in a section.

The communication types are classified into two cycle types: a small communication cycle (At a cycle of 0.1 second) and long communication cycle. The information with a high order of emergency priority is assigned to the small communication cycle and information other than emergency is assigned to the long communication cycle. The transmission rate for signals is 512Kbps.

1) Small Communication Cycle Data Contents

The following are the typical example of the small communication cycle data.

contents:

- Vehicle → Roadway

The vehicle ID, Vehicle length, Vehicle width, Vehicle Position, Daylight, μ level, Vehicle speed, A driver's intention in terms of the driving tasks, an abnormal condition of a vehicle, and so on.

- Roadway → Vehicle

The relayed data transmitted directly from other vehicles, The location of the vehicle in abnormal conditions, Warning generated by other vehicle, The location of the vehicle which generates warning and so on.

2) Long Communication Cycle Data Contents:

- Vehicle → Roadway

Vehicle's attribute, Destination, Road Conditions

- Roadway → Vehicle

Information on Emergency Vehicles in the far off distance, Traffic information, Information on unusual incidents such as accidents and natural disasters, Emergency message.

3) Vehicle Registration and Cancellation

When a vehicle goes into a new LCX section, the vehicle registration is implemented and a communication slot is assigned. The registration is valid through the each test sections if it has been done once. The registration is performed using a tentative seven-digit ID number.

When the true ID is informed via the long communication cycle, the corresponding local processor informs the processor in rear LCX section next to it and information that the vehicle has goes out of the section is passed.

5. Conclusion

We are now starting the preparation of the experimental facilities. The installation and fundamental tests will start from next spring. The experiments will be expected to dedicate the useful results to the implementation of next generation road transportation systems.

