Objectives:

Brief history of computers, networks, and gov’t
Introduce concepts.
Introduce network types, names, users.

Provide an overview of where the industry is now and where it might be going.

Two tacts:

- History and very top level view
- Nitty gritty technical details

History is brief, how it got here, why is the government involved
Electronics in early cars consisted of AM/FM radio.
Then 8-tracks, then cassette.
First real microprocessors were engine controllers.
Primarily designed to improve emissions.
Originally they supplemented the existing engine technology.
Early data links were for off-board diagnostic equipment. Diagnostic equipment was specialized and only for one module type. ALDL eventually grew to become a networking standard. All of these buses used UART technology. CCD was first real attempt at a network, including a messaging strategy.

There were / are others. Refer to slide #7, J2056.
Emissions control was a primary objective.
As processing power and memory improved so did control algorithms as well as control and sensor technology.

EPA and CARB wanted to make use of these new capabilities.
Emissions control and testing was a one-time stationary event. e.g. tailpipe testing.
Two levels of testing: corporate (CAFE) and individual (tailpipe).
They desired to move it to be an individual responsibility. e.g. the car should monitor itself.

Thus want every car to have some type of standardized diagnostic interface, hence OBD-II.
OBD-II purpose was/is to make it easy for testing and inspection stations to establish communications with the vehicle and query it for information regarding its performance.

Stored trouble codes, snapshot data, clearing trouble codes, queries, responses, security.

Additional technical details about these networks at the end of this presentation.
None of the OBD-II network standards are compatible.

Referenced standards:

J1979 is a required.
All others are recommended practices.
They provide framework for growth,
meet manufacturer proprietary requirements,
and meet minimum OBD-II requirements.
There are lots of other standards, these are not OBD-II.
But they are some form of networking.

We will only cover those that are somehow connected to vehicle applications.
**Other Network Standards**

<table>
<thead>
<tr>
<th><strong>Class 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>GM standard using the J1850 VPW implementation.</td>
</tr>
<tr>
<td>True Class 2 implementation and design is actually physical layer and data link layer independent.</td>
</tr>
<tr>
<td>Note that this protocol is a “Superset” of the minimum required OBD-II.</td>
</tr>
<tr>
<td>J1850 VPW version: 10.4 kbps and 41.6 kbps (in special diagnostic mode).</td>
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</tbody>
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<table>
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<tr>
<th><strong>Single Wire CAN</strong></th>
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<tbody>
<tr>
<td>The new standard at GM to replace J1850 VPW.</td>
</tr>
<tr>
<td>Physical layer is a single wire CAN implementation.</td>
</tr>
<tr>
<td>Class 2 messaging strategy most likely to remain unchanged. (My guess.)</td>
</tr>
<tr>
<td>SAE draft standard: J2411.</td>
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<tr>
<td>25.0 kbps and 80.0 kbps (in special diagnostic mode).</td>
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<th><strong>SCP</strong></th>
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<tr>
<td>Standard Corporate Protocol.</td>
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<tr>
<td>Ford’s messaging strategy implemented using J1850 PWM.</td>
</tr>
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<td>Note that this protocol is a “Superset” of the minimum required OBD-II.</td>
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</tbody>
</table>

Note the baud rates for Class 2 based on J1850 VPW

SWC
### Other Network Standards

- **DeviceNet**
  - A CAN network designed for industrial machine control.
  - CiA - CAN in Automation.

- **J1939**
  - A CAN network for heavy trucks and buses.
  - References CAN version 2.0B.
  - Baud rate: 250 kbps.
  - Two wire balanced signal.

- **J1708**
  - Promoted for use in heavy truck and bus applications.
  - The bus structure is, essentially, EIA-RS-485.
  - Baud rate: 9600 bps.

- **TTP - Time Triggered Protocol**
  - Developed and promoted by Technical University of Vienna.
  - Designed for Class C network applications.
  - Motorola has announced support.

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**J1939**

Consists of multiple parts.

The specification is rather rigid.
Other Network Standards

» **ITS Data Bus**
  - Intelligent Transportation Systems Data Bus (IDB).
  - PC’s and other peripherals involved.
  - Used to tie together ITS, information, entertainment, and other computer and peripheral equipment.
  - Intel, Microsoft, GM, and Ford are very active here.
  - Standards under development include: J2355, J2366, J2367, and J2368.
  - Information sources: http://www.itsa.org
  http://www.itsa.org/usstandcat.nsf

» **PC type networks**
  - USB - Universal Serial Bus; possible companion to IDB.
  - FireWire - IEEE1394; possible use in IDB-M (multimedia).

» and there are more
  - Old ones, new ones, . . .
What are each using now.

What are they moving towards.

- **What’s been heard and who’ll be using what**
  - **GM**
    - Single Wire CAN.
    - Predicted for model year 2000.
    - To replace J1850 VPW.
  - **Ford**
    - CAN bus.
    - Predicted within 3 years.
    - To replace J1850 PWM.
  - **Chrysler**
    - Still migrating toward J1850 VPW.
    - Little further information available.
Number of microprocessors and microcontrollers.

Not talking about entertainment equipment.

How the various units do or do not communicate.

Stress: there are various networks, they are not connected.
Even more processors, power, and memory.
Even more control and sensor functions.
Even more capabilities.

**Stress:** Networks are to be connected together.
Use of network bridges or gateways.
Who has done what.
Who is heading in what direction.

What I know about who is planning on doing what.

» Expectations and Predictions (?)
  - GM:
    Plans to replace J1850 VPW with Single Wire CAN (SWC) by model year 2000.
    Has already built an IDB gateway for the Cadillac demonstrator.
    Has stated they are “ready to put IDB gateways in any GM car worldwide by model year 2000.”
  - Ford:
    Plans to use CAN as the basic vehicle bus within the next 3 years. (to replace J1850 PWM).
    Plans to use IDB for convenience.
    Plan to develop their own gateway.
  - Chrysler:
    Supports IDB.
    Developed a Jeep demonstrator.
    Plans to develop their own gateway.
The database is J1850 device specific.

Evaluation Engineering article are 'supposed' to be archived on their web site.
Note that J1850 is different from UART based communications. J1850 uses defined symbols to delineate a complete message. UART based protocols rely on timing issues to convey this type of information. There is symbol ambiguity in UART systems.
These are wired ‘OR’ circuits.  
Timing is the critical element and controls bus operations.  
The KWP 2000 message maximum length is ~259 bytes,  
header+data+CRC.

The K-line is bi-directional.  
The L-line, if used, is uni-directional.

KWP 2000 is not an OBD-II protocol.  Does not have to support the OBD-II messaging strategy.
SAE offers specification download direct from their web site.

Contact information

- **Advanced Vehicle Technologies, Inc.**
  - 410-798-4038 (voice)
  - 410-798-4038 (fax)
  - e-mail: avt-inc@ari.net
  - web site: http://www2.ari.net/avt-inc/

- **SAE**
  - SAE and ISO specifications.
  - http://www.sae.org
  - 724-776-4841

- **ANSI**
  - ANSI and ISO specifications.
  - http://www.ansi.org
Watch how individuals use the various terminology.

More players on the field; means the business climate has changed.
Used to be one big guy on the block who called all/most of the shots.

My version of a legal disclaimer.