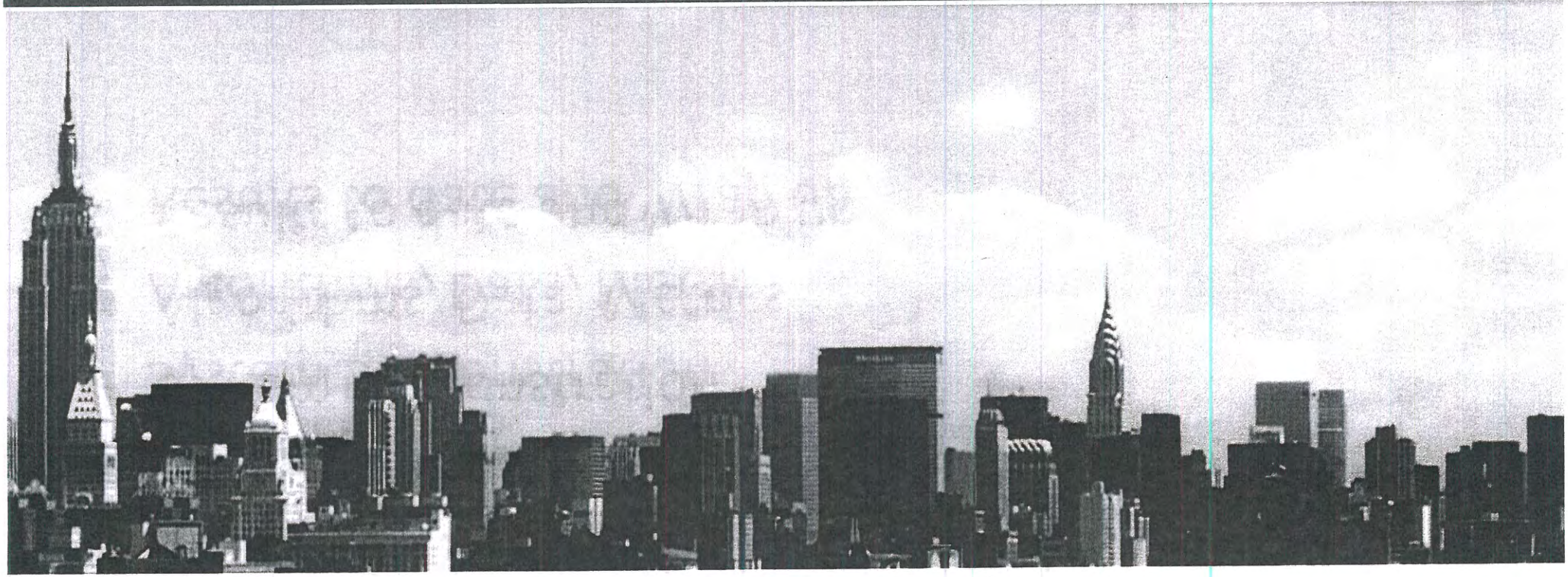
New York City Active Traffic Management
Midtown in Motion



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U.S Department of Transportation
Federal Highway Administration

NEW YORK CITY DOT

TRANSCORE.

KLD

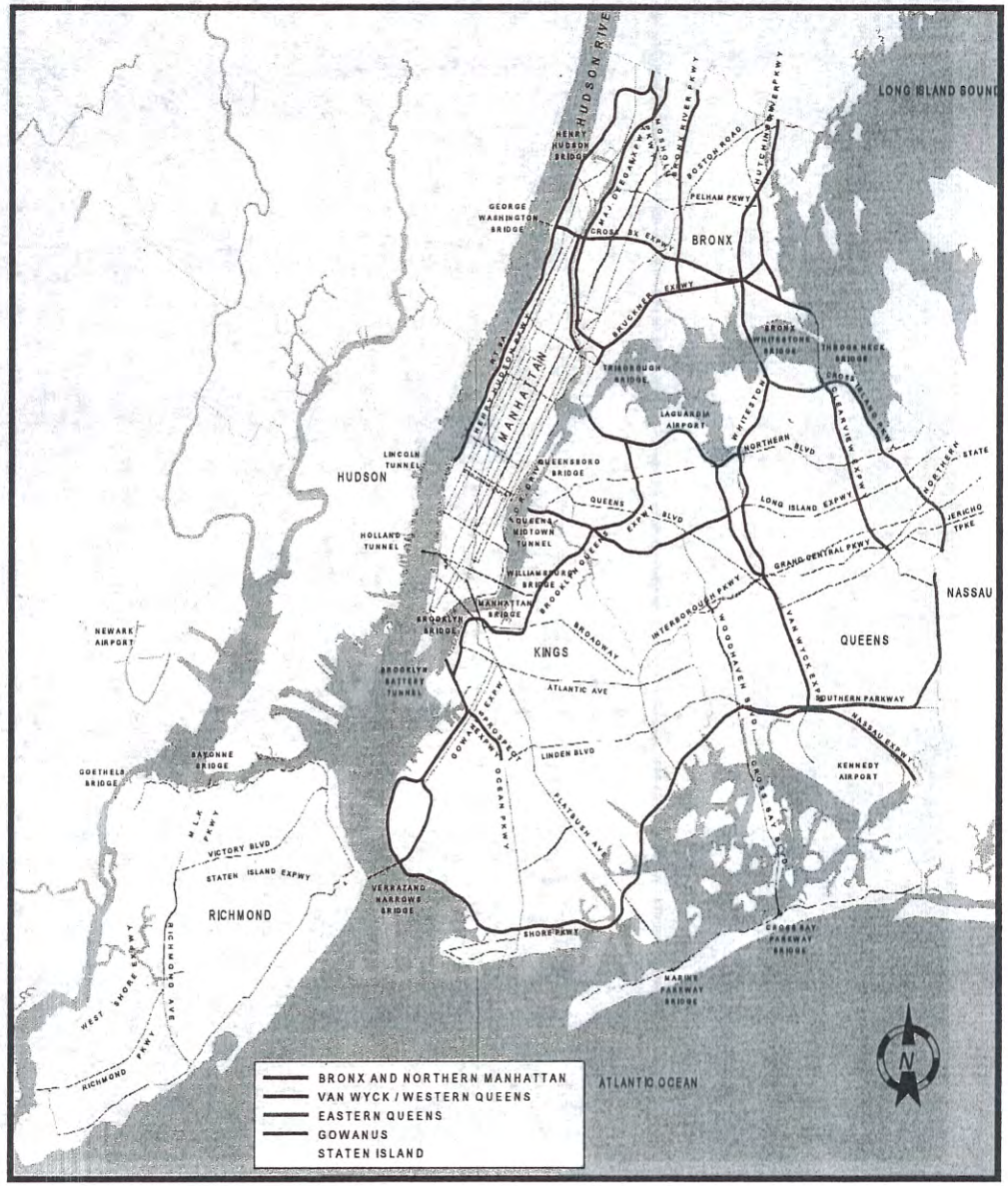
Overview

- FHWA, NYCDOT, and ITS
- Background of MIM project
- Choice of ITS Technologies Deployed
- System Design
- System Demonstration
- Algorithms, Data, Metrics
- Results to date and Wrap up

FHWA/NYCDOT TEAM PARTNERSHIP APPROACH IN ALL ITS/OPERATIONS INITIATIVES

New York City's Diverse Network

- Multi-agencies
- Multi-jurisdictions
- Multi-model
- Multi-centers
- Inter-modal
- Freight Corridor
- Regional



- 1 million vehicles/Day
- 5 million commuters/Day
- 16 major bridges/tunnels
- 13 tri-state TMC's

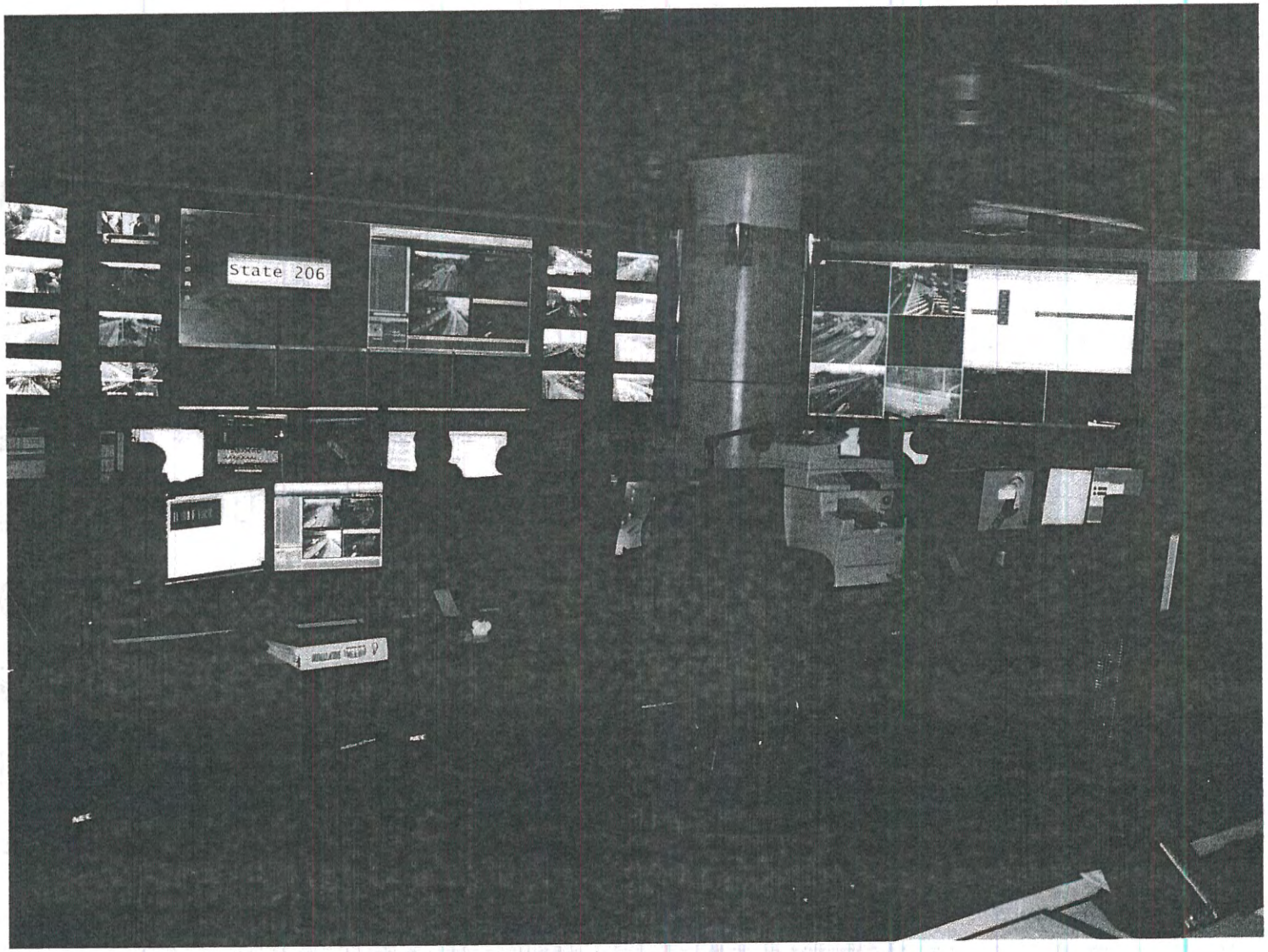
Team Partnership Approach

Time Frame	Project/Activity
1994-1996	NYSDOT/NYCDOT develop a concept and funding approach for a Joint Traffic Management Center (JTMC). With the addition of the New York Police Department, the JTMC will be a center for monitoring and management of ITS and incidents on the surface streets and limited access freeways in the 5 boroughs. The predecessor of the JTMC was the JTOC which was operational from 1999 to early 2008. Prior to the JTOC was the Gowanus TOC for the Prospect/Gowanus corridor.
1997	NY/NJ/CT Model Deployment Initiative (MDI) – With a focus on traveler information and information sharing, the MDI involved a large number of multimodal transportation stakeholders in the tri-state region.
Early 1990's-1999	NYC Early Deployment Plan (EDP) - This Federal ITS Program funded field operational tests and Early Deployment Plans in the New York City Sub-region. The NYC EDP encouraged stakeholders to assess needs, identify and prioritize ITS related projects, and plan for deployment. It served as the catalyst for all post-EDP activities (i.e. NYCSRA).

Team Partnership Approach (Contd.)