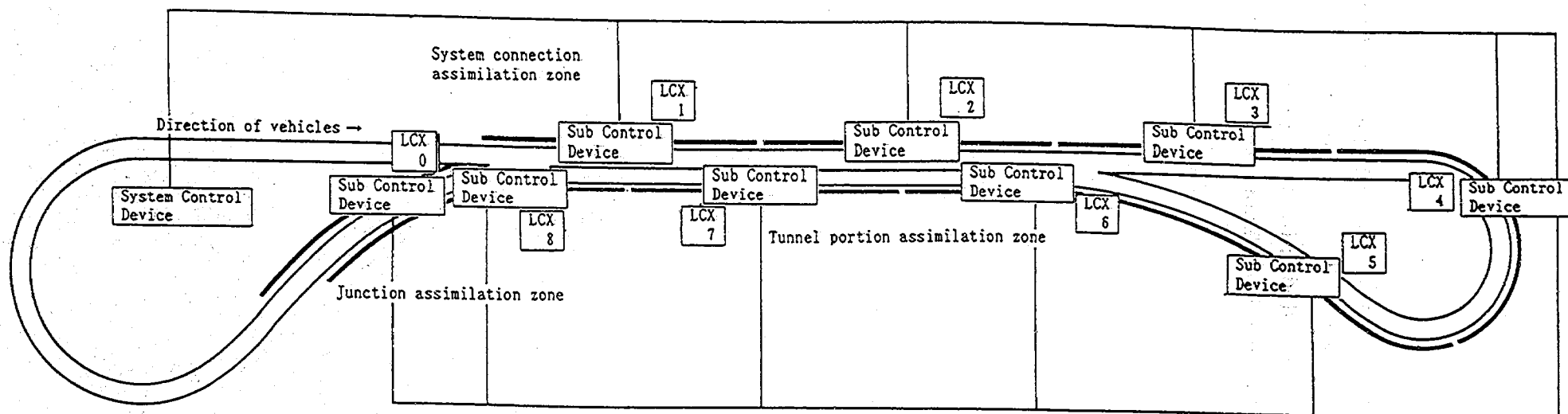


Fig.1 Headway and Lateral Control Experiment System
Layout plan

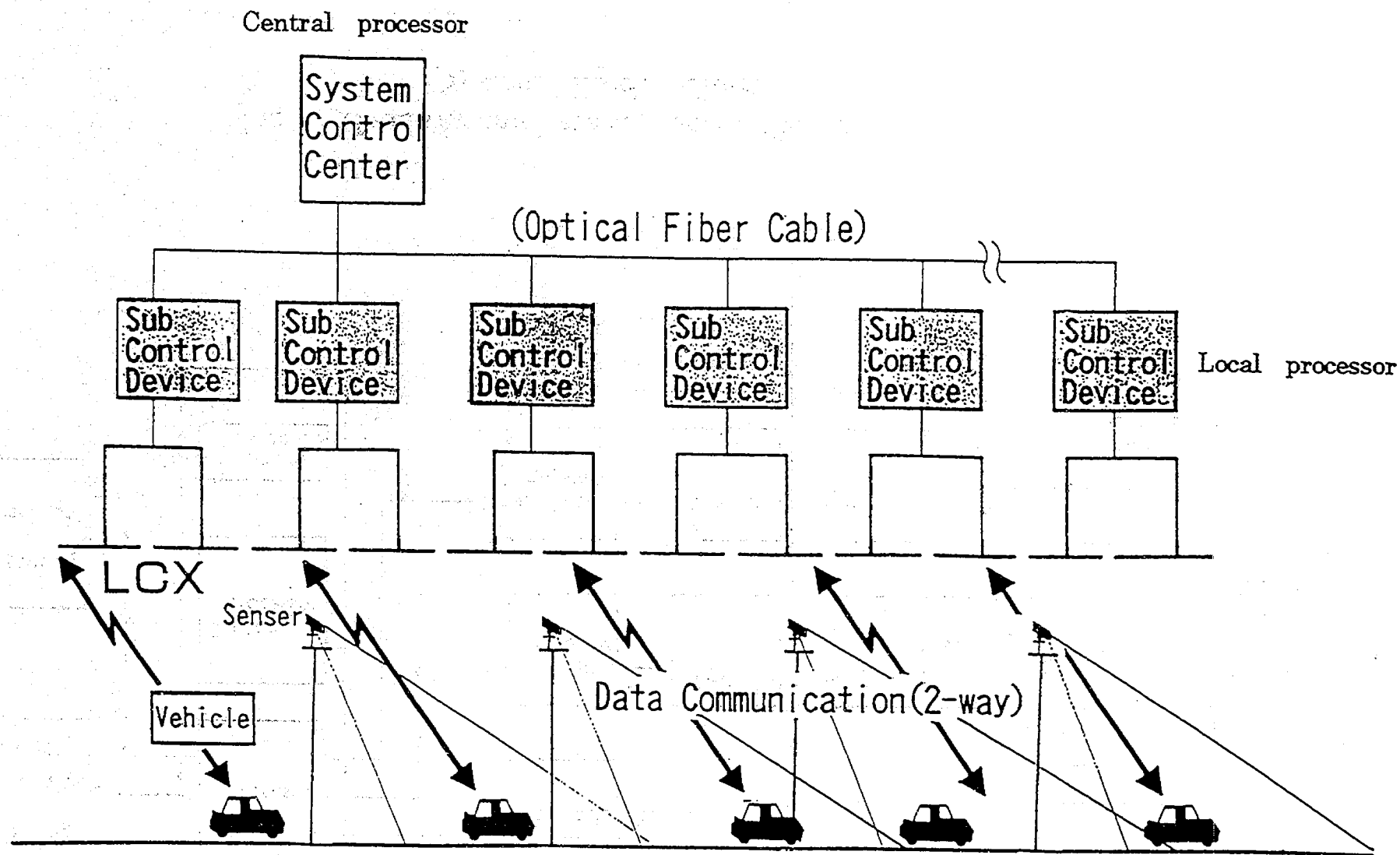


Fig.2 Experimented System Concept

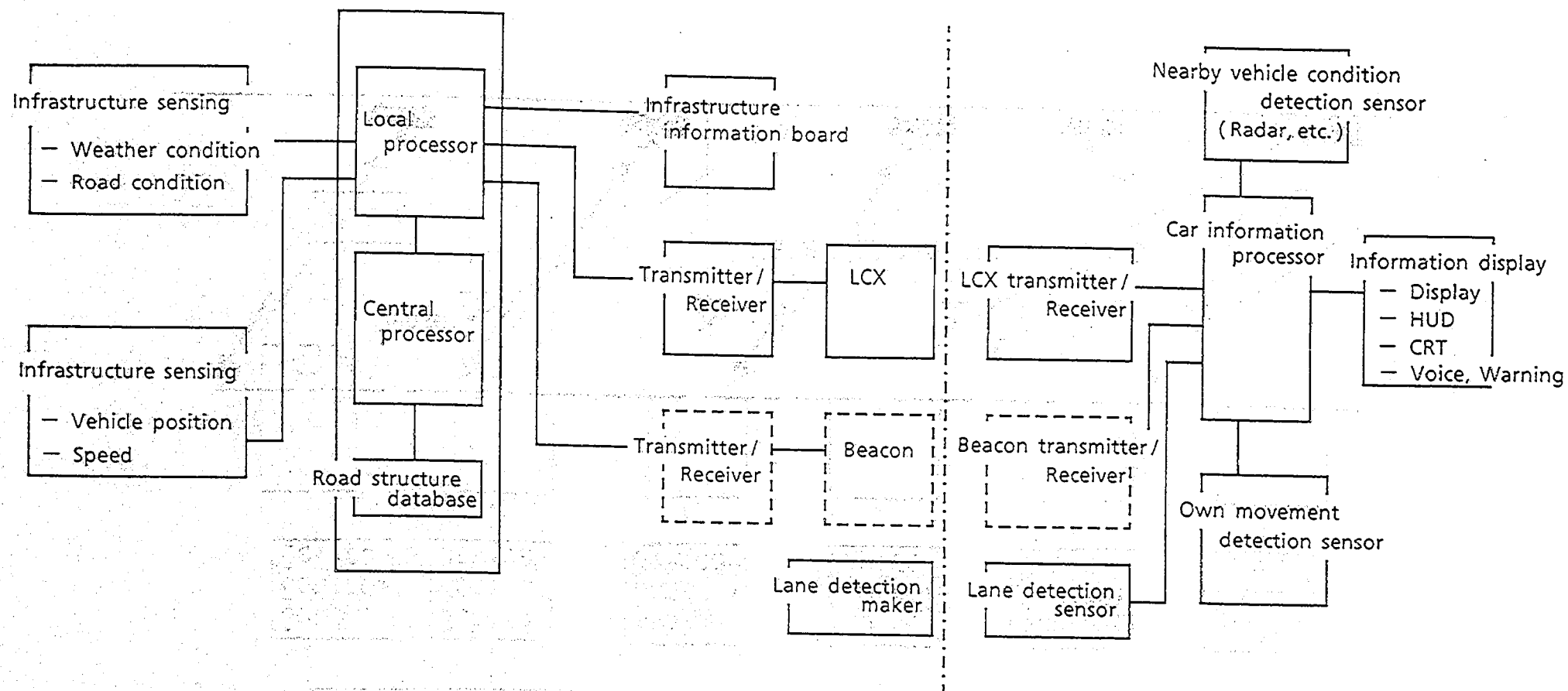


Fig.3 Headway and Lateral Control System
System Block Chart

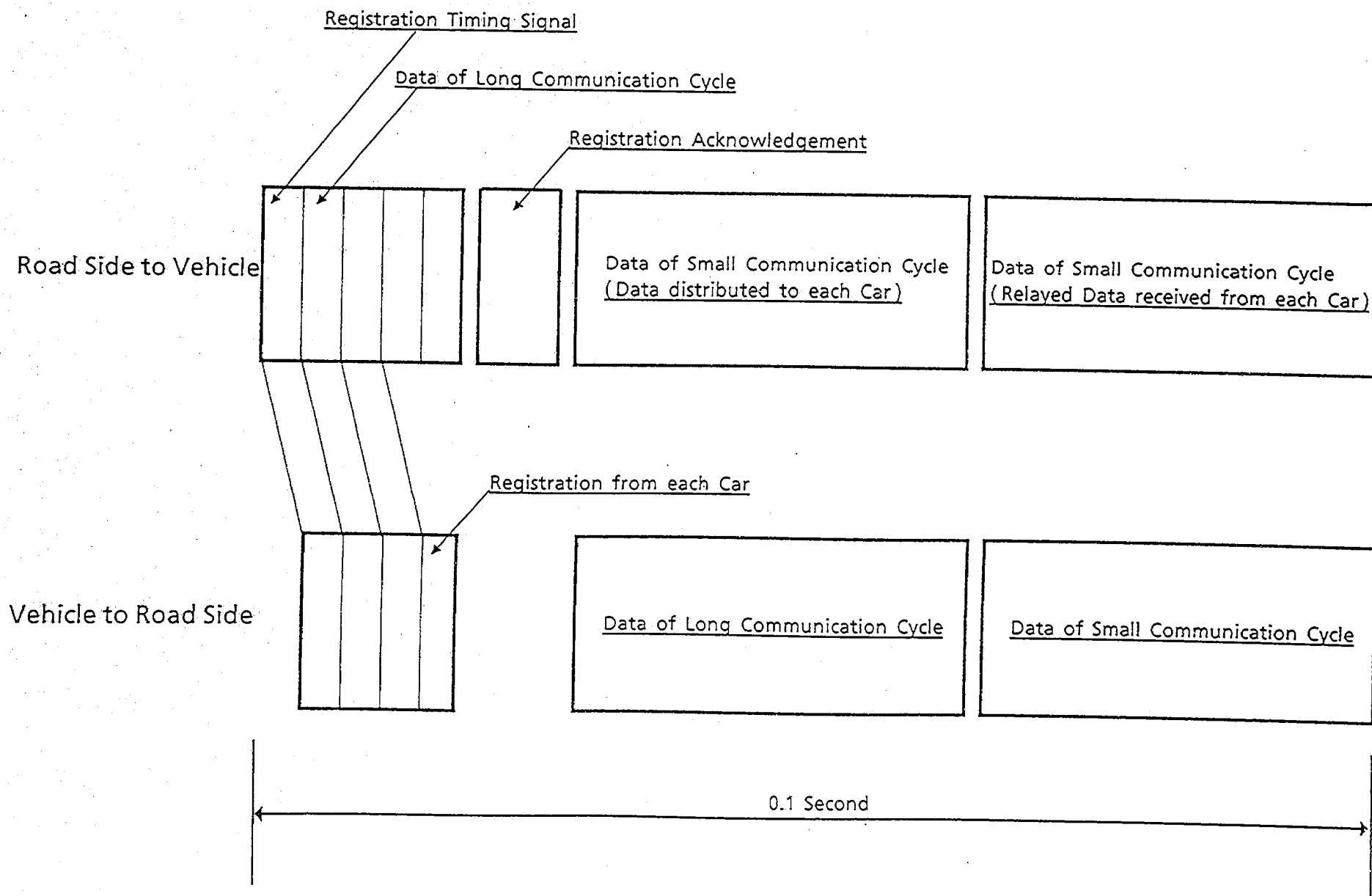


Fig.4 Example of communication Format

Effect of In-Vehicle Information Display on Driving

by the Highway Driving Simulator

" Effect of On-Board Information Display on Driving
by the Highway Driving Simulator "

Takeshi Kishima
Traffic Engineering Division
Road Department, PWRI

1. Introduction

For advanced road traffic systems like the vehicle information and communication system, the information display screen installed in the car (in the following called on-board display) plays an important role. In the future, more information will likely be provided by the on-board display to the driver. It is desirable to develop a more easily understandable on-board display with a simple operation. As the foundation for this, the effect of the operation and understanding of the on-board display on the driver while driving is examined in this research.

