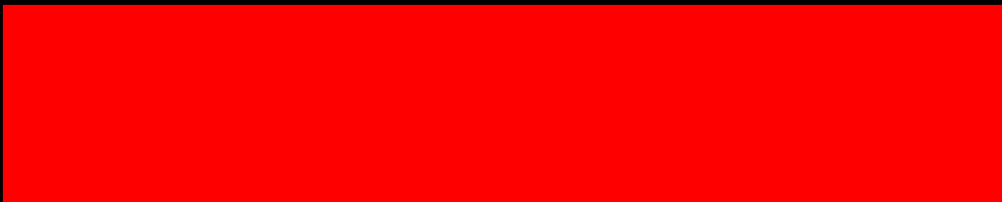


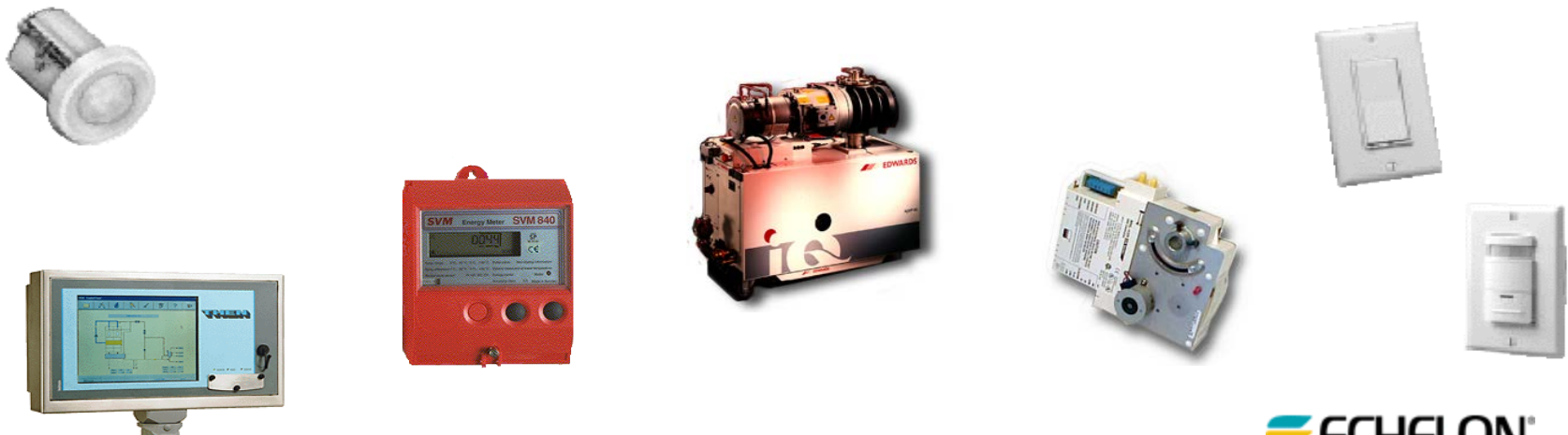


LONWORKS Introduction





LONWORKS networks are designed to transform everyday devices...

