
Traffic Performance Measurement Using High-Resolution Data –

Recent Developments on the SMART-Signal System

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Problem: Arterial Traffic Congestion



National Traffic Signal
Report Card
2007

Management	D-
Signal Operation <i>at Individual Intersections</i>	C
Signal Operation <i>in Coordinated Systems</i>	D
Signal Timing Practices	C-
Traffic Monitoring <i>and Data Collection</i>	F
Maintenance	C-
OVERALL	D

The Solution: SMART-SIGNAL

(Systematic Monitoring of Arterial Road Traffic Signals)

- An **automatic and continuous data collection system** from existing traffic signals
 - A **performance measurement system** for intersection queue length and arterial travel time, especially **under congested traffic conditions**
 - A **performance tuning system** for optimization of traffic signal parameters
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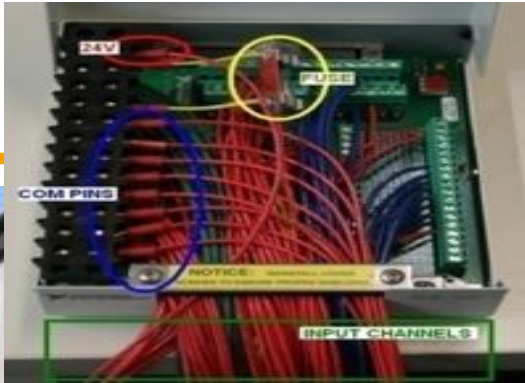


Technology Innovations

- **It provides solutions to two long-standing traffic engineering problems:**
 - **how to measure intersection queue length when the vehicular queue spills over to the detector location, and**
 - **how to estimate arterial travel time reliably.**
- **The two algorithms to solve the above problems are patent-pending.**

