

# Planning the Transition of an ITS Legacy System

APTA Trans/Tech 2011

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# OUTLINE

- Technical evolution of CAD-AVL
- Technology roadmap
- On-board SmartBus systems
- Bottom Lines

# Definitions

**CAD:** Computer-assisted Dispatch, polygamous marriage of the work to the operator to a bus

**AVL:** Automatic Vehicle Location, vehicle self-reporting of position in transit network

**Controller:** Centre managing the minute-to-minute transit network operations

**Communications:** reliable means by which voice or data is transmitted between two points

**Block-Run-Trip:**

A block is the set of trips for a vehicle from pull-out to pull-in.

A run is the set of trips for one operator's shift.

A trip is an interrupted piece of scheduled service between a start and end point.

Block can be composed of multiple runs or portion thereof.

# Technical Evolution of CAD/AVL

## Generation “0” – Manual Dispatch

Communications	UHF Radio
AVL	Non-existing
Dispatch	Manual (pull-out, pull-in) with paper schedules and boards
Controller	Incident responding & reporting

# Technical Evolution of CAD/AVL

## Generation “1” – RF Identifiers & Fixed Readers

Technology Leap	1980-90, first desktops
Communications	UHF Radio
AVL	RF ID and reader provide positional data
Dispatch	First CAD for Run-Operator assignment; but, Bus assignment remains manual
Controller	Incident responding & reporting; Determining bus bunching and schedule adherence; Database-structured with tables and logs, often home-grown solutions



# Technical Evolution of CAD/AVL

## Generation “1” – Advantages

- Ability to study system behaviour, e.g. bus-bunching
- Improve schedules to actual run times
- Inform controllers and security of assets' location
- Customer services (better information)
- Confirmed assignment at pull-out

## Generation “1” – Disadvantages

- Unreliable technology
- Long lag time between readers

# Technical Evolution of CAD/AVL

## Generation “2” – GPS & real-time data

Technology Leap	1995-2005, GPS opens for public use and advances in cellular voice and data
Communications	UHF Radio and Cellular (1xRTT protocol)
AVL	Near-real-time positional data with GPS
Dispatch	No change, but cellular allows for downloading daily schedule to each bus, ability to text message; Paper remains the back-up system
Controller	Incident responding & reporting; Plotting of buses on electronic maps to monitor bunching and schedule adherence; Database-structured with tables and logs, still using home-grown solutions



# Technical Evolution of CAD/AVL

## Generation “2” – Advantages

- Increased access to data and capability for data-mining
- Enhanced service reliability via schedule adherence
- Assisted accident investigation via logged data
- Customer services (even better information)
- Touch-screen for operators