2. Research Purpose

This research is conducted to estimate the effect of the operating and understanding of the on-board display on the driver while driving, and to estimate the amount of information presented on the on-board display quantitatively. In order to find the upper limit for the amount of information on the on-board display, the information was presented on the display inside the highway driving simulator at the Public Works Research Institute, and test persons were used for simulated driving tests.

3. Research Methods

3.1. Situation Setting

For these tests, the Metropolitan Expressway No. 3 leading to Tokyo was used as shown in Fig. 1. The test persons were assumed to drive the expressway from Sangenjaya Ramp to Edobashi Ramp through the ringroad. The Metropolitan Expressway No. 3 was assumed to be congested. The test person was continuously accelerating and decelerating with an average speed of 30 km/h due to a car in front of him. This test ended with the selection of the inner track or the outer track at Tanimachi Interchange, the entrance to the ringroad. As shown

in Fig. 1, three beacons are installed along the Metropolitan Expressway No. 3, and they supply the information from the vehicle information and communication system (VICS) shown in Table 1.

3.2. Test A (Qualitative Estimation of the Effect of the On-board Display)

First, the test person drove the course shown in Fig. 1 with no information presented on the on-board display (test A1). Next, the information shown in Table 1 was presented on the on-board display. The test person read the time to Edobashi Ramp successively by this information, and judged which of the inner or the outer track was less congested, and selected the less congested route (test A2). In the tests A1 and A2, the driving performance, the GSR appearing number, the pulse rate, etc., and the glance duration time of the on-board display by an eye-mark recorder were recorded.