Time Frame	Project/Activity
2000	Tier I/II Workshops - The Tier I/II workshops, facilitated by the National ITS Architecture Team, provided the sub-region with an initial inventory of existing and planned ITS elements. The workshops served as the foundation for the later development of a comprehensive New York City Sub-regional ITS Architecture. The workshops led stakeholders to develop a preliminary ITS architecture and Turbo Architecture database of ITS elements.
2001	NYC Sub-regional ITS Architecture Development White Paper - The four lead agencies commissioned a white paper to outline alternatives for development of an ITS Architecture. Elements of the NYC EDP and Tier I/II Workshops were identified as essentially ground work.
2002-2004	NYMTC Integration Strategy - An ITS integration visionary strategy with a time horizon of 20 years was developed, consistent with the NYMTC region's long-range transportation plan.
2001-2005	USDOT Rule 940: NYC Sub-regional ITS Architecture: The planning & development of the ITS architecture with emphasis on the "Functional Meeting" approach.
Present	Active Transportation & Demand Management

Joint Transportation Management Center (Queens)

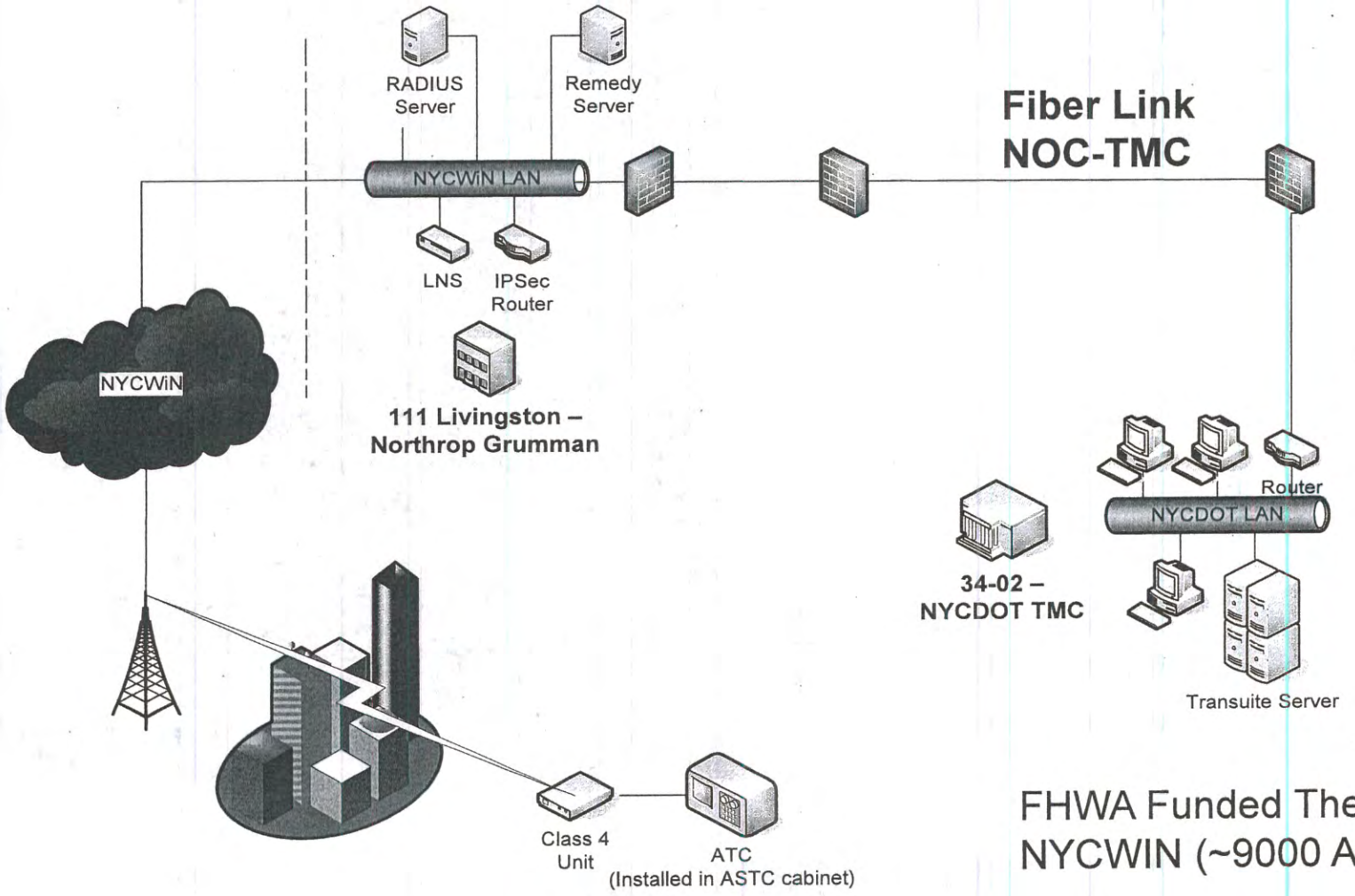


NYSDOT, NYCDOT, NYPD

New York City Department of Transportation

- TMC in Queens (Long Island City – East of the 59th St. Bridge) - intersection management & NYPD Administration
- NY City has **~12,400 Signalized Intersections**
- Circa 1970 - 2006: VTCS central real-time active control ~6100
- Manhattan: ~2,700 Outer boroughs: ~3400
- Leased telephone lines: >$7M annually ~4000 intersections
- 2007/2009: Topics IV Computerization Expansion (~2,200) & Wireless
- Long-held favored Manhattan-bound in the AM/PM outbound

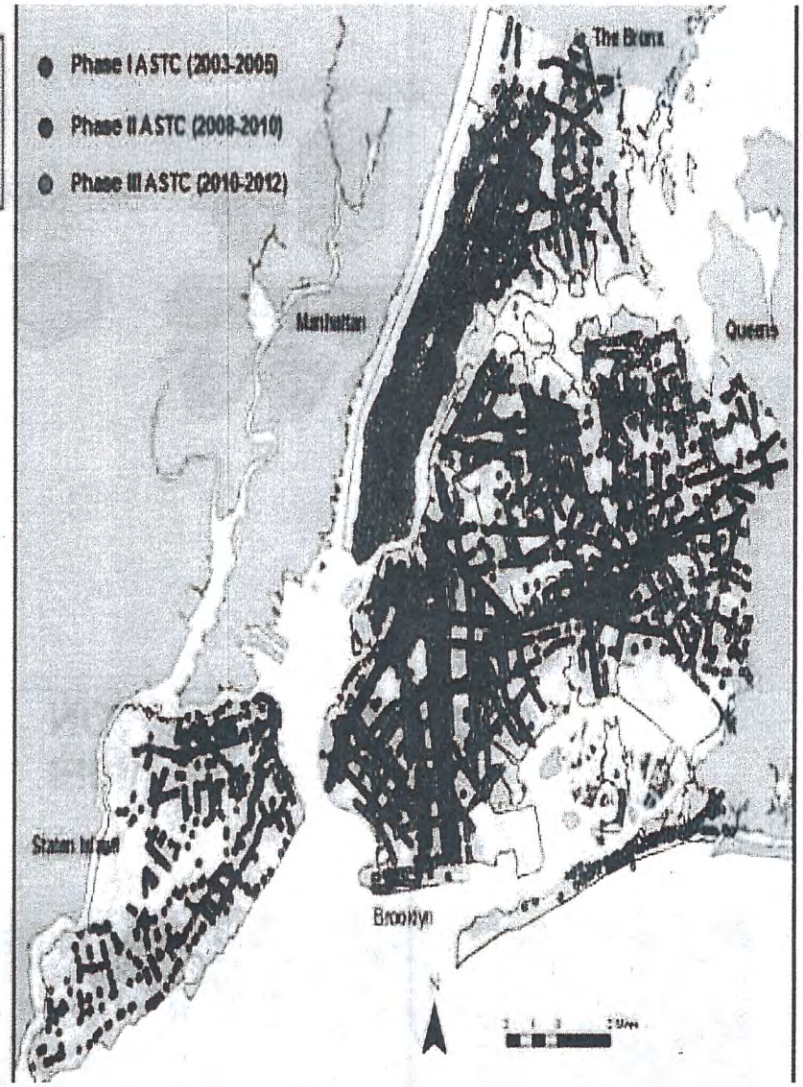
NYC Wireless Network (NYCWIN)



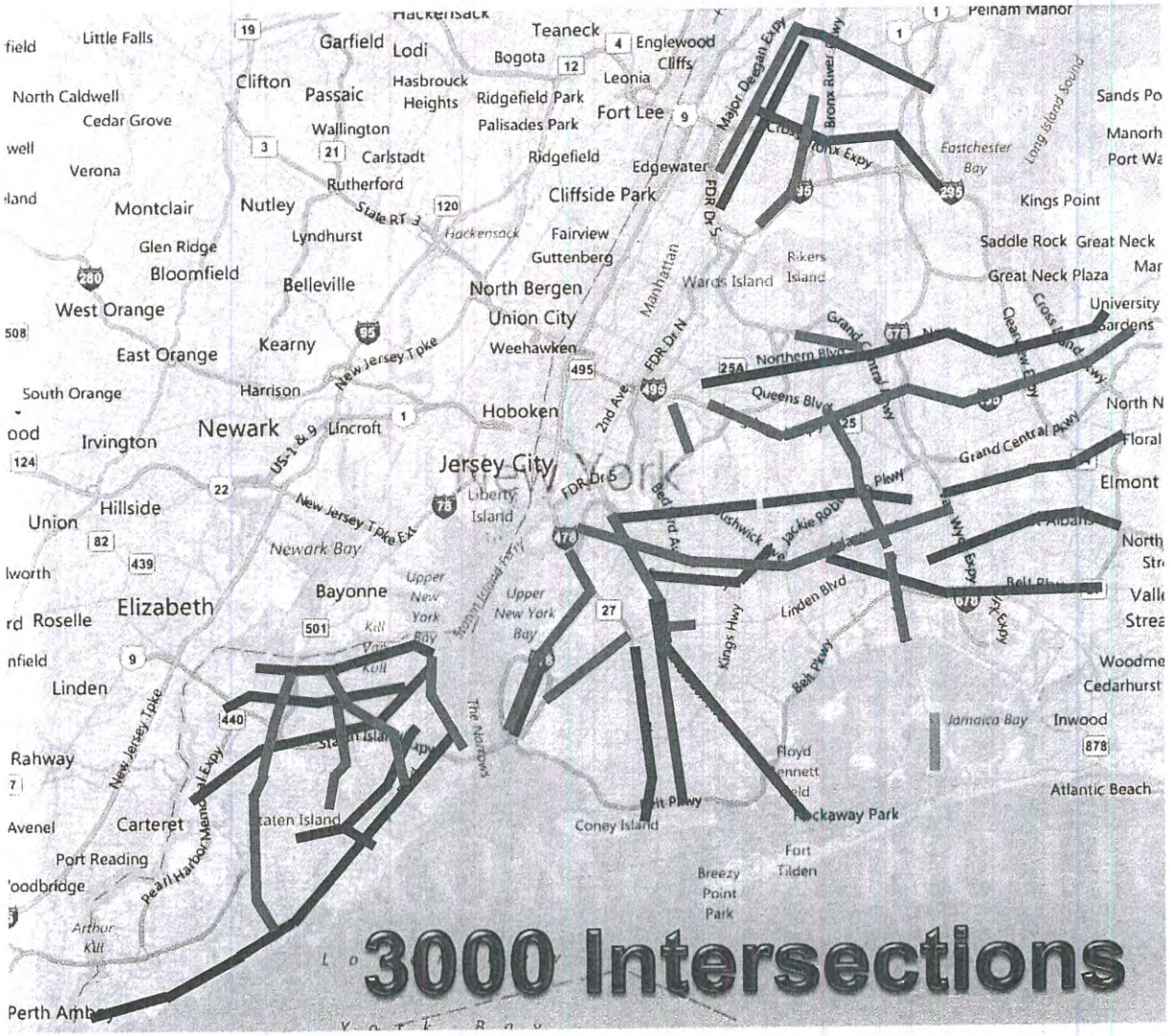
FHWA Funded The Migration to NYCWIN (~9000 ASTC's to-date).