Data Collection

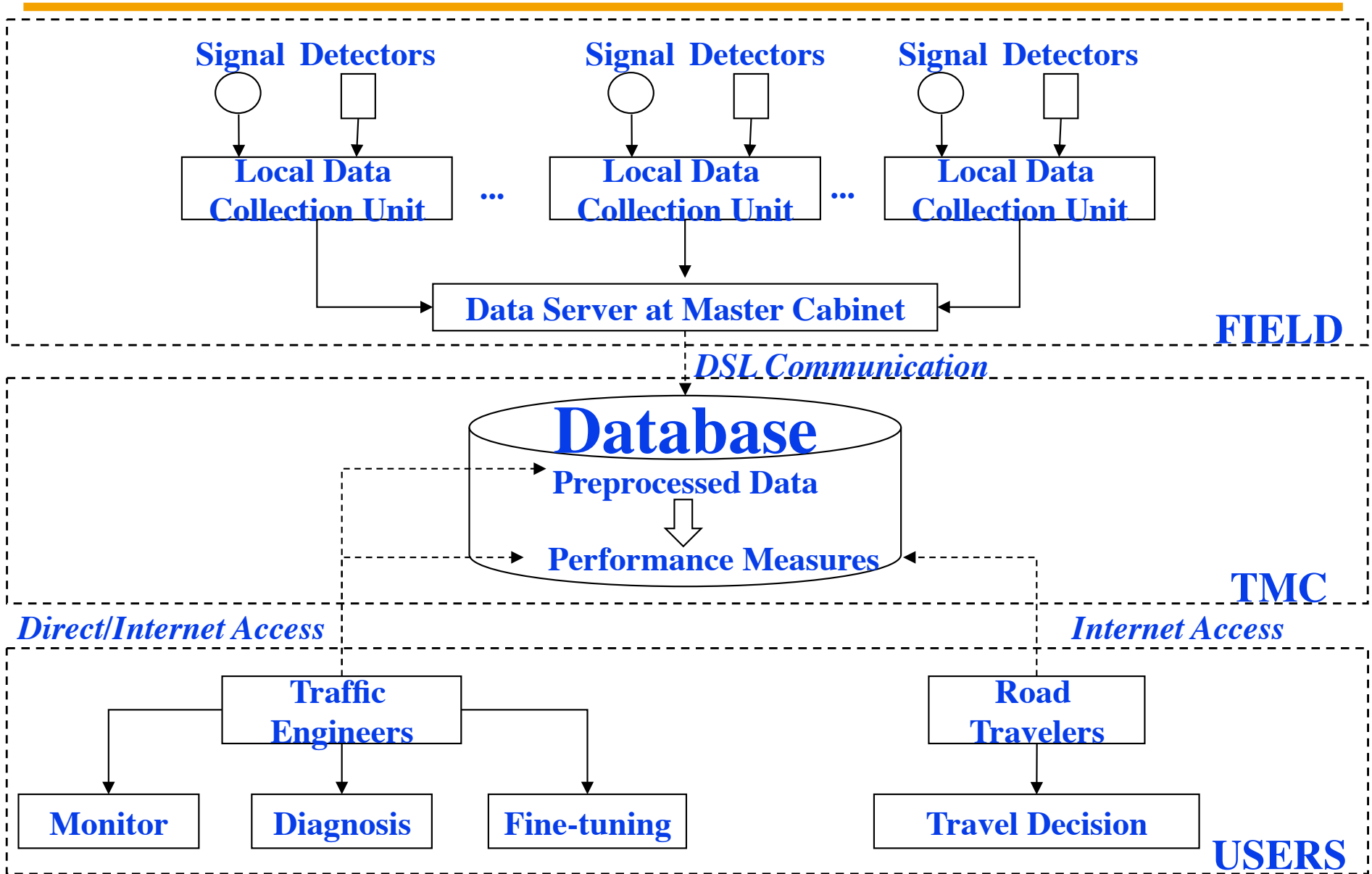
Terminal Box



DAC



SMART-SIGNAL System Architecture



SMART-SIGNAL Implementation Sites

- **11 intersections on France Ave. in Bloomington (March 07 – June 09)**
 - **6 intersections on TH55 in Golden Valley (Feb. 08 – Sept. 09)**
 - **3 intersections on PCD in Eden Prairie (Current)**