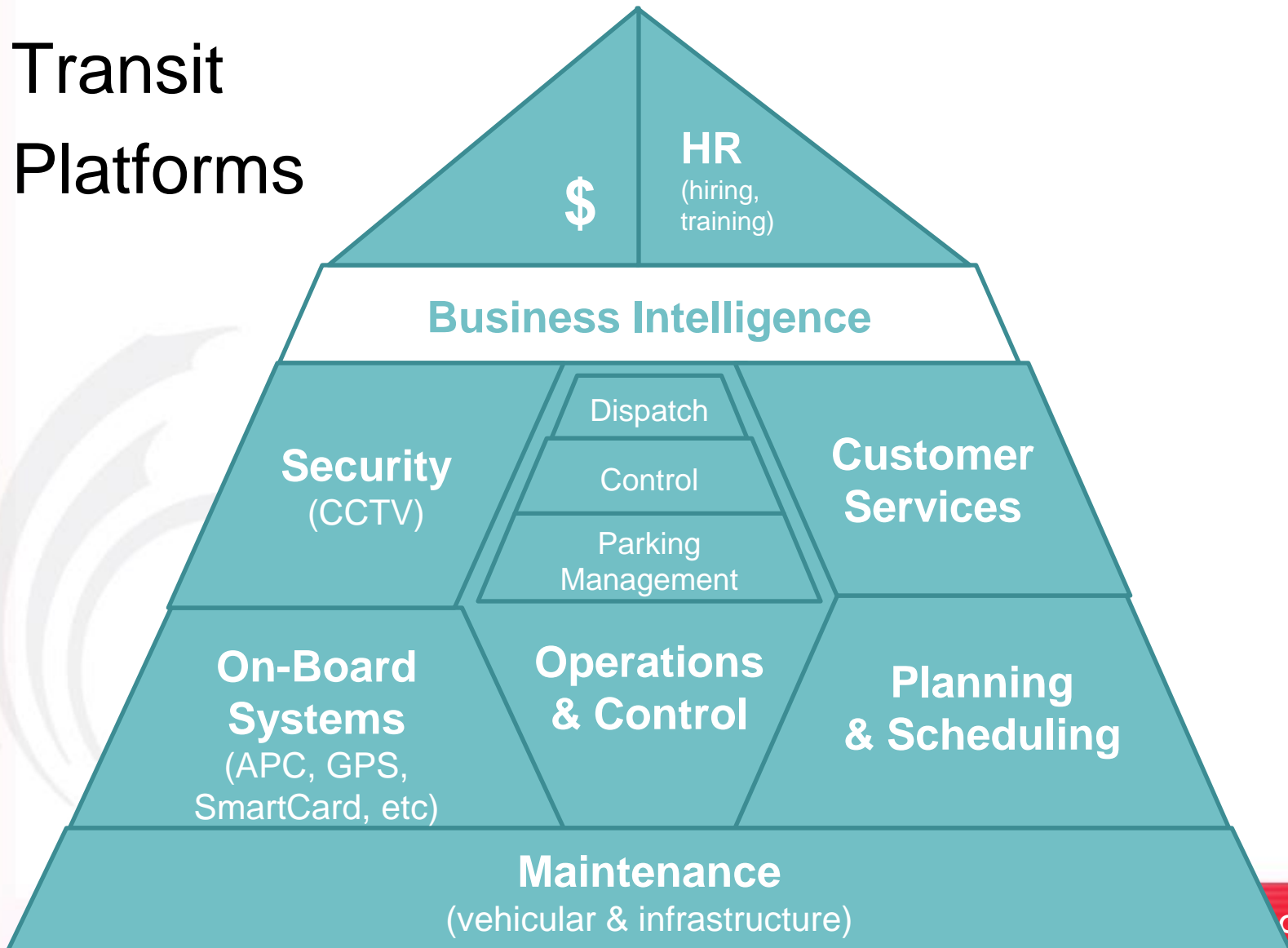
## Generation “2” – Disadvantages

- Overwhelming volume of data
- Long system upgrade (home-grown), costly developments
- Cellular operating cost (positional reporting frequency = bandwidth)