Advanced Solid-State Traffic Controllers

Advanced Solid-state Traffic Controller Deployment Program



Traffic Signal Retiming

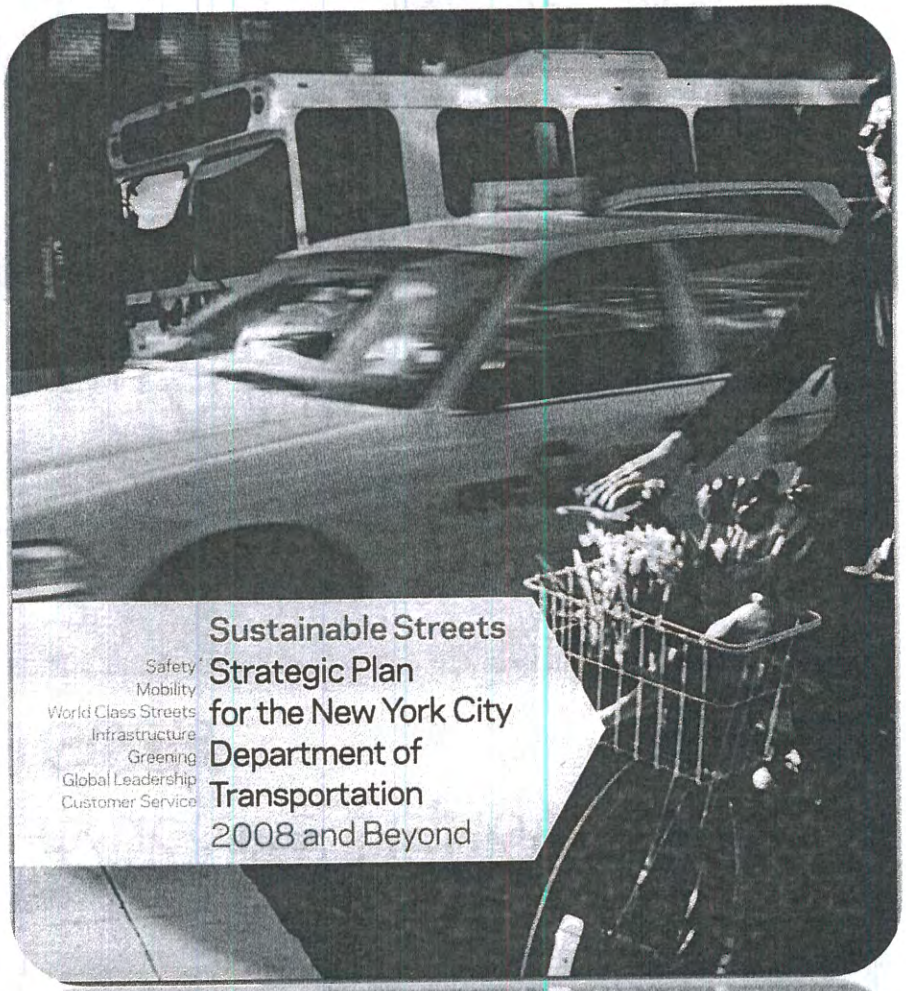


"MIDTOWN IN MOTION" (MIM) IS AN INTEGRAL PART OF THE NYCDOT ENHANCED MOBILITY STRATEGY

Bruce Schaller
Deputy Commissioner, NYCDOT

NYCDOT

- Sustainable Streets: NYCDOT's Strategic Plan
  - Vision for NYC
  - Improve Mobility
  - Modernize ITS



NYCDOT – Modernize ITS

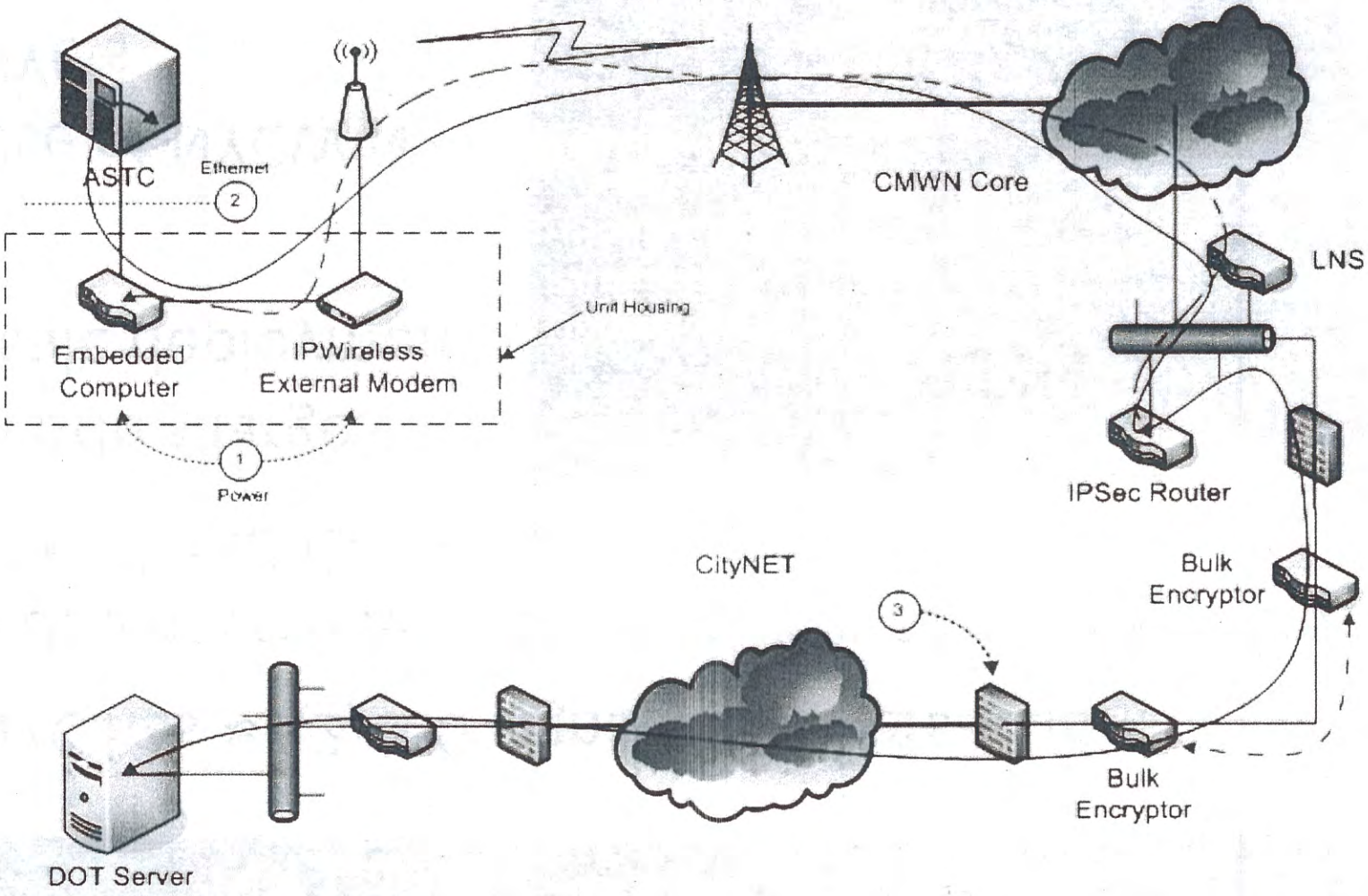
State-of-the-Art ITS Infrastructure Deployment Program Goals

NYCDOT – Modernize ITS

- NYC has ≈ 12,400 signalized intersections
- 9,000 have been upgraded to smart controllers (ASTC) and the remaining are in progress
- World's largest scale deployment
- Use of NYCWiN – NYC's communication network

