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**
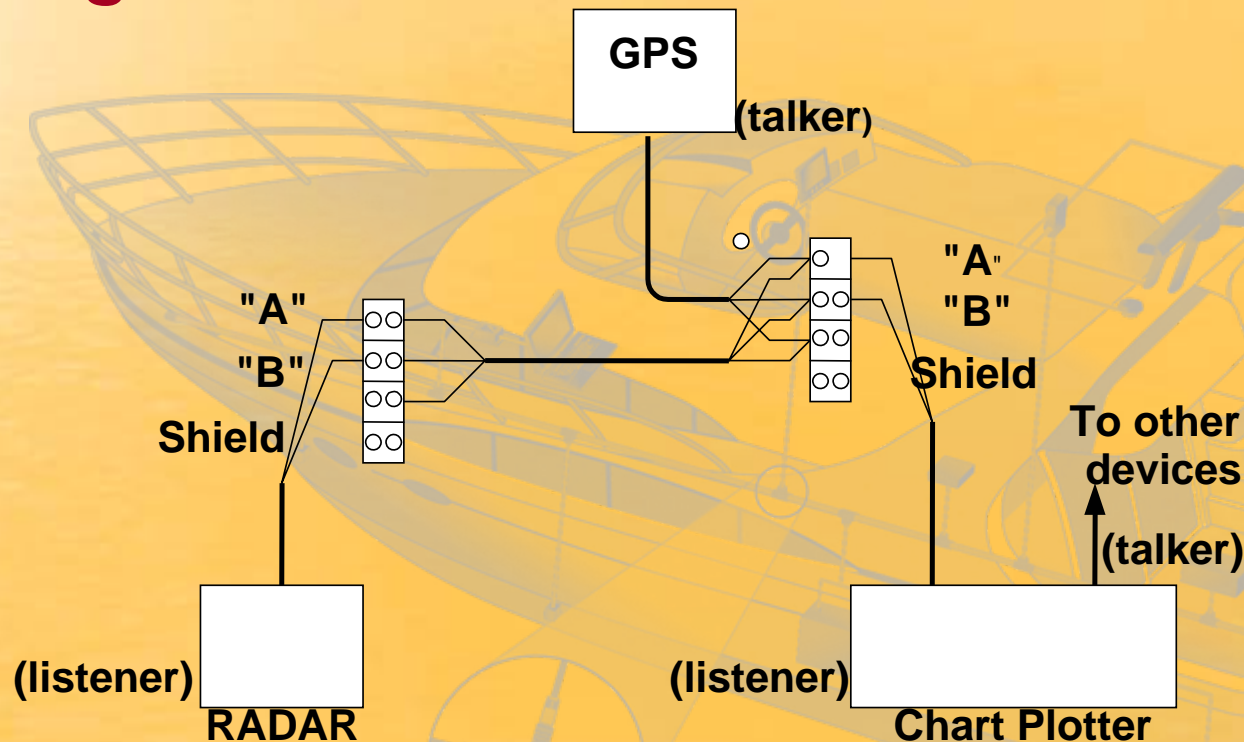   3. **Assist purchasers in selecting compatible equipment**

- **NMEA 0183 (Ver. 3.01) Standard**
  - **Is a serial data <u>interface</u>**
  - **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

GPS

(talker)

"A"
"B"

Shield

"A"
"B"

Shield

To other devices

(talker)

(listener)

RADAR

(listener)

Chart Plotter

- **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 enviornment
- 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**
    - <u>**Physical**</u> **Layer**
    - <u>**Data Link**</u> **Layer**
    - <u>**Network**</u> **Management**
    - <u>**Application**</u> **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

Network Drop Cable to Device

Available in Two Sizes Micro (light) and Mini (heavy)

