National Marine Electronics Association

NMEA 2000® Network
and
Other Marine Networks

Why NMEA 2000

June 2005
• Sampling of Networking Systems
  – HSB2, Magic Bus, Marine Network, N2, NavNet, SeaTalk, SimNet, SmartCraft
  – NMEA 0183
  • (not a network, a serial interface)
  – NMEA 2000®
• Proprietary Manufacturer Networking Systems (sampling)
  - HSB2, Marine Network, N2, NavNet, SeaTalk, SimNet, SmartCraft
  • Communicate among themselves
  • No sharing of other’s data
• **NMEA Standards**
  
  - **Serve the public safety**
  
  • **Developed from manufacturers, private and government organizations, dealers and equipment operators**
    
  - **Goals:**
    1. Facilitate the public interest in the interconnection and interchangeability of equipment
    2. Minimize misunderstanding and confusion between manufacturers
    3. Assist purchasers in selecting compatible equipment
• NMEA 0183 (Ver. 3.01) Standard
  – Is a serial data interface
  – Operates at 4.8 kilobits/sec
    • Delivers 6-8 messages (sentences)/sec
    • Terrific for simpler applications
      – Device to device connectivity
  – International Electrotechnical Commission (IEC) 61162-1 is harmonized with NMEA 0813
• **NMEA 0183 (Ver. 3.01) Standard**
  - Single talker multi-listener
  - Universal method for data exchange between two devices
  - **Recommends** a physical layer
  - Complicated installation and setup
  - Open to miss-interpretation
• **NMEA 0183 (Ver. 3.01) Simplified Circuit**  
  - Single Talker / Multi-Listener

![Diagram of simplified NMEA 0183 circuit](image)
• NMEA 0183 - HS Standard
  - Operates at 38.4 K baud
    • (0183 operates at 4.8K baud)
  - Sentences are compatible
  - International Electrotechnical Commission (IEC) 61162-2 is harmonized with NMEA 0813 HS
• NMEA 2000® Standard
  - “Open” Network System Based on CAN (Controller Area Network)
  - Developed by a myriad of industries under NMEA guidance
    • Academia - Kansas and Oklahoma State
    • Networking and Computer Industry
    • U.S. Coast Guard Research and Development
    • 40 organizations for 5 years
• **NMEA 2000® Standard**
  – Beta Tested
  • 12 electronic manufacturers and the U.S. Coast Guard under the guidance of NMEA
    – Furuno USA, JRC, Litton Marine, Navionics, Northstar, Raymarine, Simrad, Teleflex, Trimble, Wood Freeman
    – Kvaser, Vector Can Tech (CAN Companies)
• **NMEA 2000® Standard**
  - Complete network protocol
  - “Open” standard for electronics, electrical and engine data all on the same network
  - Exchange of data between multiple manufacturers equipment simultaneously
  - Marine manufacturers collaborating and creating an “open” network environment
  - Entrepreneurs developing NMEA 2000 diagnostic tools
• NMEA 2000® Standard
  – Mandates a physical layer
  – Real-time data stream (single cable)
  – Standard connectors and cables
  – International Electrotechnical Commission (IEC) 61162-3 is NMEA 2000
• **NMEA 2000® Standard**

• **Built on the OSI Model**
  - **Physical** Layer
  - **Data Link** Layer
  - **Network Management**
  - **Application Layer**
• **NMEA 2000® Standard**
  - **Mandates** Physical Layer
    • Cables
    • Connectors
    • Terminators
    • Power
• **NMEA 2000® Standard**
  
  • **Physical Layer Network Length**
    
    • Light < 100m (328ft) 4 Amps
    • Heavy ≤ 200m (656ft) 8 Amps
    • Drop ≤ 6m (19ft)
• NMEA 2000® Standard
  – Connectors

Available in Two Sizes
Micro (light) and Mini (heavy)
• **NMEA 2000® Standard**
  - Standard cables and connectors
    • Simple installation for adding a device
      - "Plug and Play"
  - **Waterproof**
  - “Screw on” connectivity
    • Cable and connectors will not come apart
  - Data and Power with one cable
• **NMEA 2000® Simplified Circuit**
  - Multi - Talker / Multi - Listener

![Diagram of NMEA 2000 circuit with labels for Terminating Resistor, Backbone Cable, Tap (T-connector or barrier strips), NMEA 2000® Device, Power Supply Connection, + VDC, Gnd, Shield, and Drop Cable.]
NMEA 2000 Simplified Network

For Example Only

NMEA 2000 To/from RS232 Gateway

Trunk Termination Resistor

GPS

Wind Sensor

Radar

Engine Monitor

Compass

Battery

Display

Laptop

NMEA 0183 To/from RS232 Gateway

Trunk Line

Drop Line

Tee Connector

NMEA 2000 To/from NMEA 0183 Gateway

NMEA 0183 Instrument

(real installation in most cases will be different)
• **NMEA 2000® Standard**
  - Multi-Talker + Multi-Listener
  - Multi-Master, No Single Controller
  - Single Channel Parallel Bus
    - 250 Kbits/sec (50 times faster than 0183)
    - 200 Meter Length
  - 50 Physical Nodes
• **NMEA 2000® Standard**
  - CAN (Controller Area Network)
    • Develop by Intel and Bosch
    • Used in control processes for industrial applications
    • Used in automotive
    • Used in factory automation
- NMEA 2000® Standard
  - Why CAN?
    - Proven robust error free protocol
      - Automatically determines repeated errors
      - Will take node off line to protect network
    - Priority messaging embedded
      - Collision avoidance - bit wise arbitration
      - Critical messaging always gets thru
### NMEA 2000® Standard

#### CAN vs. Ethernet

<table>
<thead>
<tr>
<th></th>
<th>Can</th>
<th>Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Consumption</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Low</td>
<td>High (Radar, Video)</td>
</tr>
<tr>
<td>Collision Avoidance</td>
<td>Yes</td>
<td>No Avoidance (Collision Detection)</td>
</tr>
<tr>
<td>Message Priority</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
• **NMEA 2000® Standard**
  - Certification of Products
  - Products must meet strict certification process
    - Assure products meet the standards
    - To assure products will operate on the network properly and behave predictably
    - Products must be tested by NMEA
    - Only products that have been certified can use the LOGO