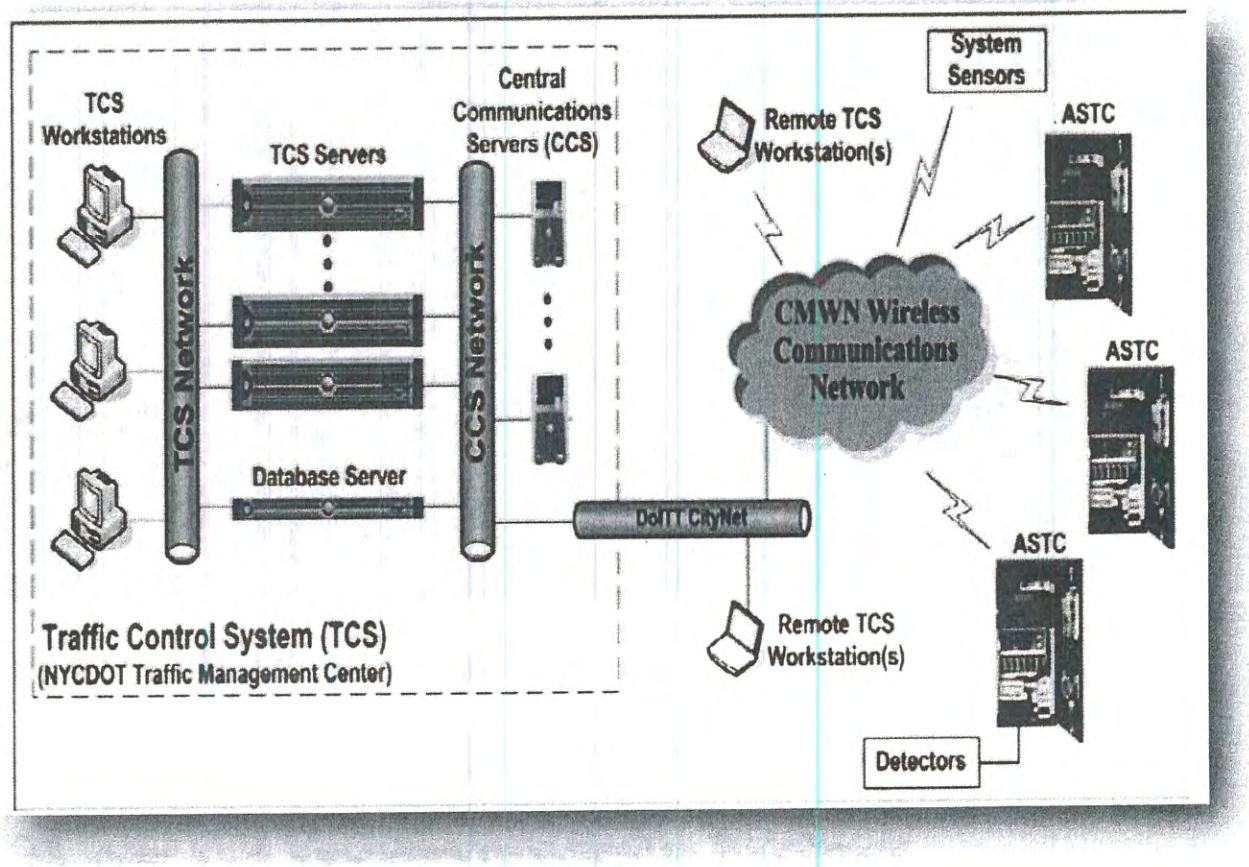
NYCDOT – Modernize ITS

- NYCWiN – New York City Wireless Network



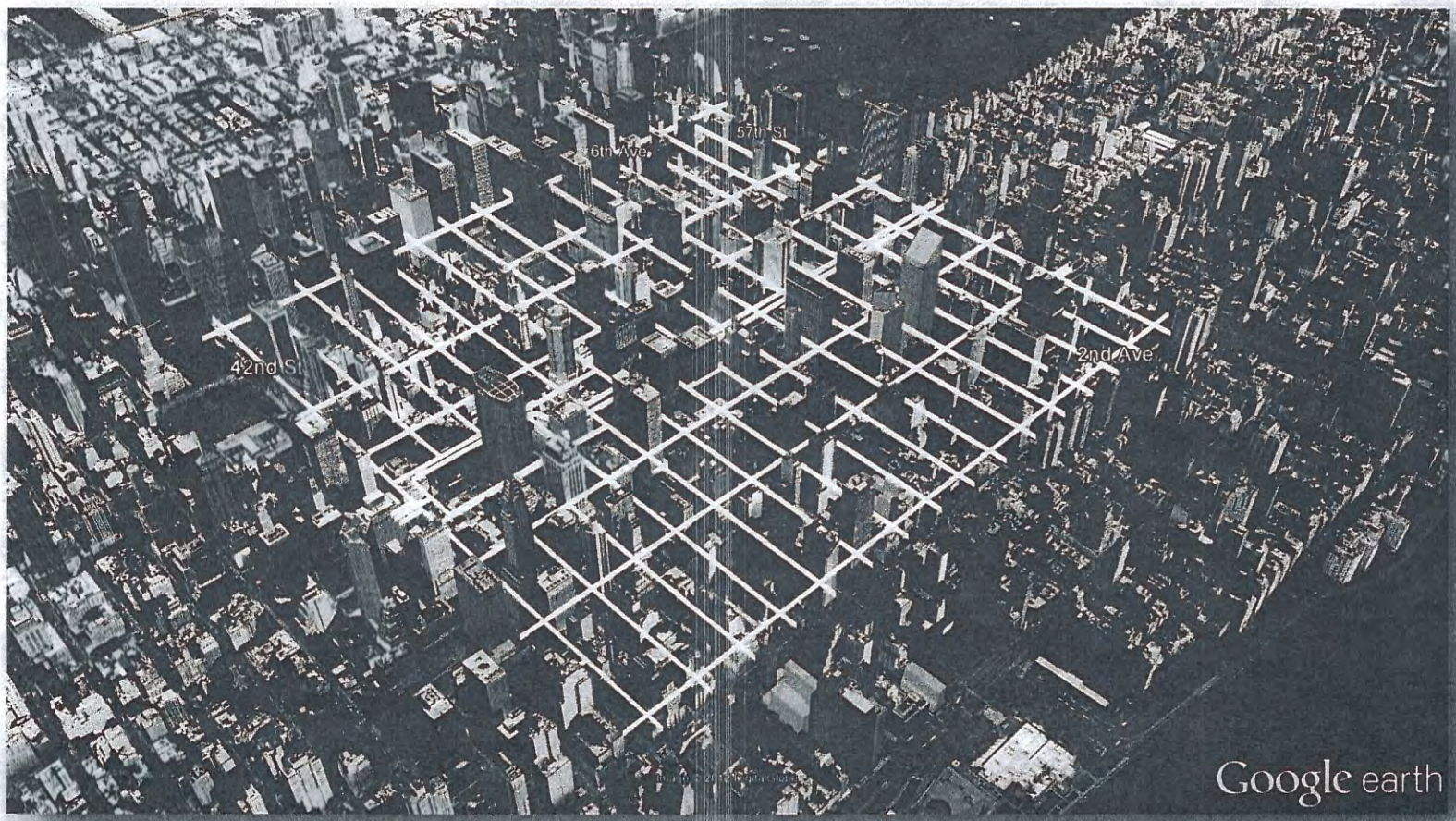
NYCDOT – Modernize ITS

- NYC Traffic Control System (TCS) to replace VTCS
- ASTC
- NTCIP field communications
- Traffic Responsive
- TSP oriented
- Real-time data collection
- Dynamic split adjustment
- Adaptive Traffic Control



Midtown in Motion (MIM)

- *MIM – An off shoot of the ITS Modernization project*
- Study Area -- Midtown Manhattan – Powerhouse of NYC
- Initial Zone: 2 Ave to 6Ave, 42St to 57St



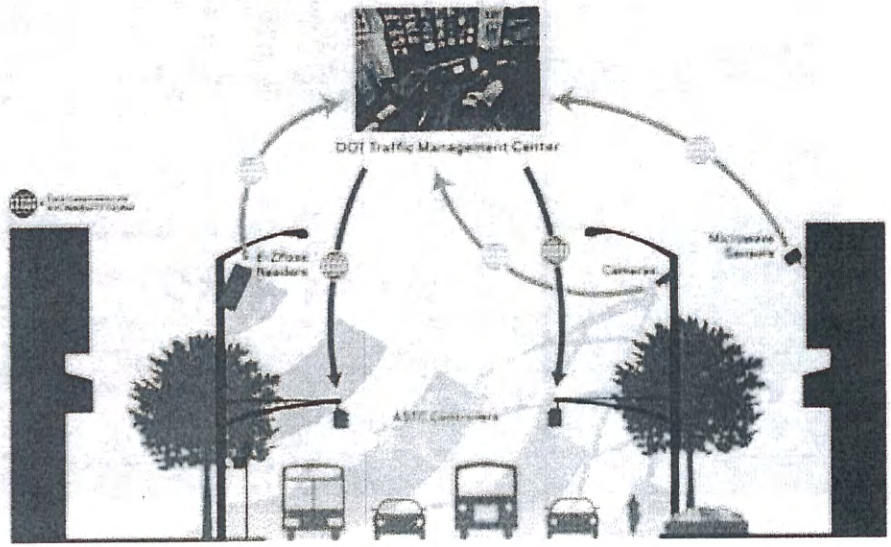
THE LOGICAL FOUNDATION FOR THE MIM ACTIVE TRAFFIC MANAGEMENT INITIATIVE

Mohamad Talas, PhD P.E. PTOE
Deputy Director, NYCDOT ITS

Project Challenges and Approach

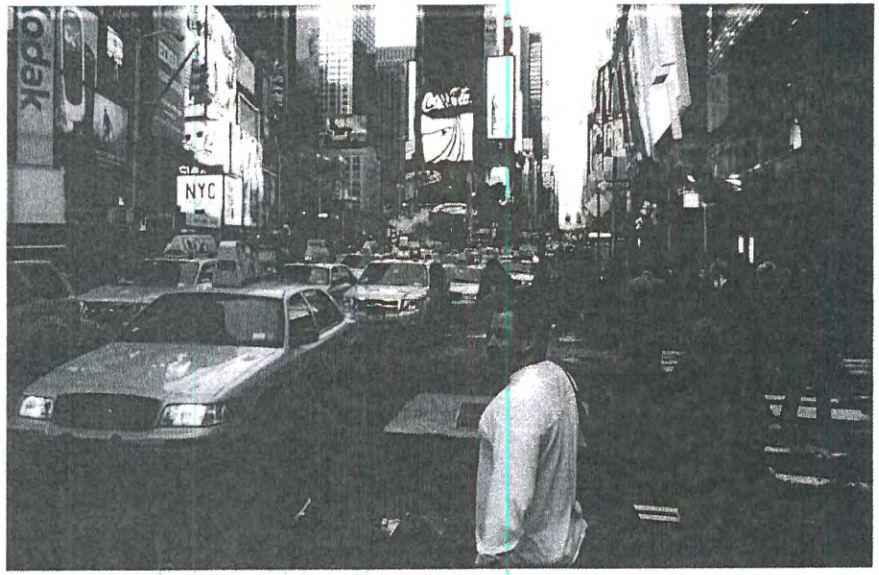
- Dense CBD
- Oversaturated, congested
- Low vehicle speeds (< 10 mph)

- Need reliable data to manage and assess performance
- Need a centralized system to monitor and control



Project Challenges and Approach

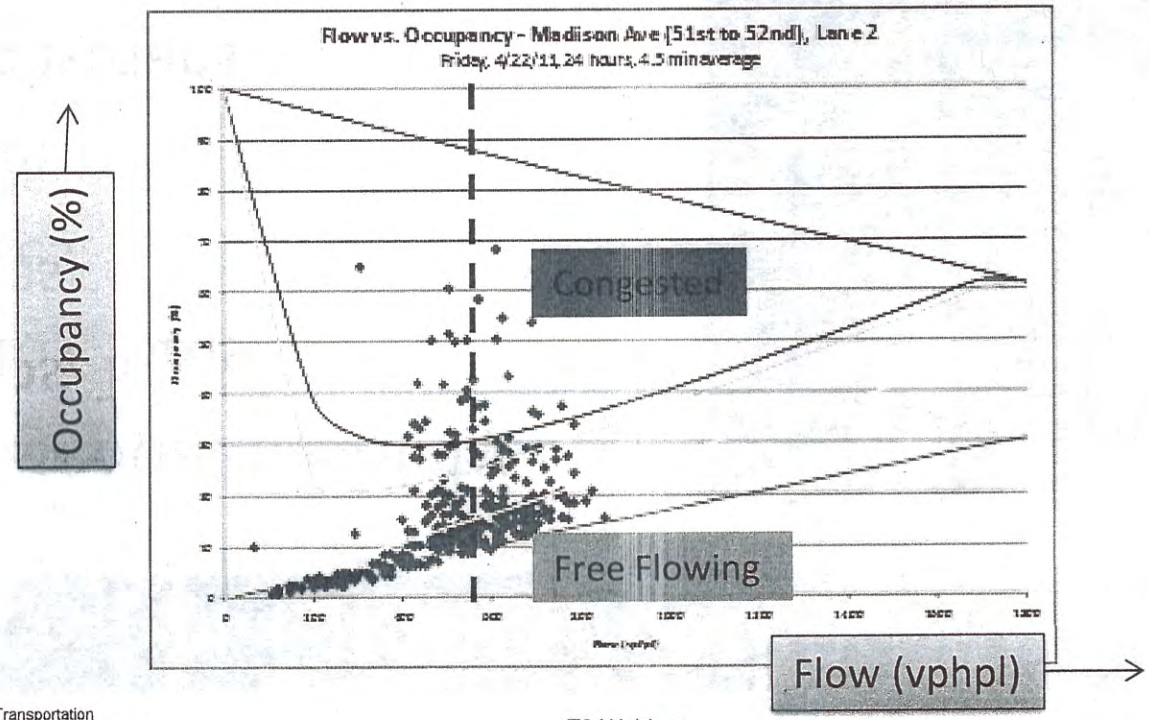
- Multi-modal mobility
  - Autos, Taxis
  - Buses
  - Bikes
  - Pedestrians



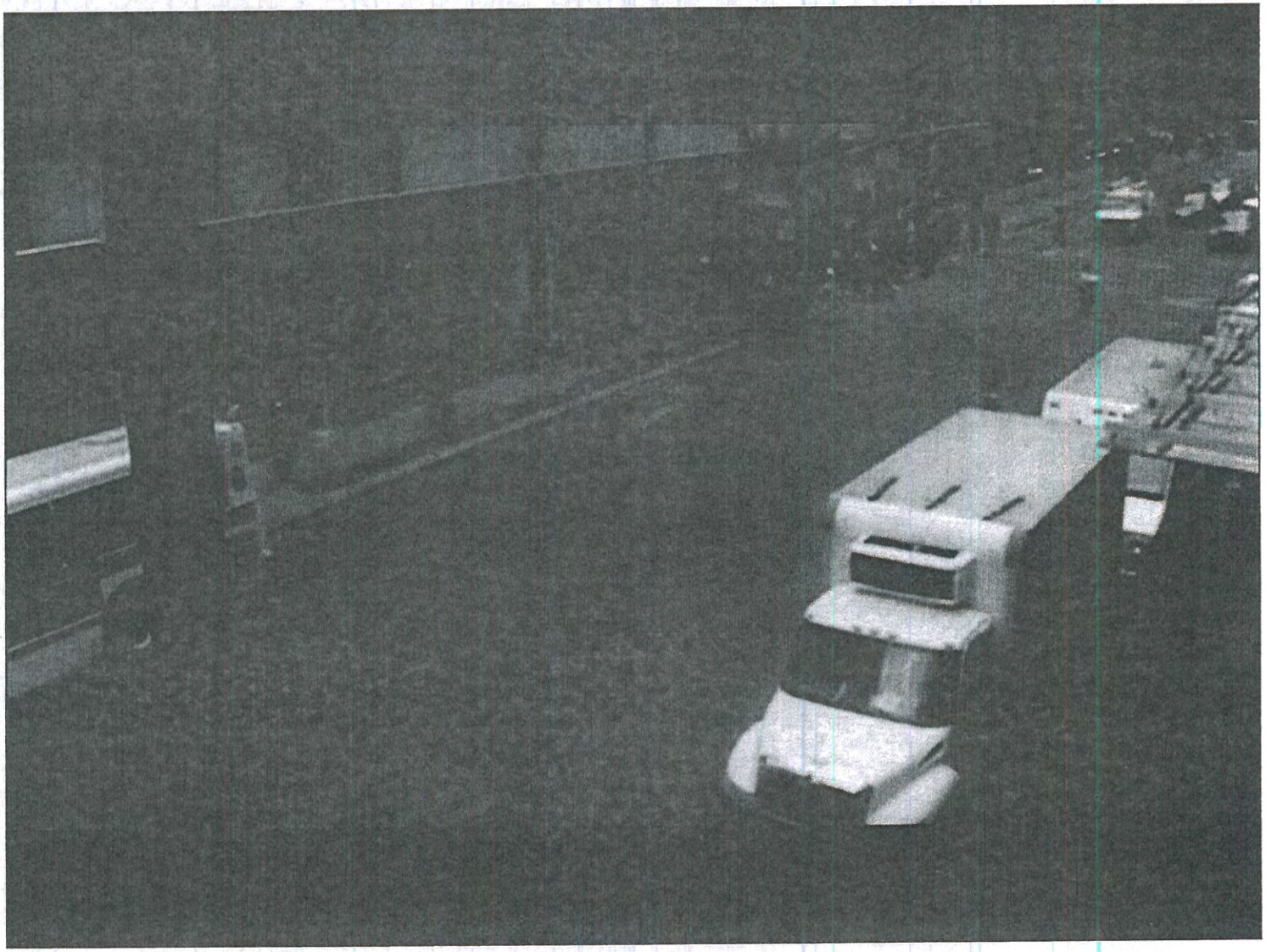
- Fixed cycle lengths (90s)
  - Synchronization across dense grid
  - No pedestrian push button/actuations
  - Minimum phase requirements addressed