Female

Female
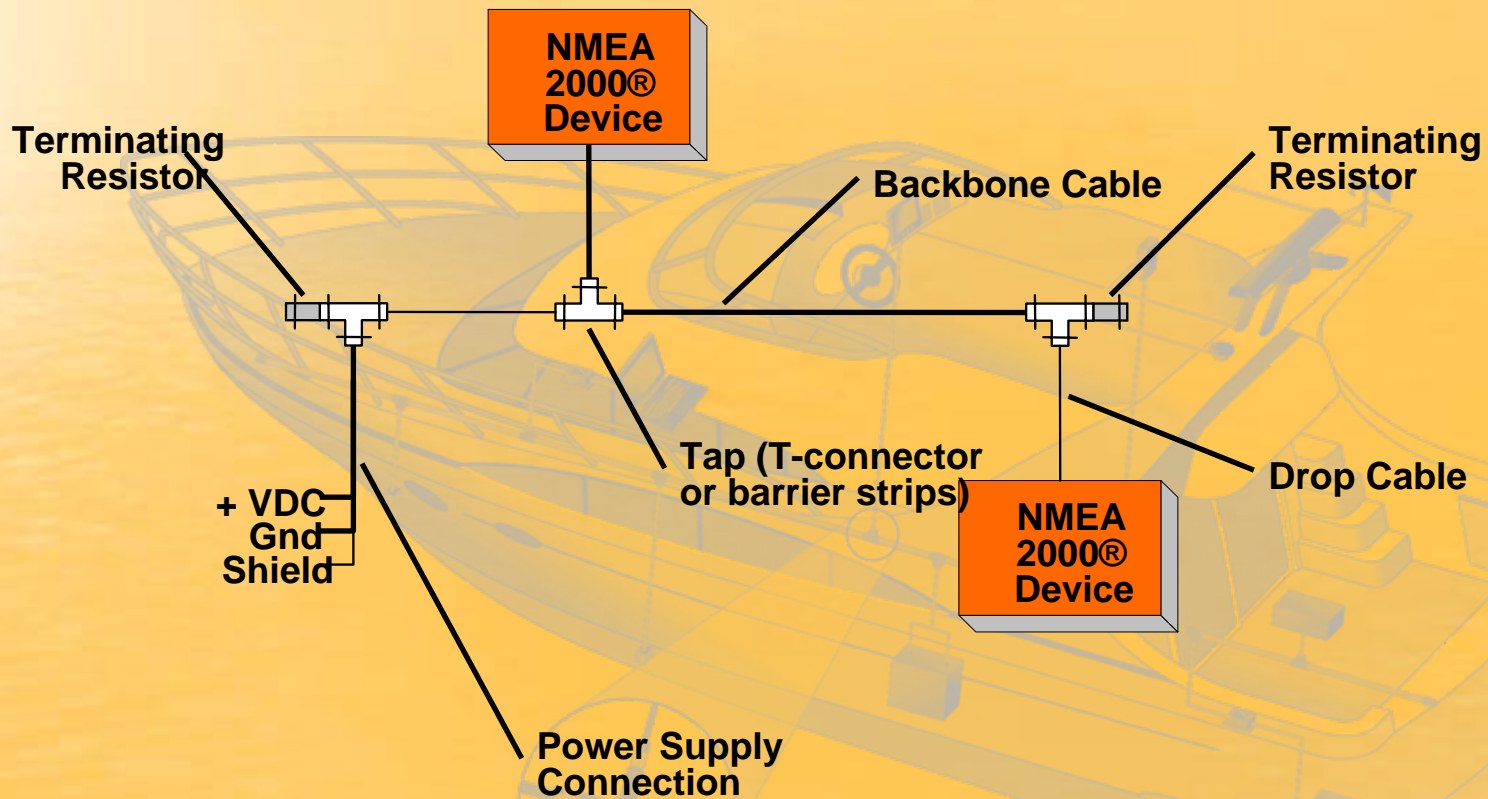
Female

Network Cable

Network Cable

- **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**

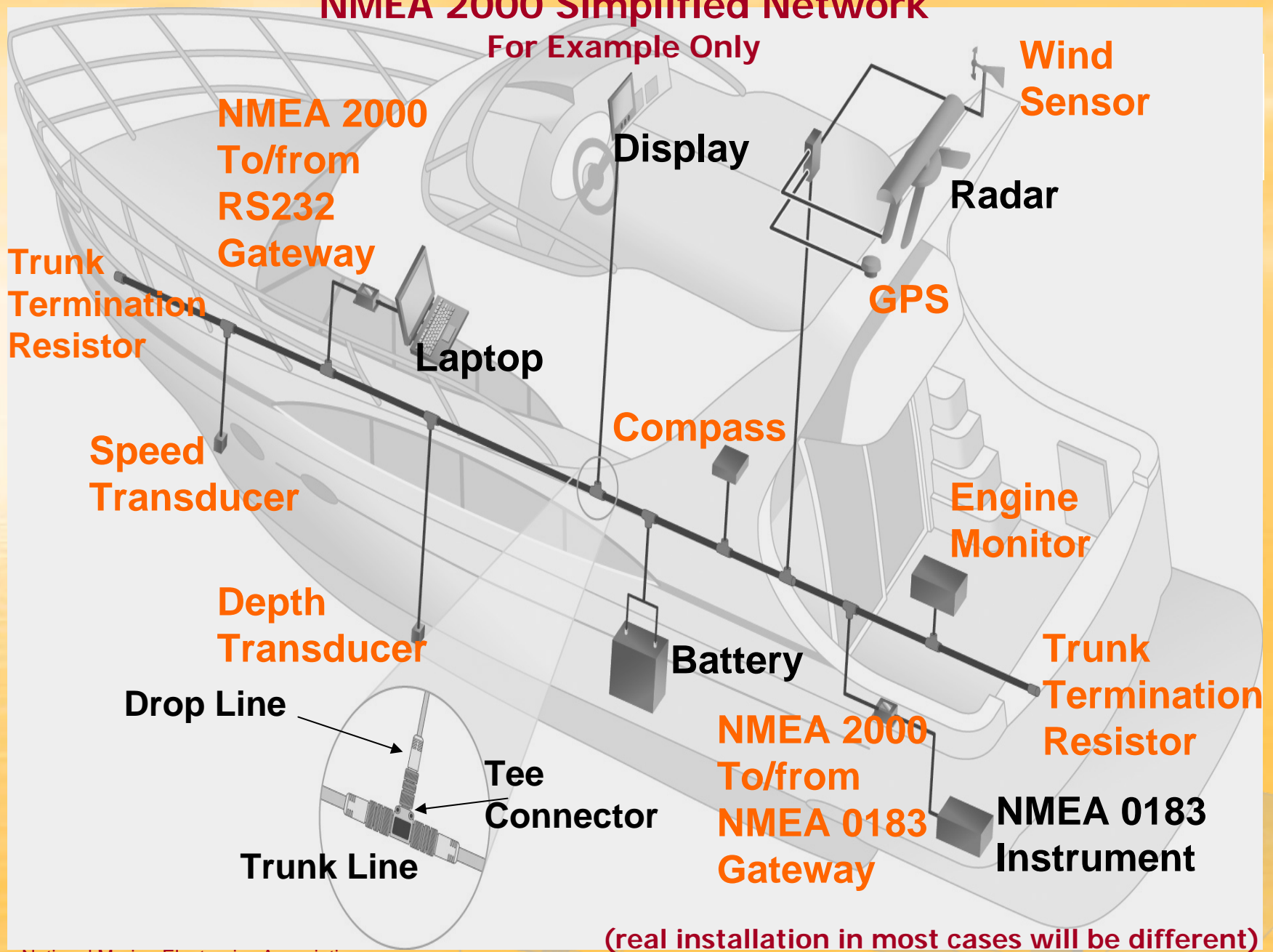# • NMEA 2000® Simplified Circuit
– Multi - Talker / Multi - Listener

NMEA 2000® Device

Terminating Resistor

Backbone Cable

Terminating Resistor

Tap (T-connector or barrier strips)

Drop Cable

NMEA 2000® Device

+ VDC
Gnd
Shield

Power Supply Connection

NMEA 2000 Simplified Network
For Example Only

Wind Sensor

NMEA 2000 To/from RS232 Gateway

Display

Radar

Trunk Termination Resistor

GPS

Speed Transducer

Laptop

Compass

Engine Monitor

Depth Transducer

Battery

Trunk Termination Resistor

Drop Line

Tee Connector

NMEA 2000 To/from NMEA 0183 Gateway

NMEA 0183 Instrument

Trunk Line

(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

	Can	Ethernet
Power Consumption	Lower	Higher
Bandwidth	Low	High (Radar, Video)
Collision Avoidance	Yes	**No Avoidance (Collision Detection)**
Message Priority	Yes	**No**

- # **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**