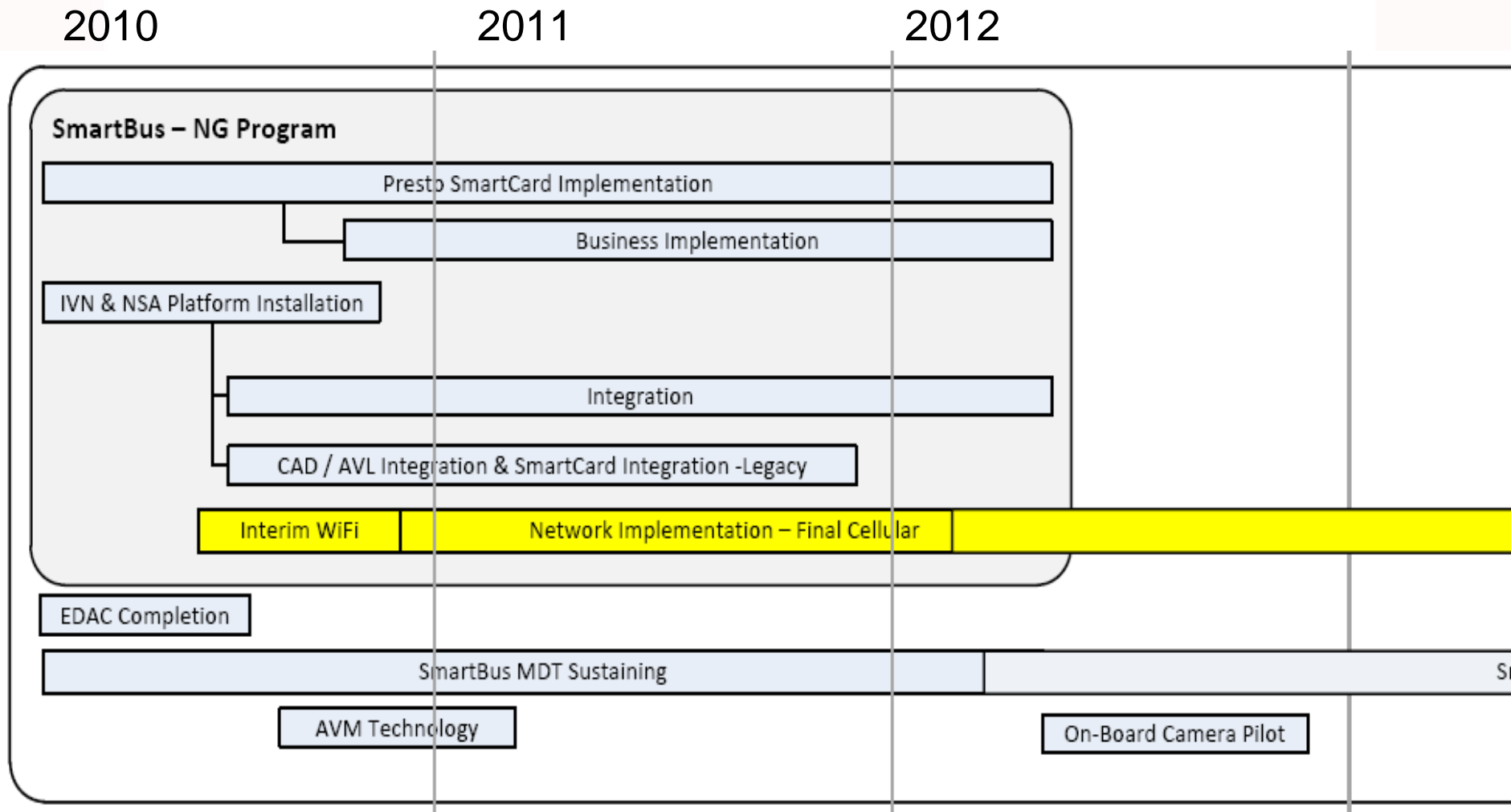


# Technology Roadmap

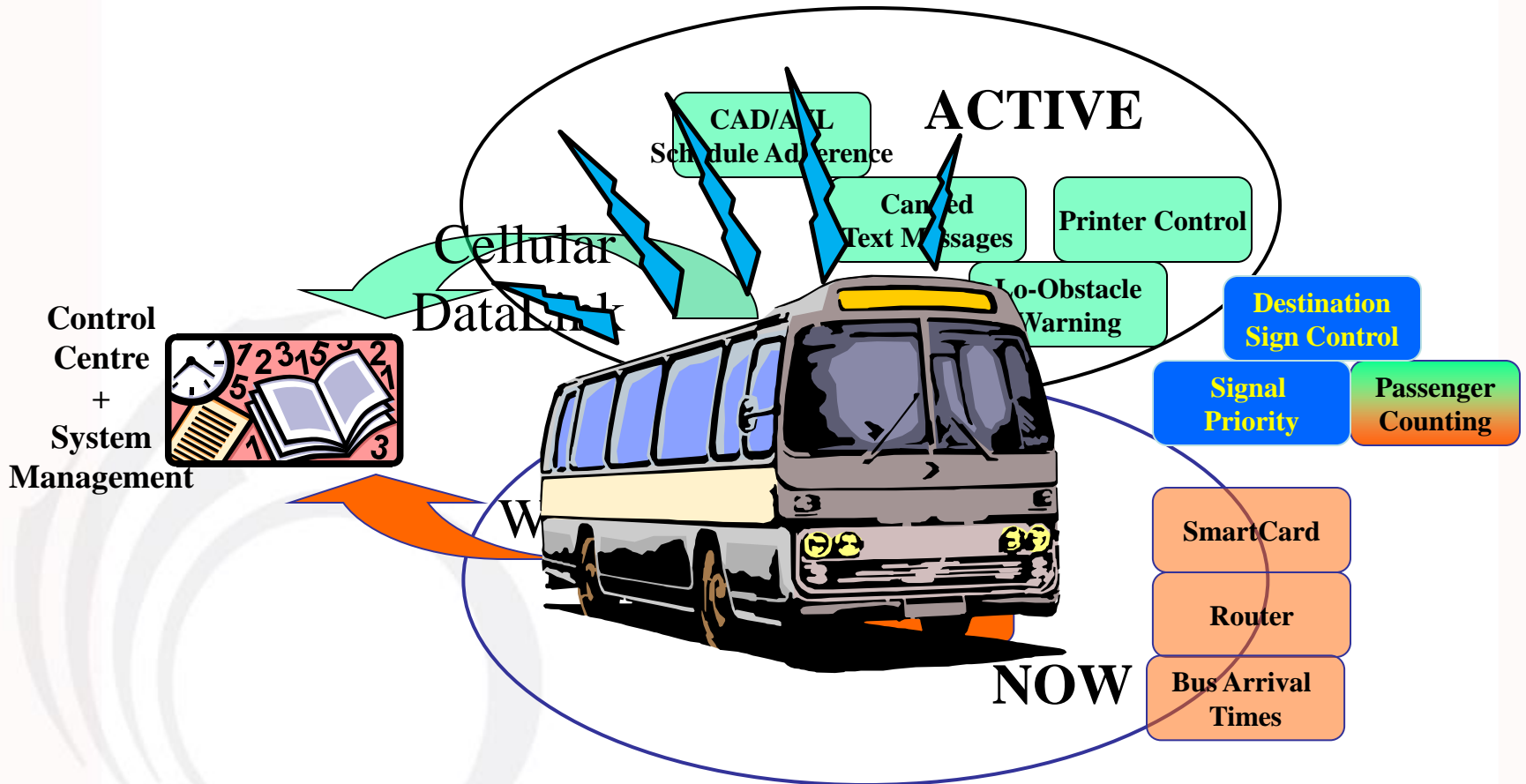