ITS Design

- Microwave Sensors
  - Use both flow & occupancy
  - Given flow – different occupancies, different flow conditions
  - Concept of regimes
  - Define level of congestion using both measures

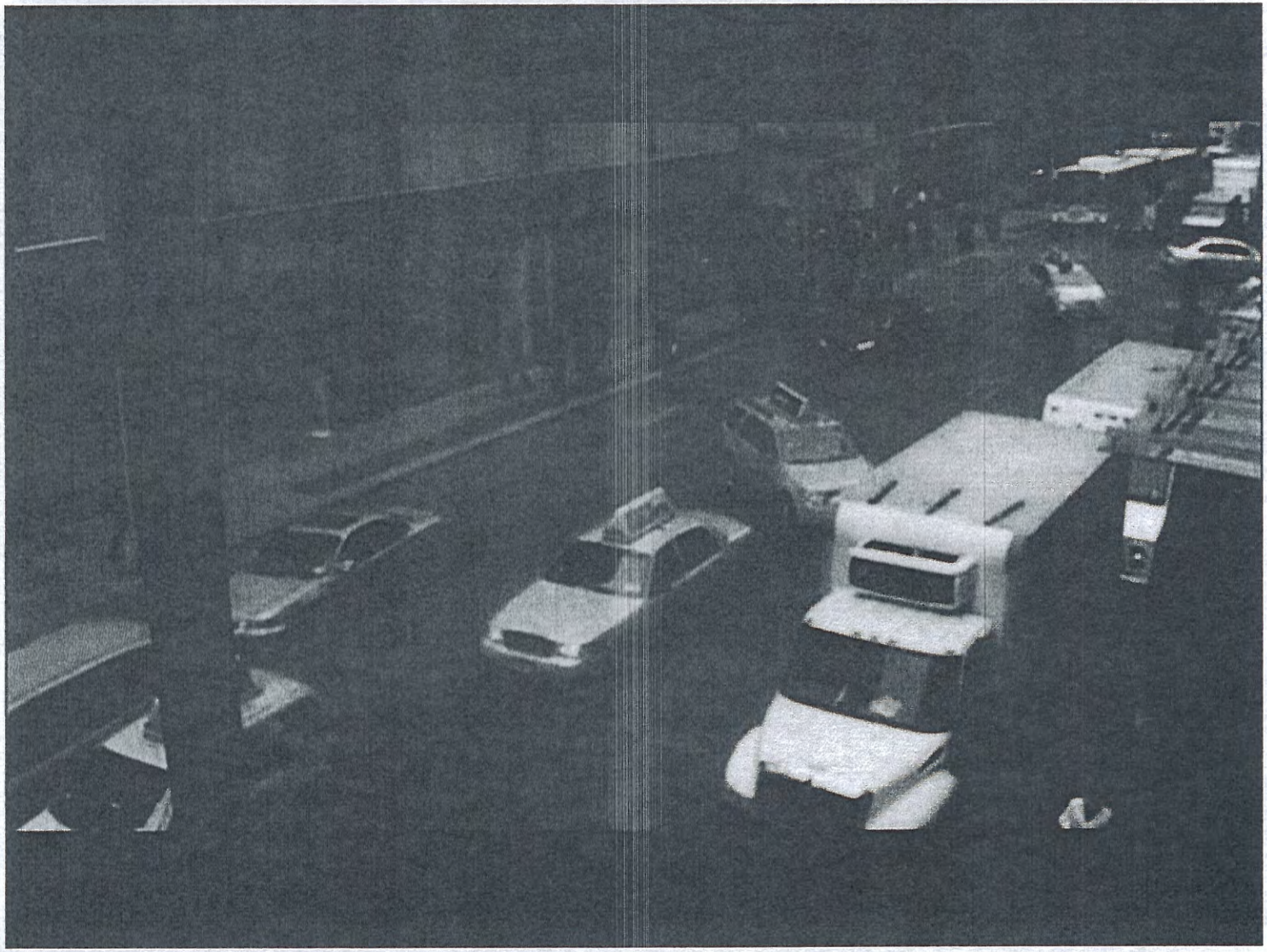


≈10% Occupancy



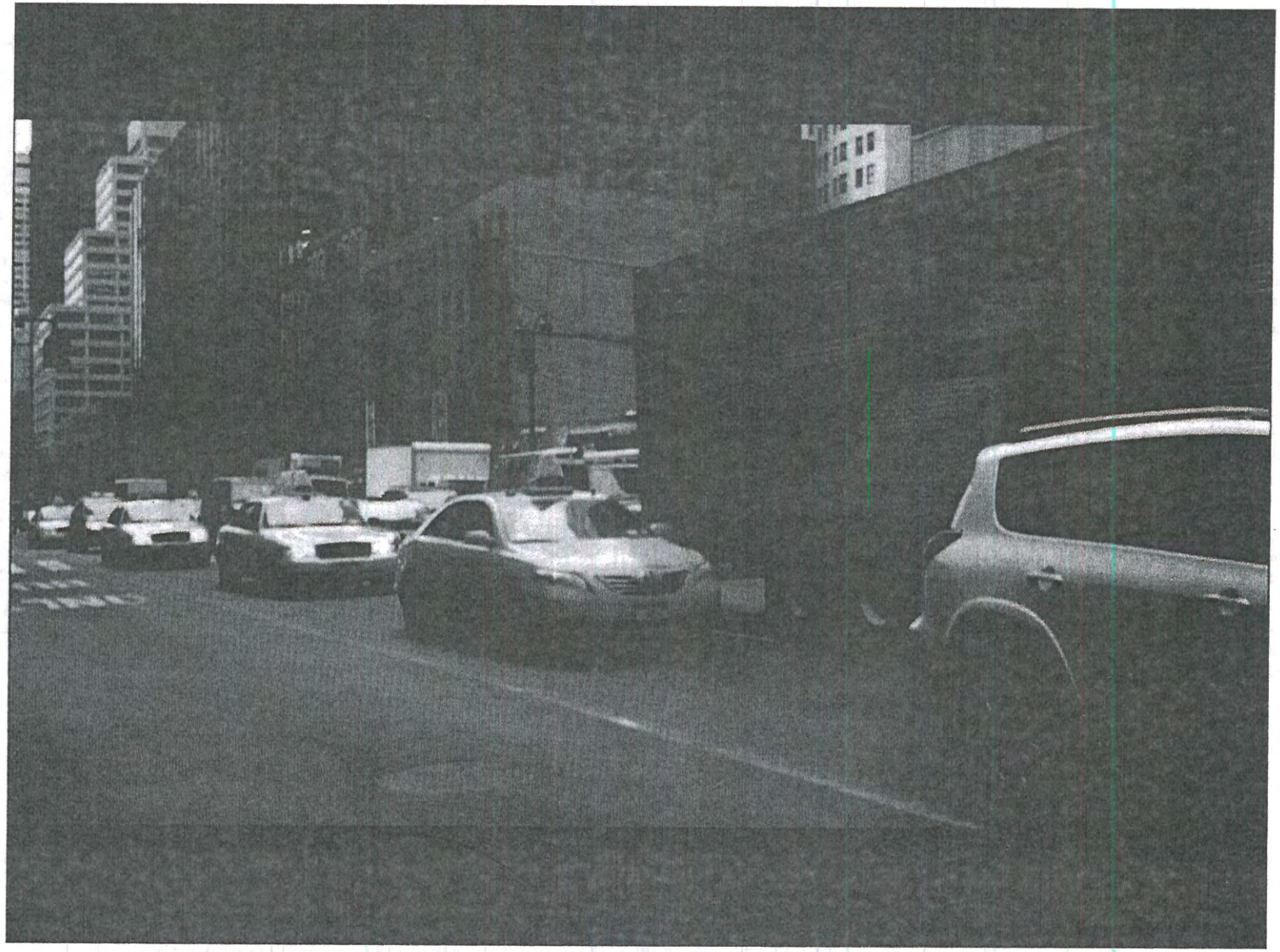
Lexington Ave between 58th and 59th Street