 - **6 intersections in the City of Pasadena, California (Iteris, Current)**
 - **14 intersections on TH13 (Fall 2011, Expected)**
 - **16 intersections on TH55 (Fall 2011, Expected)**
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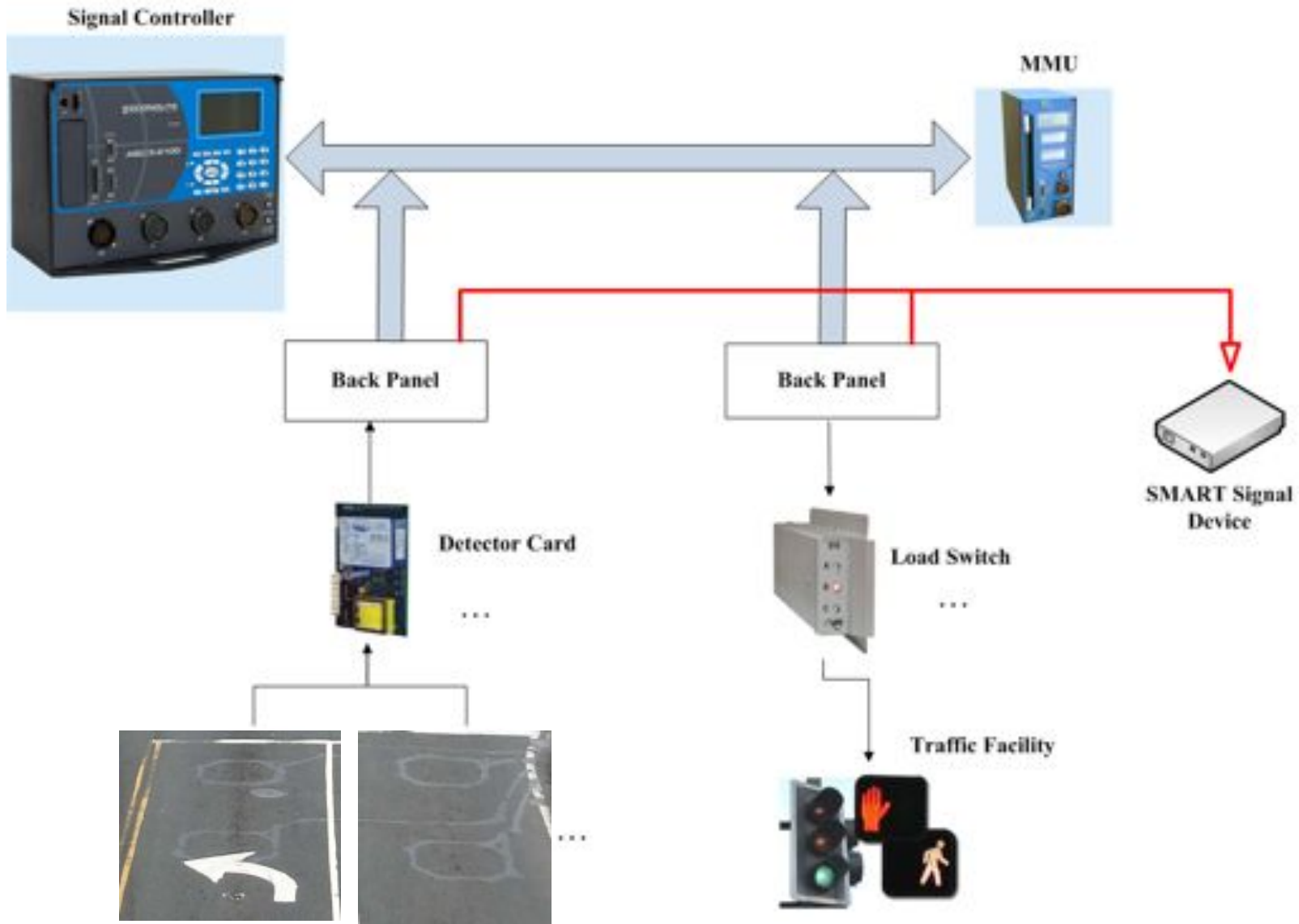
Recent Developments