3.3. Test B (Quantification of the Displayed Information)

The use frequency of on-board displays will be likely increasing in the future. The information volume will also be increasing. It is necessary to estimate the amount of information presented on the on-board display quantitatively, because of avoiding a situation where an excess of information presents an obstacle for driving. However, no method for quantitative estimation of the amount of information presented on the on-board display has been established so far. Accordingly, we conducted the following test B as a trial for quantification.

In test B, the test persons drove the same course as in test A. Random numbers instead of visual information from the vehicle information and communication system were displayed on the on-board display as shown in Fig. 2. The test persons drove while reading these characters out. In the tests B1, B2 and B3, 10, 20, 30 numbers were given respectively. The driving performance, the GSR appearing number, the pulse rate, and the glance duration time of the on-board display were measured in the same way as in test A. The attempt was made to express the amount of information presented on the on-board display as the character numbers on the basis of the glance duration time, the driving position and the following distance, etc.

4. Experiment Results

4.1. Results on Test A

Test A is conducted to estimate the qualitative effect of information presented on the in-vehicle display on driving. Table 2 shows the average values and the standard deviations of the lateral distance from the driving

center position and the following distance, where the case of information supply is compared with the case of no information supply. The values are larger in the case that the information is presented on the on-board display. Fig. 3 shows the difference of the pulse rate as the multiples of the normal rate and the GSR appearing number between the information supply case and the no information supply case. According to this figure, these values for information supply onto display are not quite different from those for no information supply. In this test, it was recognized that the test persons' driving performance are affected by the information supply and that the psychological effect on driving was not so appearing. According to the experiment results of eye movement, 16.9% of the total driving time is required to glance the in-vehicle display. For the driving speed, the test person drove ordinarily at the slower speed in the case of information supply.

4.2. Results on Test B

Test B is conducted to estimate the quantitative effect of information presented on the on-board display on driving. Table 3 shows the average values and the standard deviations of the lateral distance from the driving center position and the following distance, in the case that 10, 20 and 30 characters are presented. These values are not so increasing with the increasing number of the characters presented on the on-board display. Fig. 4 shows the difference of the pulse rate as the multiples of the normal rate and the GSR appearing number in the case that 10, 20 and 30 characters are presented. According to this figure, these values are not changing with the increasing number of the characters. The difference between the various character number supply is not observed, according to the driving performance, the pulse rate and the GSR appearing number. The glance duration time of the on-board display is increasing with the increasing number of the characters presented on the on-board display. From this point of view, this value is affected by character number. The regressive expression between the character number and the glance duration time of the on-board display can be obtained as shown Table 4.

In the test B, the effect of information presented on the on-board display on driving is not clearly observed, in the case that up to 30 characters are presented on the in-vehicle display.

5. Future Themes

In test A and test B, it is assumed that the highway driving simulator at Public Works Research Institute reproduces the real field accurately. The highway driving simulator is useful to measure the indicators, driving

performance, speed change and glance duration time of the on-board display. To estimate the indicating method of information on the on-board display using the highway driving simulator, we need to confirm that the highway driving simulator reproduced the real field. To estimate the applicability of the highway driving simulator, the experiment on the highway driving simulator is compared with the experiment on the test course. The same test course at Public Works Research Institute is used in both experiments. The experiment conditions and the measuring items are as follows.

(1) Experiment Conditions

a) Subject

aged and un-aged

men and women

persons with various driving history

b) Operating speed

speed range with around 40~140km/h

c) Weather condition

day and night

fine and rain

(2) Measuring Items

a) Operating performance

lateral distance from the operating center line

speed change in driving

b) Glance duration time

required time in glancing the on-board display

eye movement in driving

Table 2 (a) Lateral Distance from Driving Center Position

	information supply		no information supply	
	standard deviation	average	standard deviation	average
Men	0.297	1.420	0.579	1.789
Women	0.385	1.165	0.573	1.612

Table 2 (b) Following Distance

	information supply		no information supply	
	standard deviation	average	standard deviation	average
Men	24.126	40.972	32.239	49.746
Women	22.791	42.600	28.046	46.143

Table 3 (a) Lateral Distance from Driving Center Position

	10 characters supply		20 characters supply		30 characters supply	
	standard deviation	average	standard deviation	average	standard deviation	average
Men	0.232	1.571	0.157	1.208	0.222	1.498
Women	0.176	1.044	0.153	1.086	0.174	1.227