≈ 30% Occupancy



Lexington Ave between 58th and 59th Street

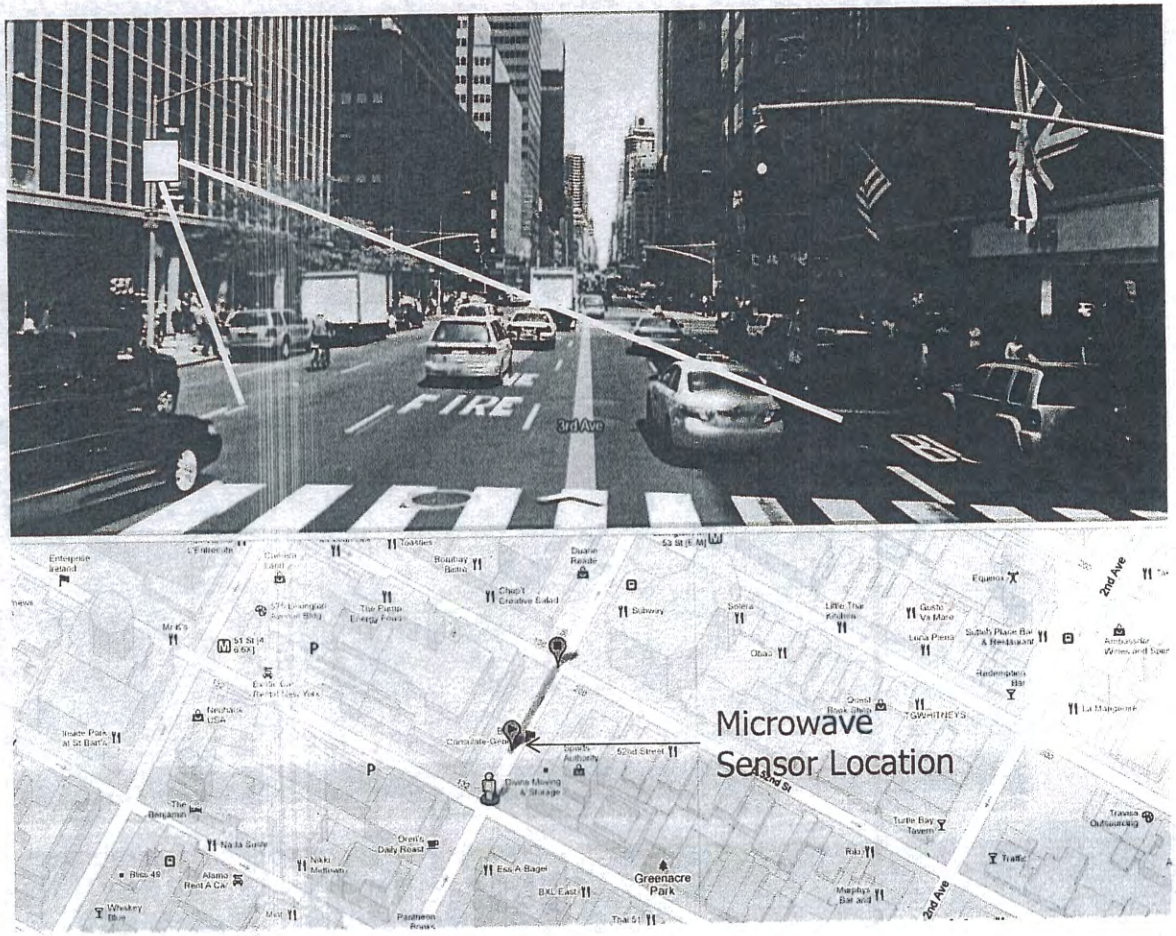
≈ 50% Occupancy



3rd Ave between 44th and 45th Street

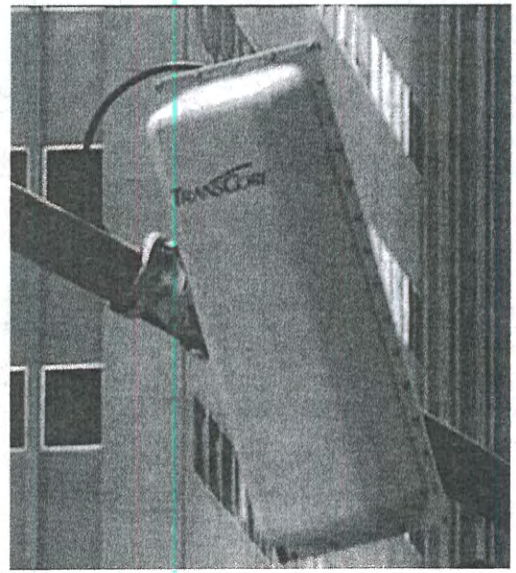
ITS Design

- Microwave Sensors
  - Mid block location ideal



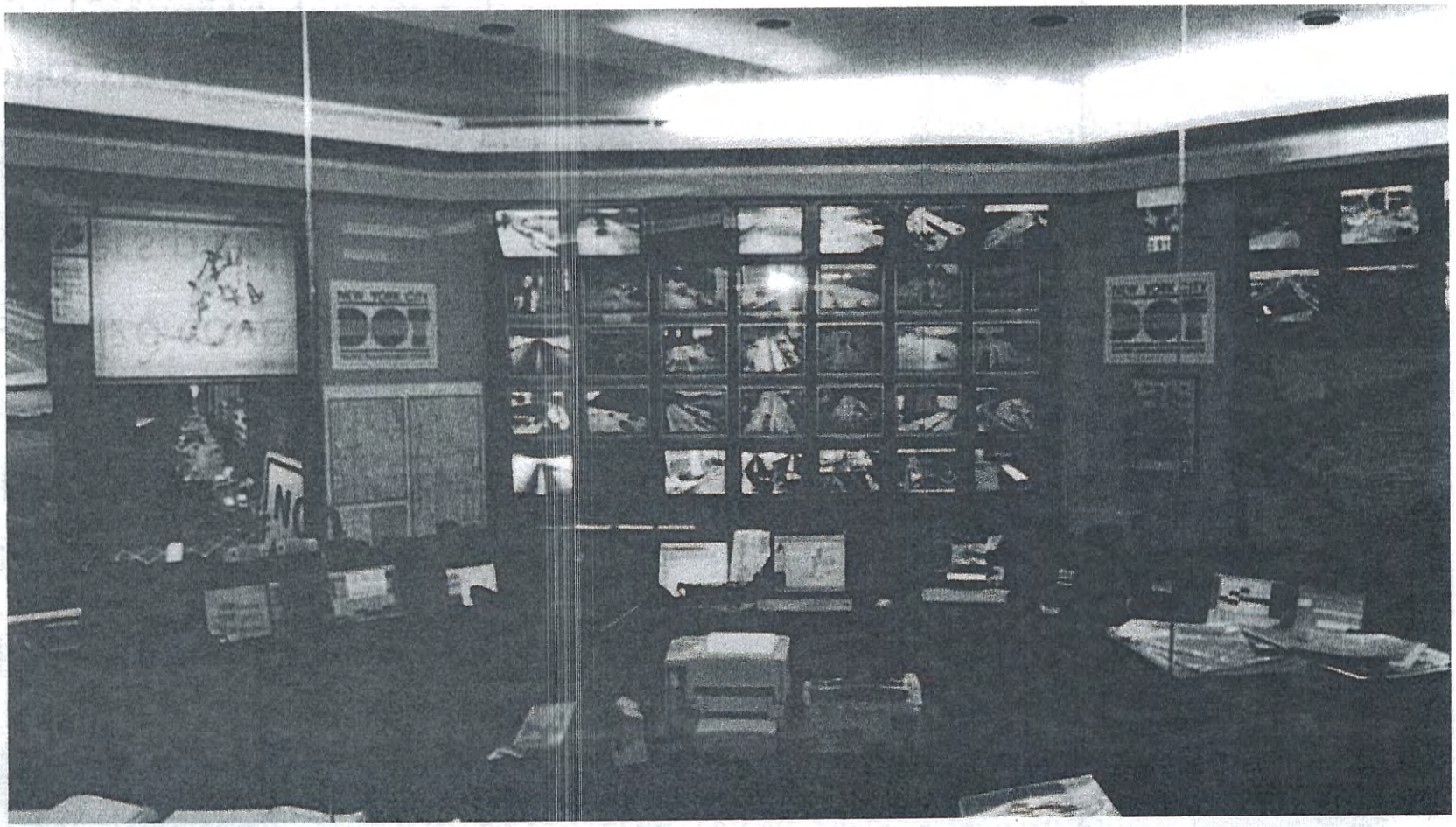
ITS Design

- ETC Tag Readers
  - Unique environment with high penetration of ETC tags
  - Strategic placement
  - Maximize coverage
  - 2 readers per location
  - Reliable source of travel time
  - Works under congested conditions and slow vehicle speeds



ITS Design

- Video Cameras
  - Observe, Verify, and Monitor

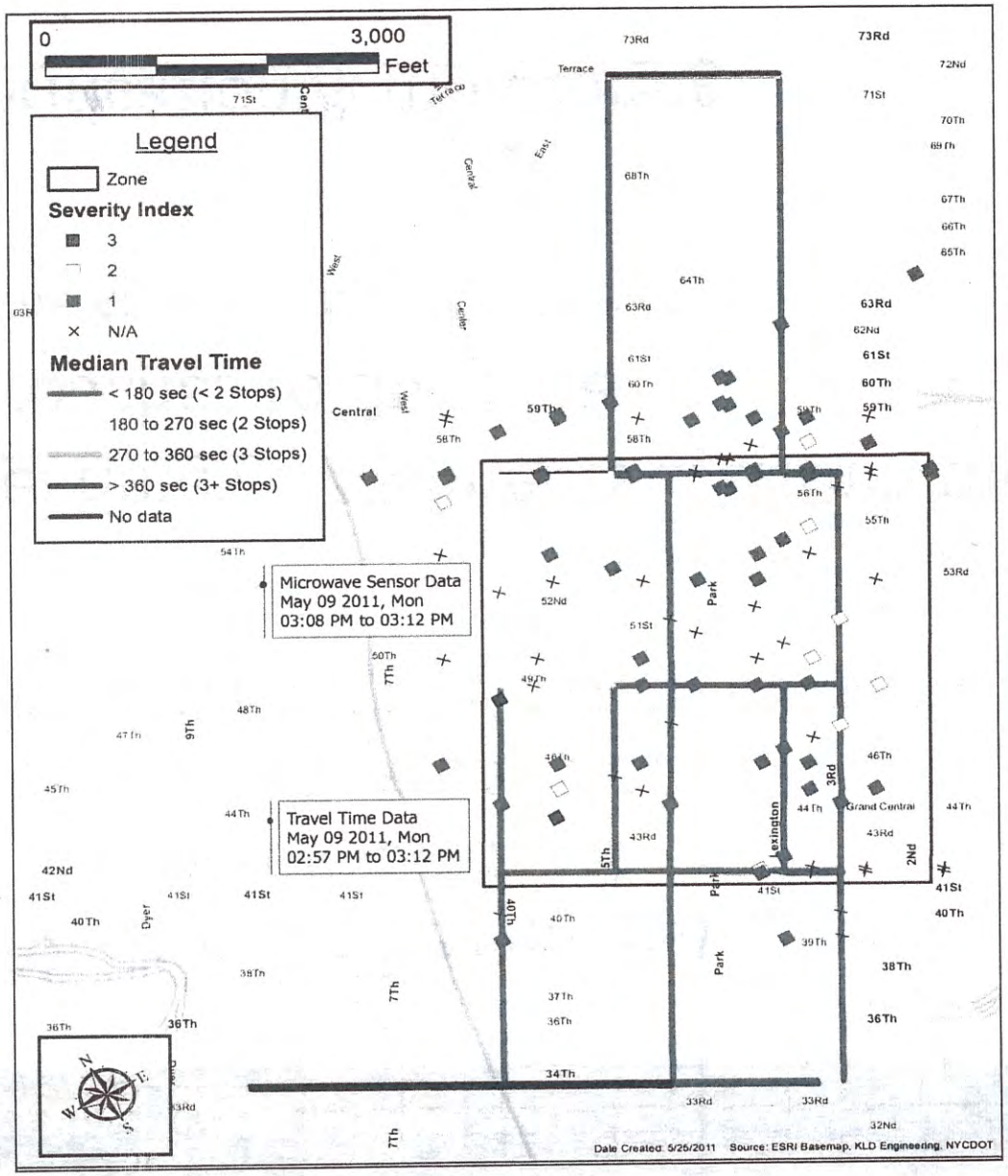


Sensor Network

- Microwave sensors, for flow and occupancy throughout the area and at key locations
  - Flow in thru lanes, as an indicator of need for action
  - Occupancy when combined with flow indicates level of congestion
- ETC readers, for travel times in segments … within the zone and on the approaches to the zone
  - Typically, 8-block segments on north-south arterials
- Video cameras for verification & monitoring

Sensor Network Deployed

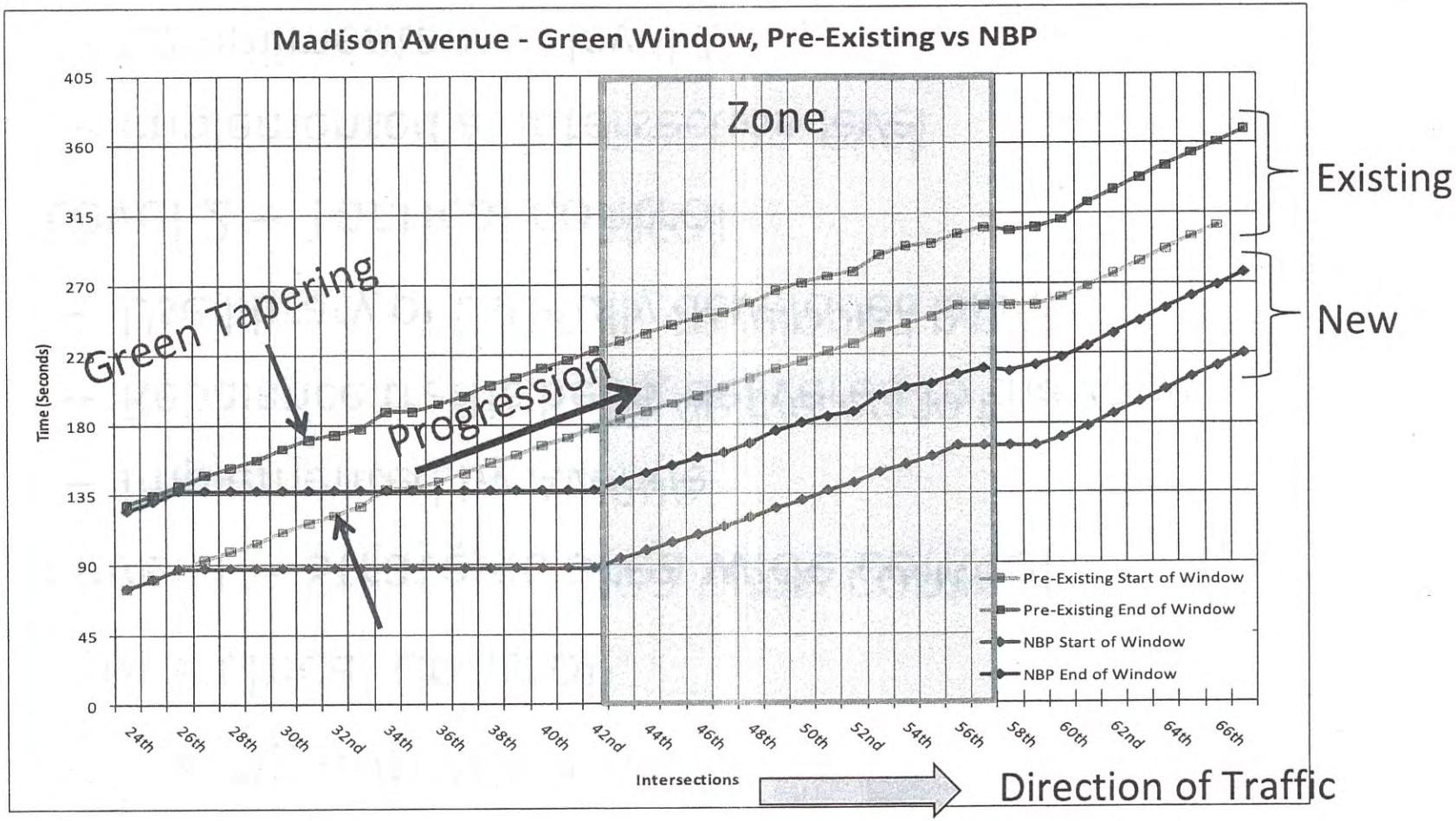
- ETC Tag Readers
  - Travel Time
  - 23 readers
- Microwave Sensors
  - Flow and Occupancy
  - 100 sensors
- Cameras
  - Field Conditions
  - 25 IP cameras