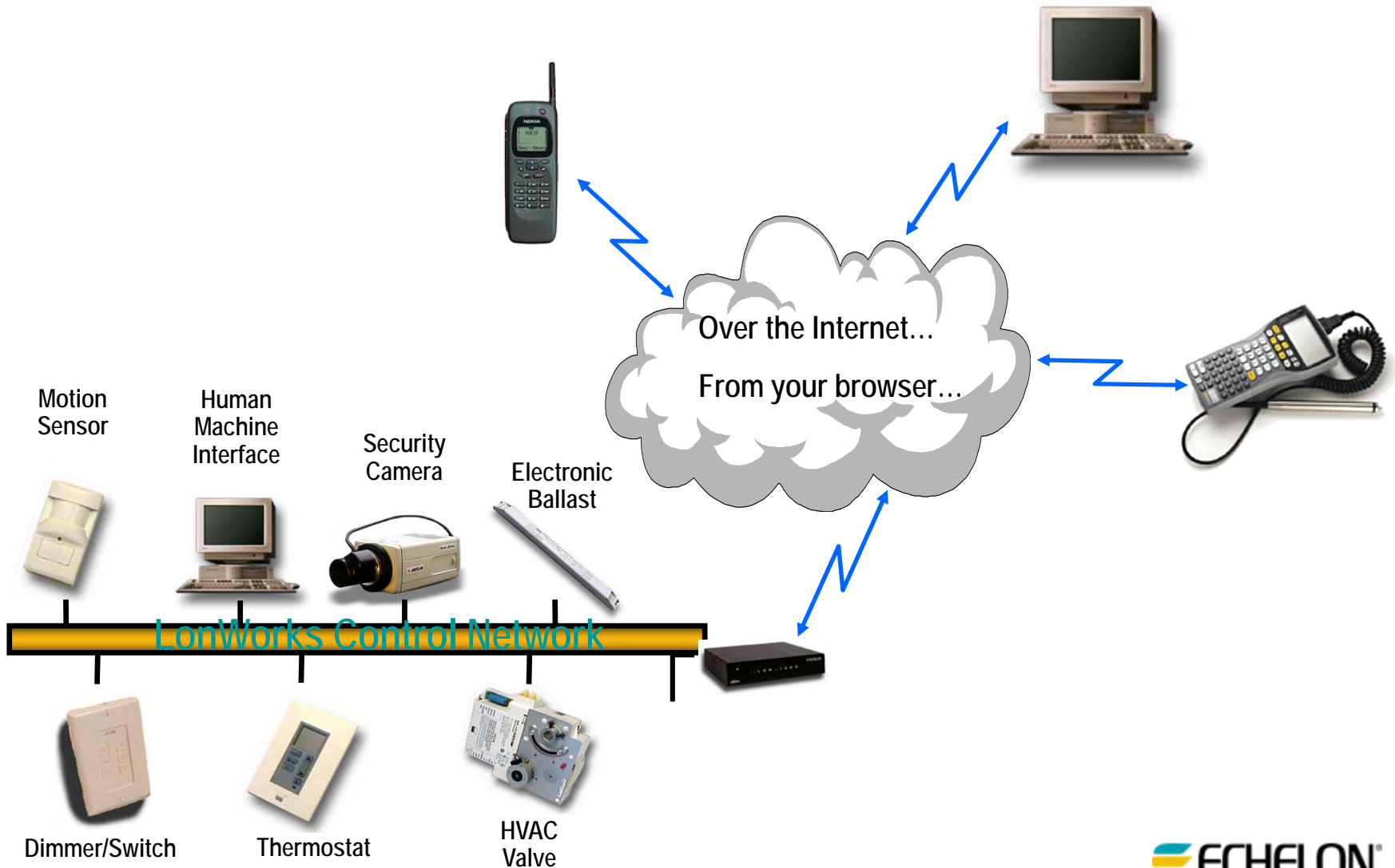




...into intelligent, interoperable, networked devices that communicate on a peer-to-peer basis using open standards...



... accessible from anywhere in the world



LonWorks at Work or Play everyday

Chances are you've already experienced the power of LonWorks at home, work or play without realizing it.

- Seen a Broadway play? LonWorks lighting systems light many Broadway stages
- Been to Las Vegas lately? LonWorks devices control the fountain show each night at the Bellagio Hotel
- Got Milk? LONWORKS devices run the largest milk distribution facility in Greece
- Ridden the New York City Subway? The New York City transit Authority has adopted LonWorks as the standard to control device throughout its subway cars
- Received a parking ticket in Amsterdam? LonWorks technology keeps Amsterdam's parking meters working

LonWorks Applied

Where does LonWorks get used and by whom:

- Automotive manufacture - parts pull, testing paint spaying
- Electro-pneumatic braking on trains
- Food Processing
- IC manufacture - gas distribution and tools
- Material handling
- Paint booths
- PCB Manufacture
- Printing
- Pulp and Paper mills
- Textiles - dyeing
- Water and Waste water treatment
- Building Automation Control systems
- Home Automation

A LON Story

- Local Operating Network
- Echelon founded in 1988 by AC ‘Mike’ Markkula
 - ◇ CEO of Apple Computer
- First Neuron chip created in 1991
- Echelon is global
 - ◇ 200+ employees
 - ◇ Nasdaq listed ELON
 - ◇ 100+ products
- LonTalk is an open protocol
 - ◇ ANSI/EIA