Table 3 (b) Following Distance

	10 characters supply		20 characters supply		30 characters supply	
	standard deviation	average	standard deviation	average	standard deviation	average
Men	8.586	40.110	10.441	31.497	10.603	32.632
Women	9.593	38.466	9.314	33.409	12.241	39.613

Table 4 Regression Expression between Glance Duration Time and Character Numbers

	glance duration time (sec)			regression expression
	10 CHs	20 CHs	30 CHs	
Total	20.66	35.39	48.05	$Y = 1.3695X + 7.312$
Men	22.22	35.66	50.87	$Y = 1.4328X + 7.59$
Women	19.10	35.13	45.23	$Y = 1.3062X + 7.03$

Y : Character number

X : Glance Duration Time

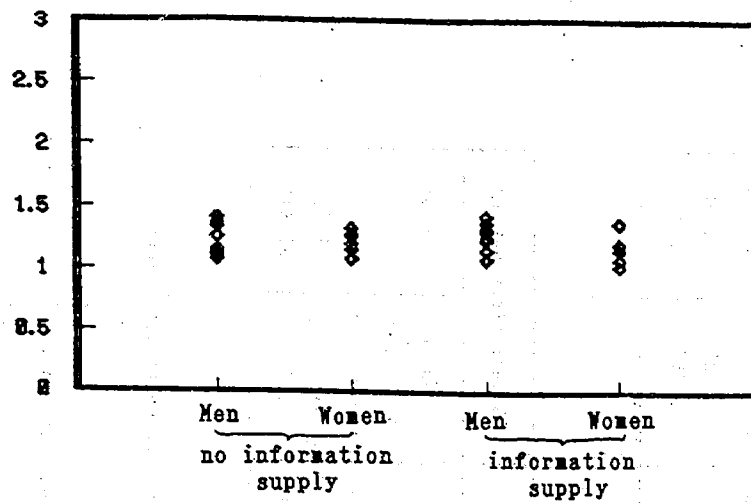


Fig.3 (a) Pulse Rate as the Multiple of Normal Rate

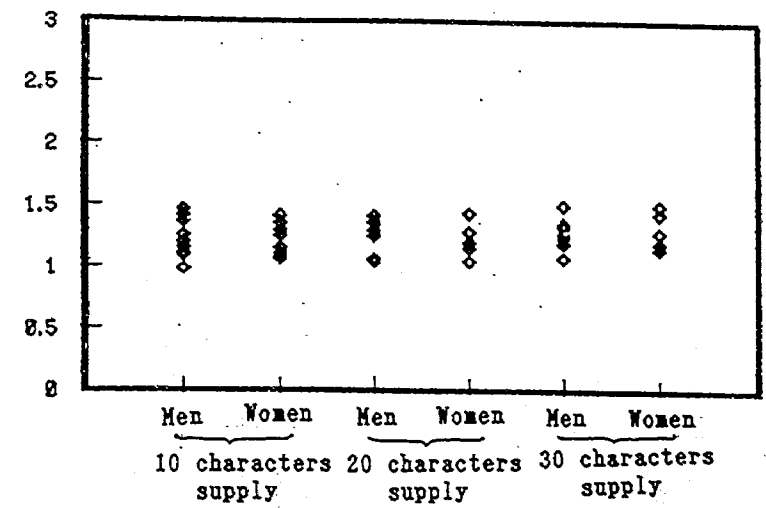


Fig.4 (a) Pulse Rate as the Multiple of Normal Rate

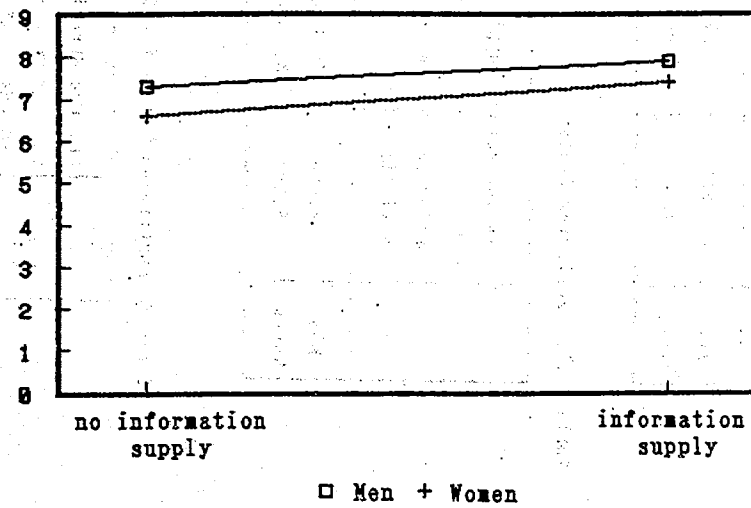