Control Policy

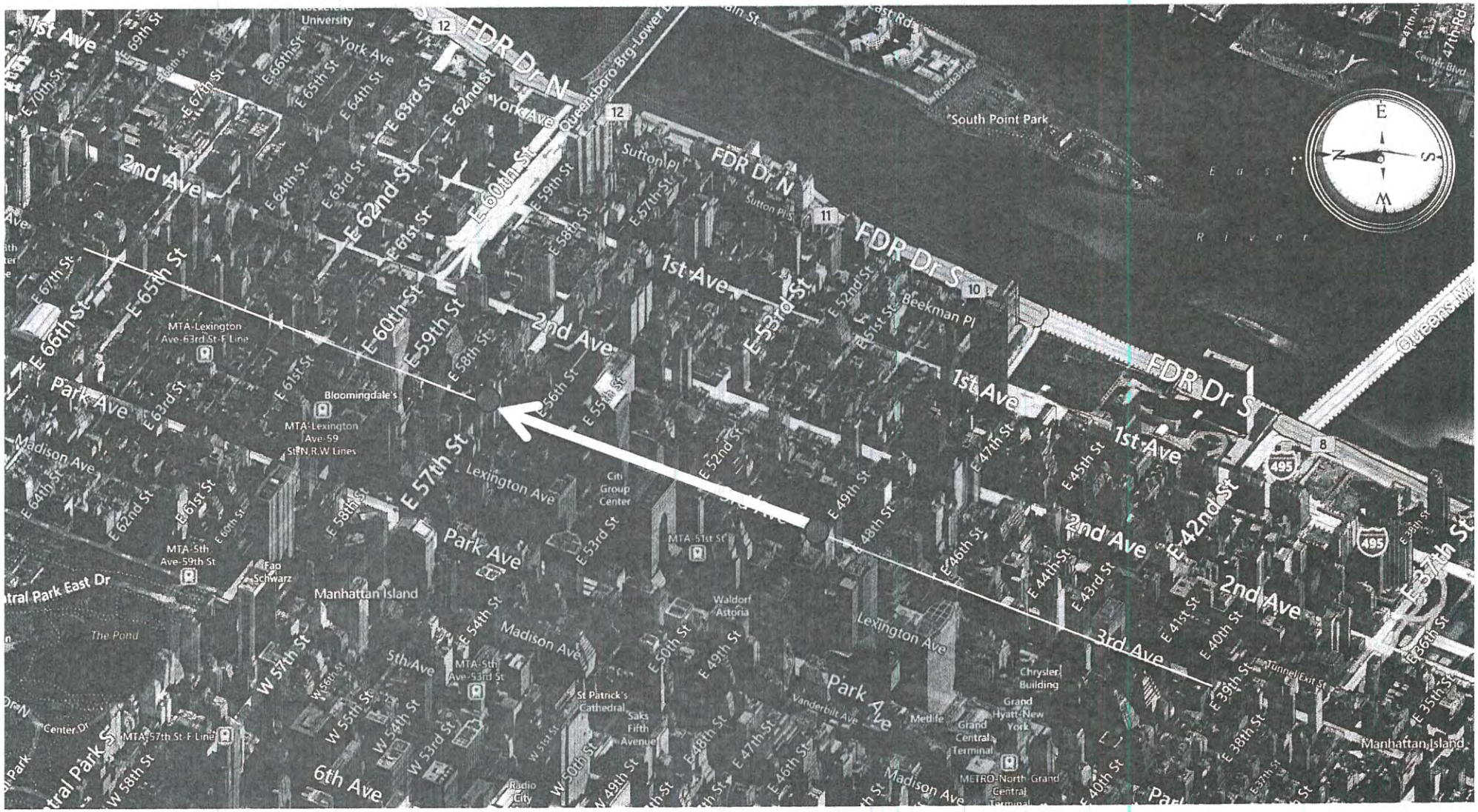
- For an extremely complex grid network, developed following approach
- Hierarchical Control
- Level 1 – Strategic area wide control
  - Implemented by Avenue
  - Rebalance traffic being delivered to the zone
  - Use library of carefully developed plans
- Level 2 – Tactical control
  - Implemented at intersection level
  - Complimentary to level 1
  - Balance queueing and minimize gridlock condition

Level 1 Control – Plan Library Design



- Develop library of plans and field test
- Define trigger condition based on real time data

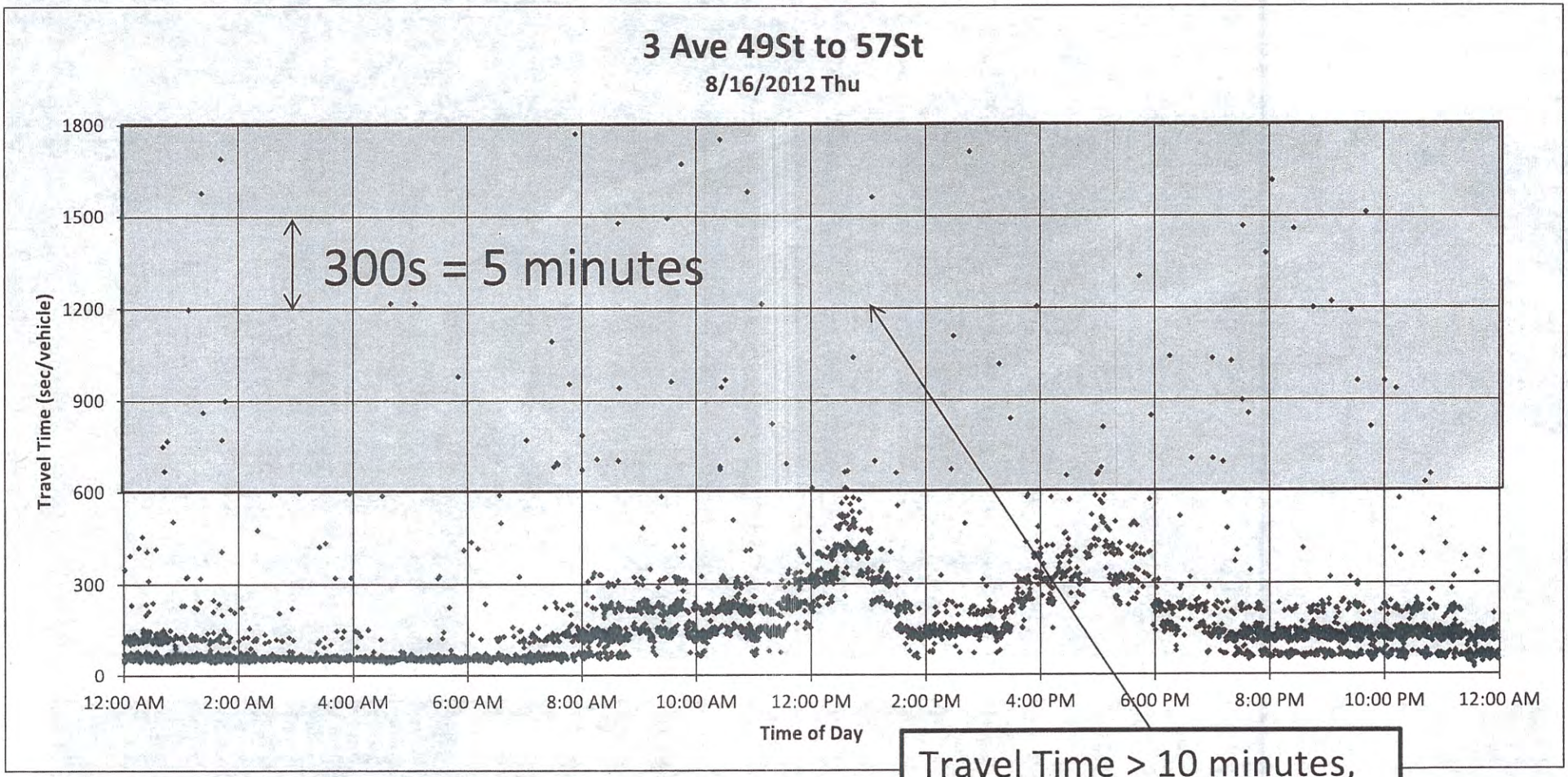
Travel Time – Underlying Patterns



Illustrative Section: 3rd Ave – 49St to 57St – 8 Blocks, 2000 feet – 8 traffic lights in the trip