- **Expanding System Functionality**
 - **New algorithms are being developed**
- **Developing New Data Collection Hardware**
 - **Mainly for the TS-2 Cabinets**
- **Developing An Integrated Web Portal**
 - www.signal.umn.edu
- **Technology Transfer**

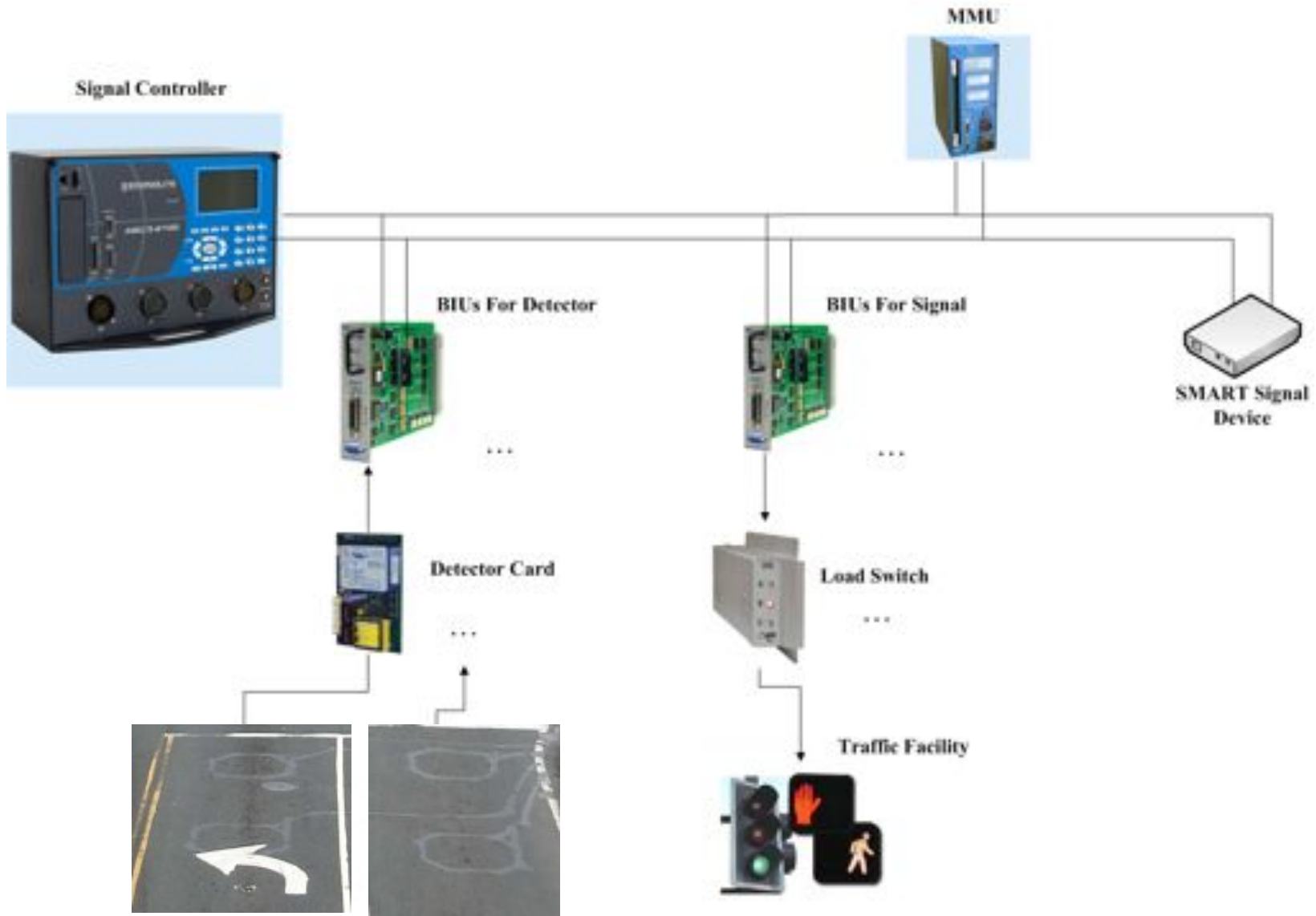
Algorithms Under Development

- **Vehicle classification / speed estimation**
 - Both arterial and **freeway** applications
- **Integrated Corridor Management (ICM)**
 - Balancing freeway and arterial traffic
- **Queue length / travel time prediction**
 - Stochasticity of Arterial Traffic Flow
- **Fine-tuning signal timing parameters**
 - Offsets, Green Splits, “Break Points” for time of day
 - ...