Fig.3 (b) GSR (Galvanic Skin Response) Value

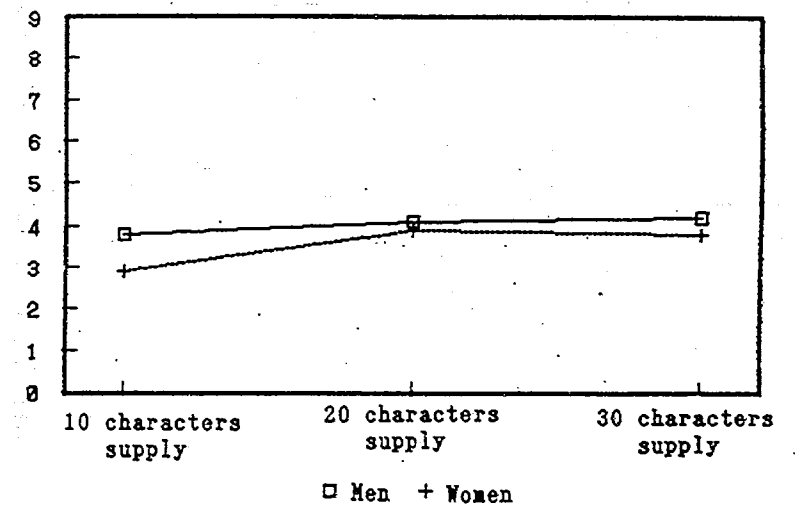


Fig.4 (b) GSR (Galvanic Skin Response) Value

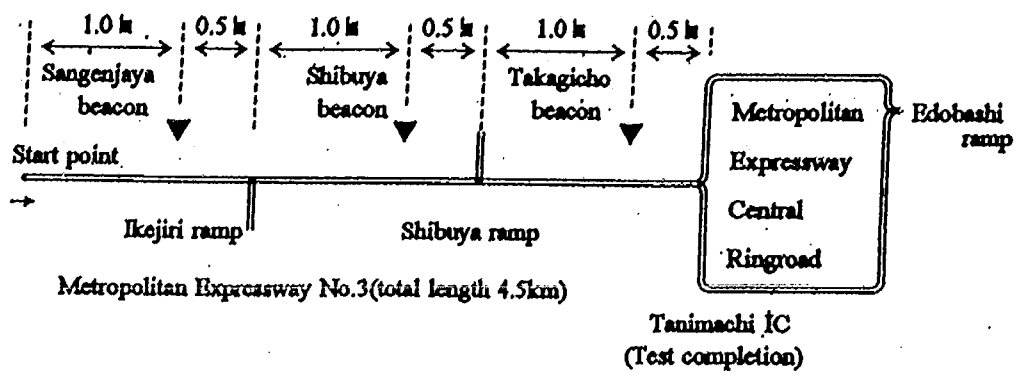


Fig. 1 Test course

Table 1 Traffic information

Information	Location of beacons		
	Sangenjaya	Shibuya	Takagicho
Parking area			
Time to be taken			
Route guidance			

36579	37048
37260	02579
16531	34502
34942	13864
84951	68024

Fig. 2 Display character information
(10 random numbers)

日米科学技術協力協定に基づく
第2回日米IVHS合同分科会概要集

ISSN 0386-5878
土研資料 第3359号
平成7年 月(1995)

本報告書は、1994年11月に米国のワシントンD.C.で開催された第2回日米IVHS合同分科会の概要をとりまとめたものである。合同分科会では、研究発表、日米共同研究に関する討議、スタディツアーが実施された。

キーワード：日米IVHS合同分科会、日米共同研究、IVHS

郵便はがき

3 0 5 - □ □

郵便切手
はつて下
さい。

建設省土木研究所

道路研究室

御中

茨城県つくば市大字旭一番地

No. _____

No. _____

配布先住所

配布先氏名

土木研究所資料 第 3 3 5 9 号 部

上記のとおり受領しました。

所 属 (住所)

氏 名

印