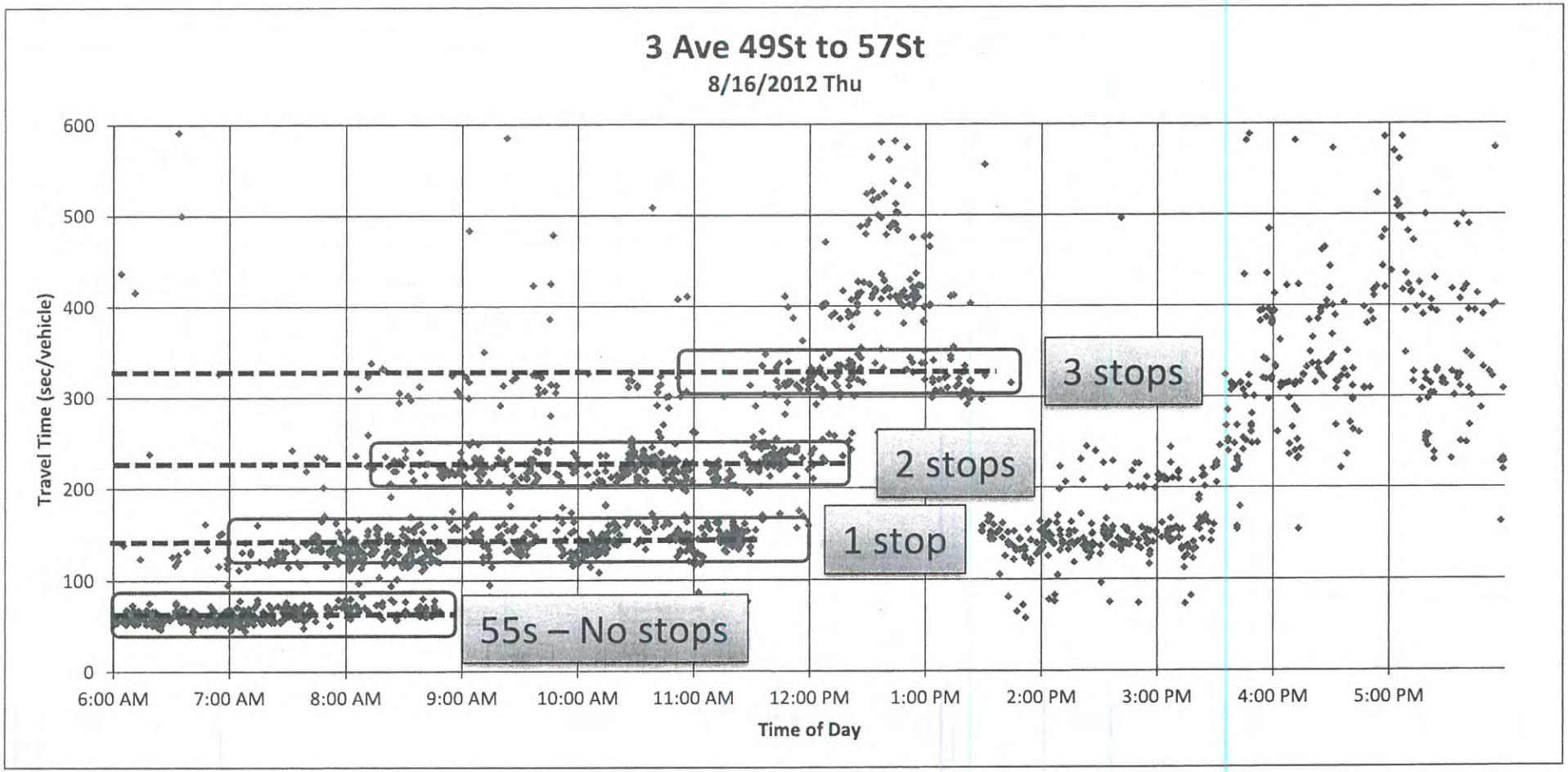
Travel Time

- One day sample
- Ideal travel time for 2000 feet at 25mph is 55 seconds

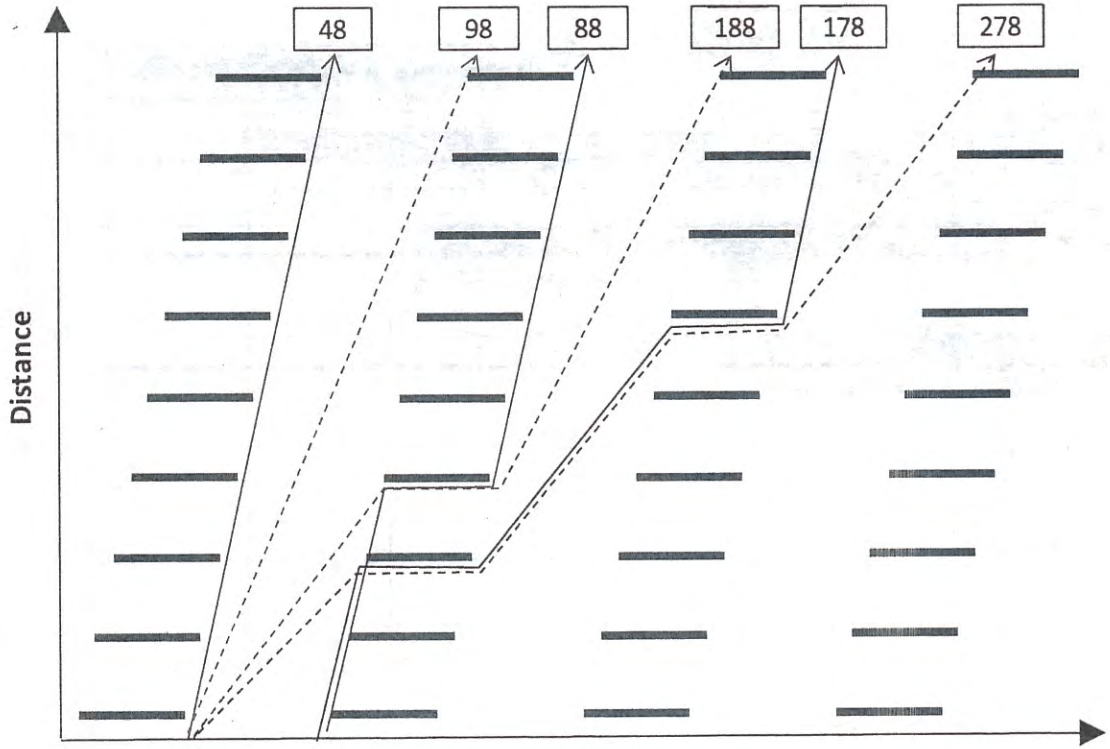


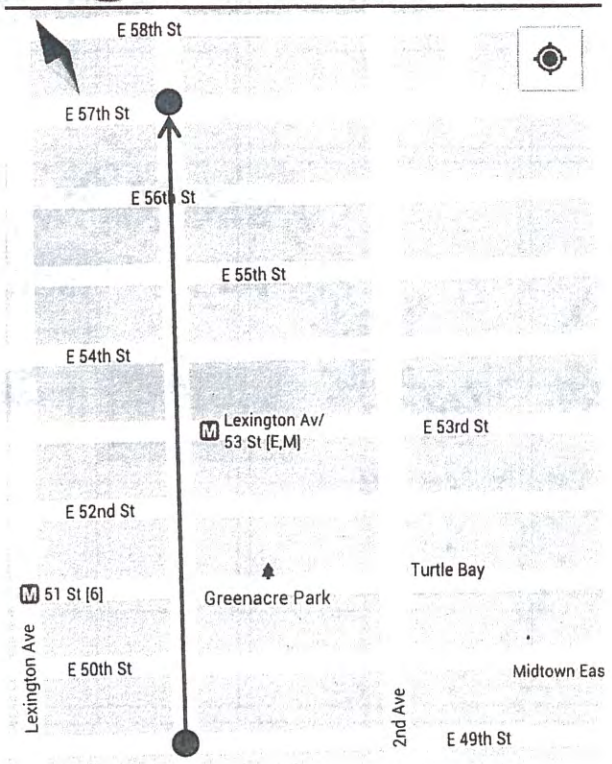
Travel Time – Underlying Patterns

- Close up view of travel time less than 10 minutes
- Clusters/groups – separated by stops



Travel Time – Underlying Patterns





Trajectory of Minimum Travel Time with No Stop

Trajectory of Maximum Travel Time with No Stop

Trajectory of Minimum Travel Time with One Stop

Trajectory of Maximum Travel Time with One Stop

Trajectory of Minimum Travel Time with Two Stops

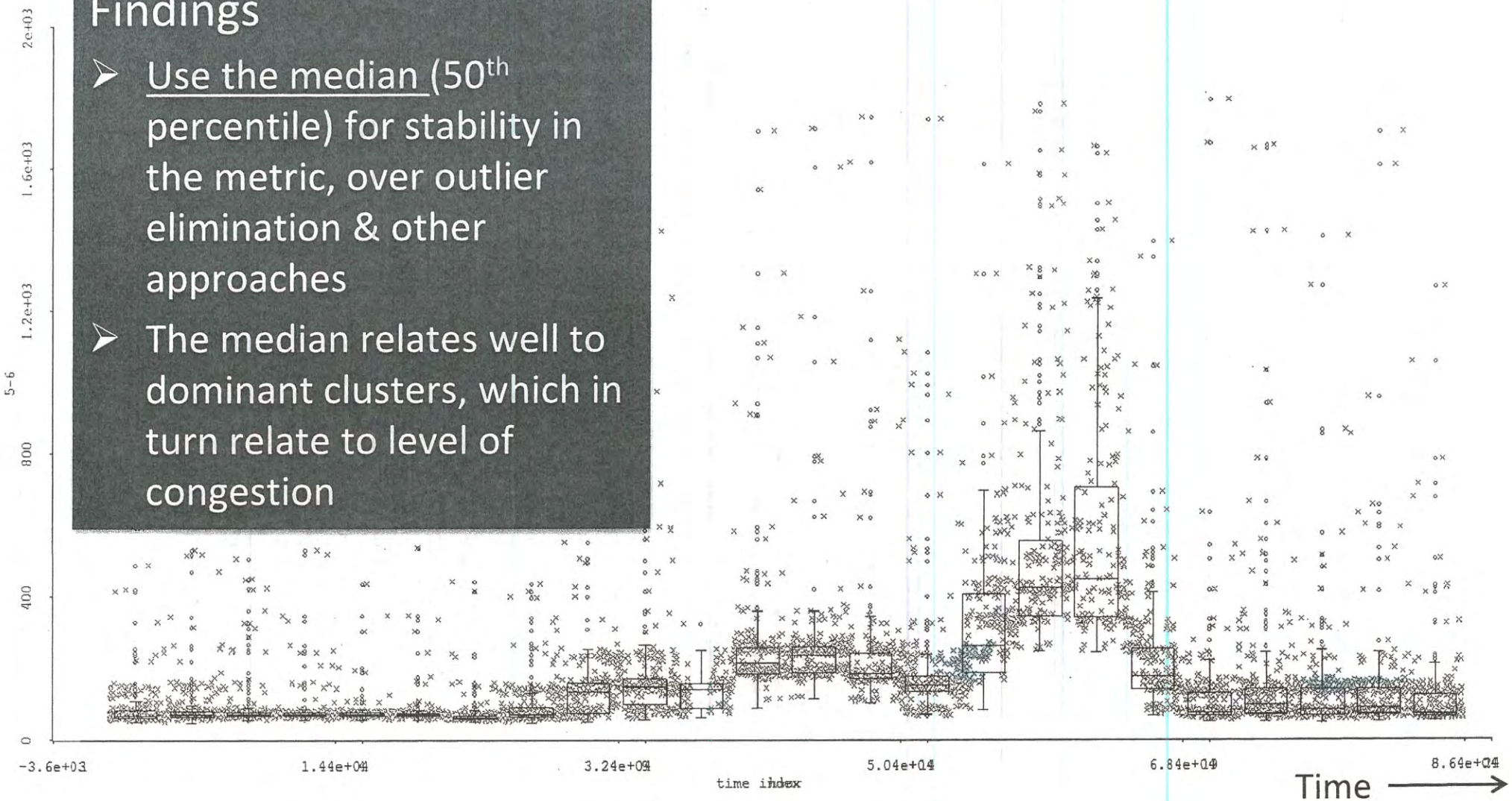
Trajectory of Maximum Travel Time with Two Stops

XX Estimate of Travel Time

Travel Time – Selecting a Metric

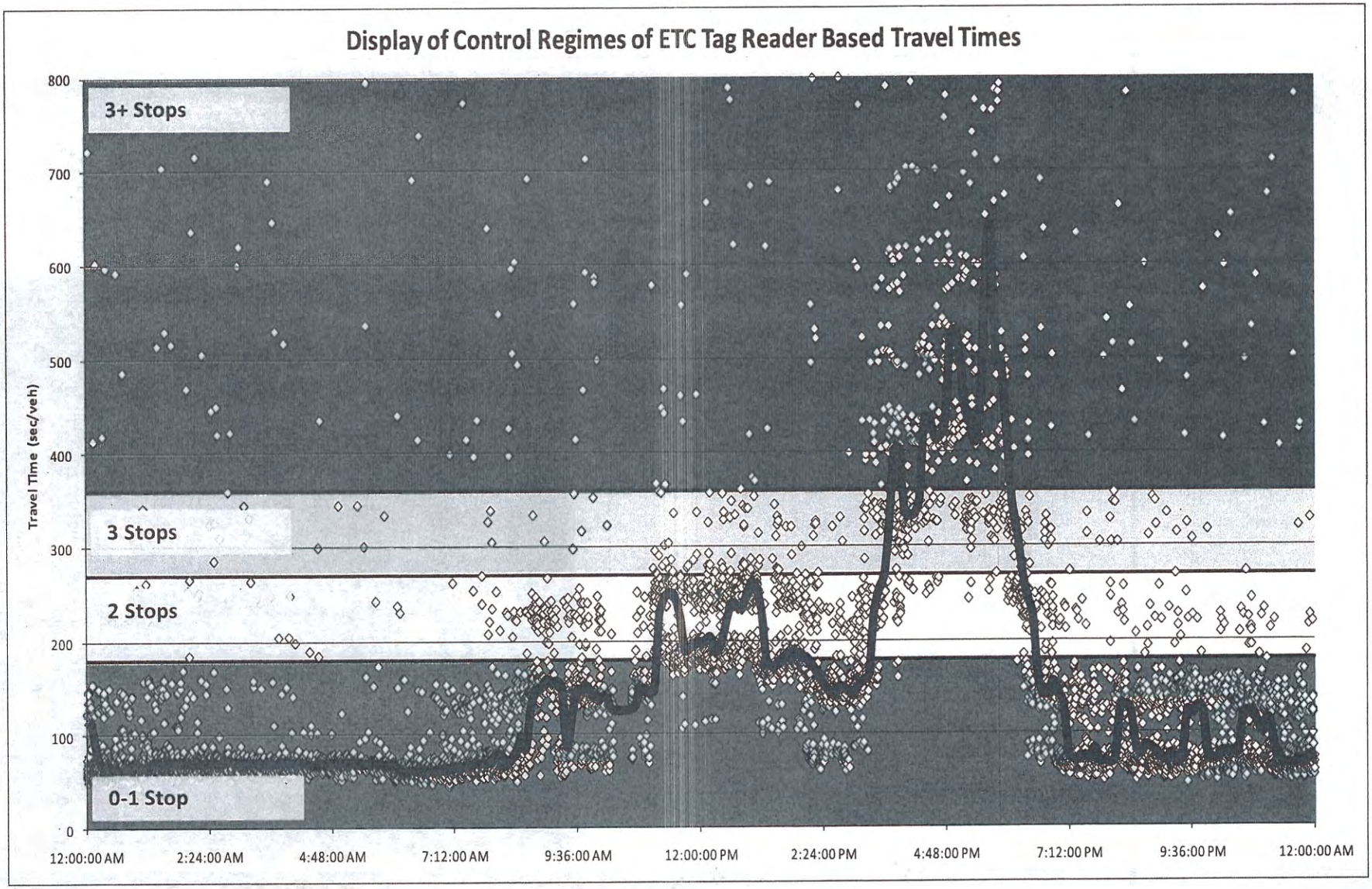
Findings

- Use the median (50th percentile) for stability in the metric, over outlier elimination & other approaches
- The median relates well to dominant clusters, which in turn relate to level of congestion



Box and Whisker Plot and Raw Data

Relation of Travel Time to # of Stops



Solid line = Median

Level 1 Control

- Define trigger conditions based on real time data

Travel Time	Area Wide Control Plan
2 Stops	Network Balancing Plan (NBP)
3 Stops	Advanced Control Plan (AC1)
3+ Stops	Advanced Control Plan (AC2)

- NBP – Simultaneous offset, minimal green tapering
- AC1 – Simultaneous offset, increased green tapering
- AC2 – Simultaneous offset, higher green tapering