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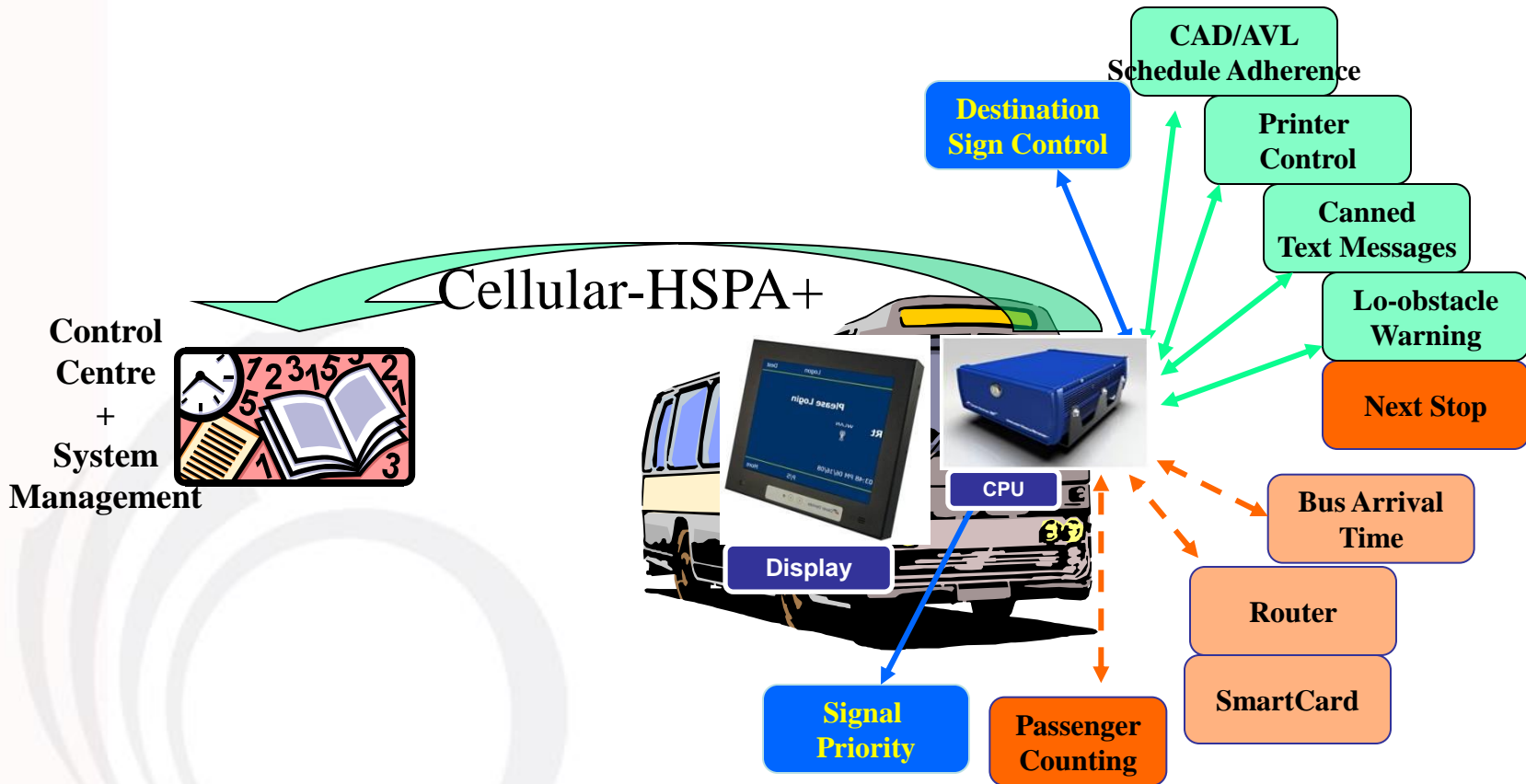
# Technology Roadmap