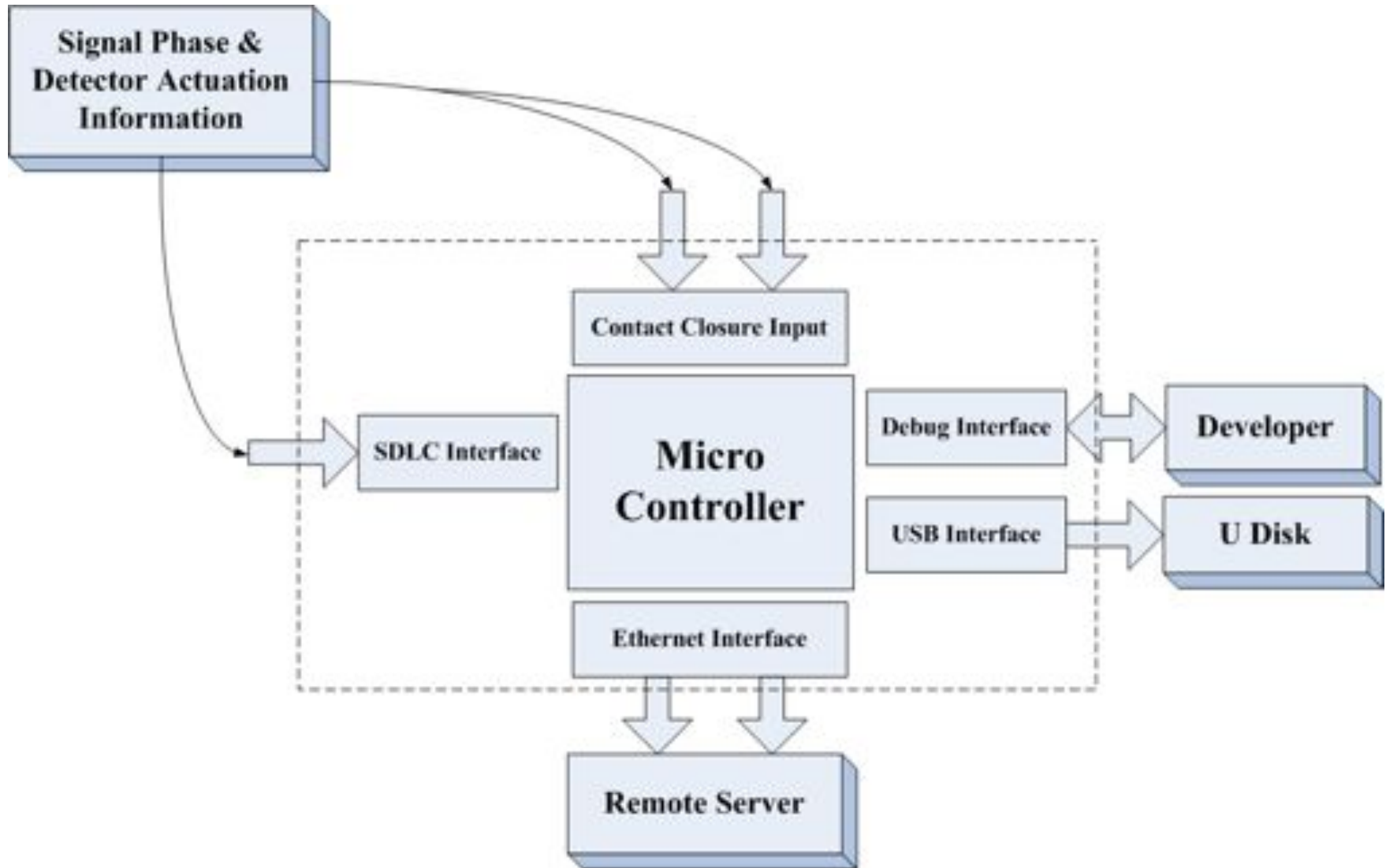
Data Collection in TS1 Cabinet

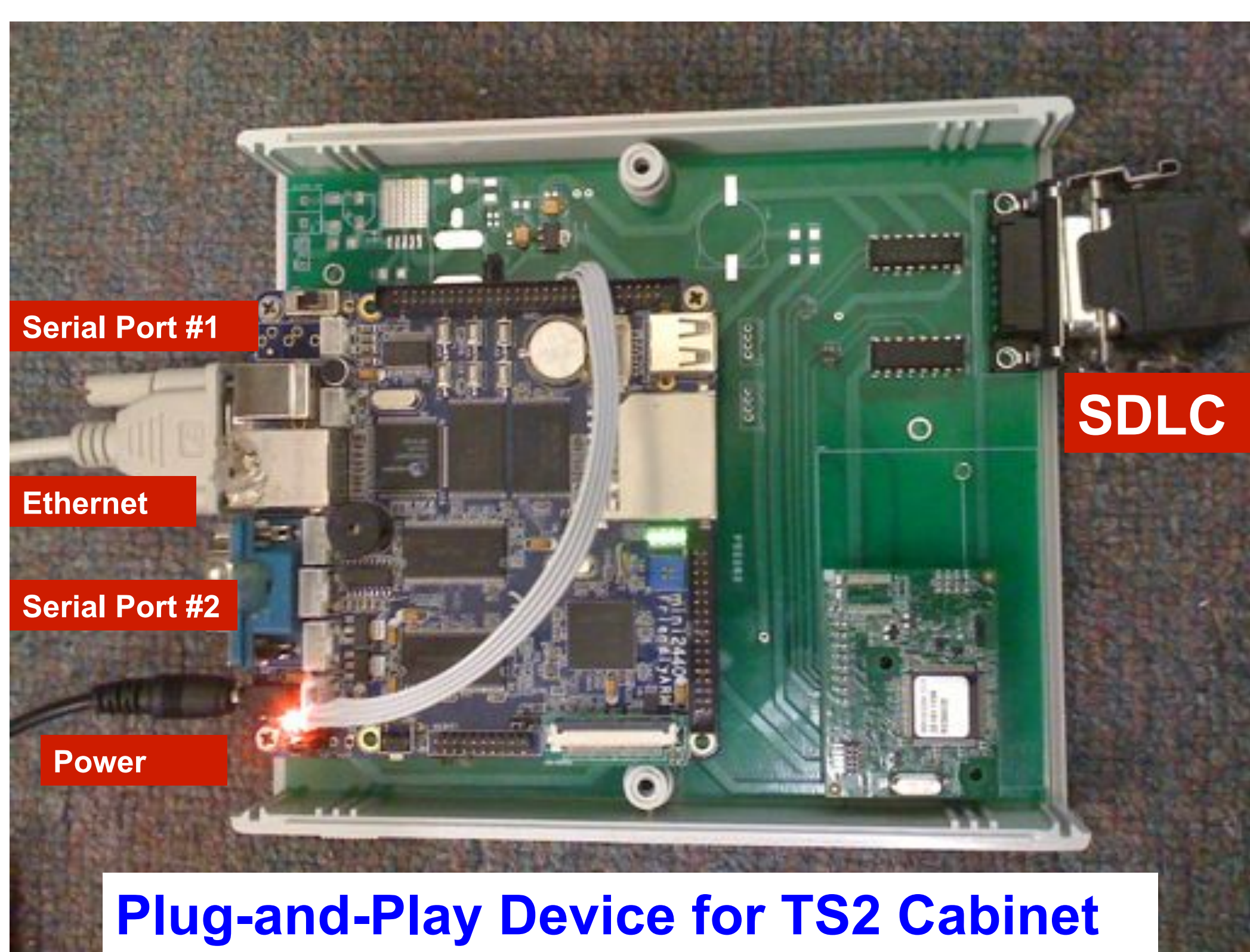


Data Collection in TS2 Cabinet



Hardware Design-Block Diagram





Serial Port #1

Ethernet

Serial Port #2

Power

SDLC

Plug-and-Play Device for TS2 Cabinet

Field Implementation

- **Four Simple Steps:**
 1. Plug in SDLC Port.
 2. Plug in power adapter.
 3. Plug in Ethernet connection.
 4. Turn on the power.
- **To debug in the field:**
 1. Connect your laptop with the device using the Serial Port.
 2. Log into the field device using the Linux system.

<http://signal.umn.edu>

The screenshot displays the 'Smart Signal' web application interface. At the top, the University of Minnesota logo and 'Smart Signal' text are visible, along with a navigation icon. The main header reads 'Systematic Monitoring of Arterial Road Traffic Signals'. The interface includes a sidebar with navigation options like 'SMART Sign', 'Implementation Sites', and 'Resources'. The main content area shows data for the 'Boone' intersection, with filters for 'Start Time' (09-09-2009 06:30:00) and 'End Time' (09-09-2009 07:00:00). A table lists queue lengths for four directions: TH55 EB, Boone SB, TH55 WB, and Boone NB. Below the table is a line graph titled 'Intersection Queue Size: Boone' showing the number of vehicles in the queue over time from 06:30 to 07:00. The graph shows a fluctuating line with peaks around 15-20 vehicles. The Windows taskbar at the bottom shows the system time as 11:37 PM.