# On-Board SmartBus System (Generation 2)



# On-Board SmartBus System (Generation 3)



# On-Board SmartBus System (Generation 3)

## Generation “3” – True SmartBus & Bandwidth

Technology Leap	2010, Common protocols and cellular bandwidth
Communications	UHF Radio and Cellular (3G/4G, HSPA+)
AVL	Real-time positional data at high frequency
Dispatch	Automate all assignment (run-operator-bus) from bus to CAD; Emergence of COTS-CAD and parking management
Controller	Same functions; Finger-on-pulse due to real-time data; Empowering clients with real-time information on “where’s my bus”; Emergence of COTS-Control systems

# On-Board SmartBus System (Generation 3)

## Generation “3” – Advantages

- Increased access to data and capability for data-mining
- Enhanced service reliability via real-time arrival for customers
- Ability to exploit data into business intelligence for better decision-making
- Simplified off-board communications – elimination of WiFi network infrastructure and maintenance
- Single on-board ITS platform

## Generation “3” – Disadvantages

- Legacy of back-office systems
- Some increase to operational costs

# Bottom Lines

(investment costs for 1000 buses)

Generation 1 – RFID	\$10M (1985)
Generation 2 – GPS	\$ 8M (2000)
Generation 3 – Bandwidth	\$10M (2010)

After inflation, lower investment costs, for improved services and increased capabilities

Thank you

Merci

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