UNIVERSITY OF MINNESOTA
Smart Signal

Systematic Monitoring of Arterial Road Traffic Signals

SMART Signal/Implementation Sites/Trunk Hwy 55/Queue Length

Intersection: Boone Start Time: 09-09-2009 06:30:00 End Time: 09-09-2009 07:00:00

Data available between 08/20/2008 and 08/08/2009

TH55 EB:	D3, D4, D7, D8
Boone SB:	D16, D17, D18, D20
TH55 WB:	D1, D2, D9, D10
Boone NB:	D11, D12, D19, D21, D22

Intersection Queue Size: Boone
Start Time: 09/09/2009 06:30:00 End Time: 09/09/2009 07:00:00

Queue Size (Number of Vehicles)

Time(s)





100%

11:37 PM

Technology Transfer

- **Licensed to Iteris, Inc. for technology demonstration in the City of Pasadena**
- **In discussion with the University's OTC for a start-up company to commercialize the technology**

Lessons Learned from SMART-SIGNAL

-  **Although traffic is traditionally modeled as “continuous flow”, traffic, after all, is discrete.**
 -  **Measuring traffic flow parameters using the data collected at the individual vehicle level**
 -  **Don’t aggregate data before useful information being derived**
 -  **Technological advances support such data collection at affordable prices**
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Acknowledgements