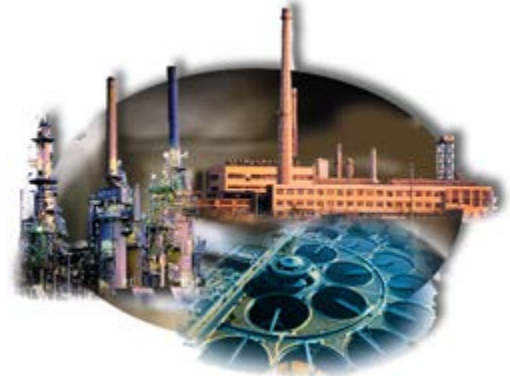


Echelon is focused on four primary markets



Building Automation

Home/Utility Automation



Industrial Automation

Transportation Automation



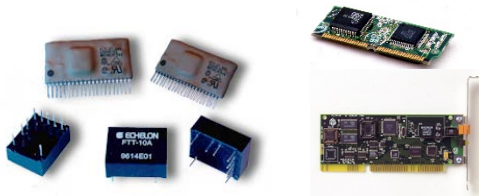
Echelon makes tools for building end-to-end solutions...



Network Management Software



Development Tools



Power Line & Twisted Pair Transceivers, Controllers, NICs



Routers, Internet Servers



...and for connecting everyday devices to (and over) the Internet



i.LON 10



i.LON 1000



i.LON 100

- The *i.LON*[™] Internet Server family enables millions of existing LONWORKS products to be accessed via the Internet

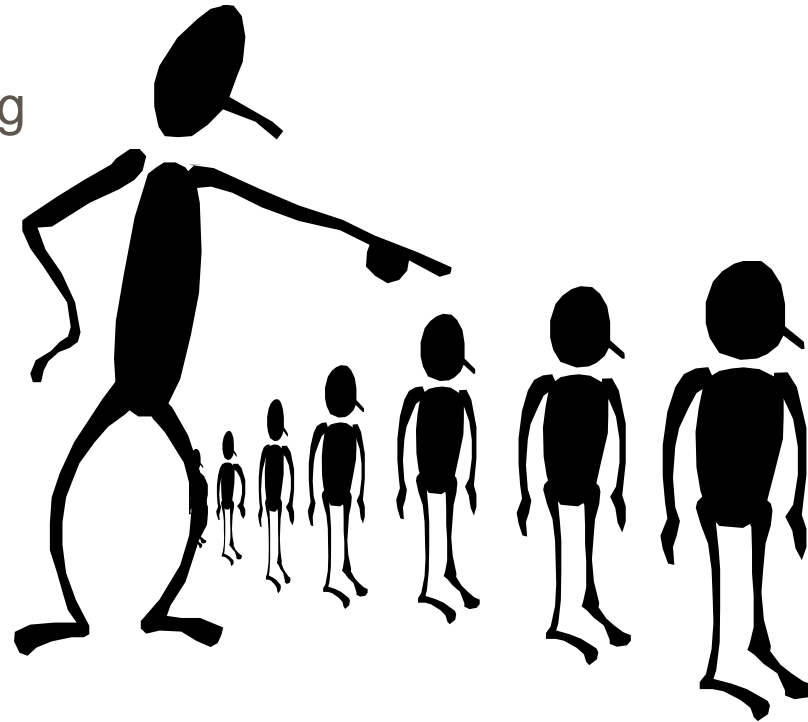
LONWORKS Network Design

LONWORKS Technology Review

Kinds of Control Algorithms

- **Master/Slave**

- ◇ a single controller making all the control decisions
- ◇ Single point of failure
- ◇ Difficult to expand
- ◇ Costly to install – more wiring needed to connect sensors and actuators
- ◇ Proprietary programming
- ◇ Proprietary solutions



Kinds of Control Algorithms

- Peer-to-Peer

- ◇ Distributed control intelligence
- ◇ No single point of failure
- ◇ Easy to expand and add more devices
- ◇ Less costly wiring installation
 - *No home I/O wiring runs*



Open and Independent

- Robust, reliable, proven device networking protocol on a chip
- Manufacturers of smart devices can get to market quickly
- End users no longer locked into single supplier
- Integrators can choose best of breed devices
- LonTalk is media independent
- LonWorks tools operate on multiple platforms
- Multi-industry standards group ensure interoperability



Look for the LONMARK Label

300+ members from 17+ countries ensuring plug-and-play operation

- Non-profit industry association
 - ◇ Includes manufactures, integrators, application developers, and end-users
- Establishes technical guidelines
 - ◇ Industry specific task groups
- Promotes the LONMARK standard and certifies product conformance
- Provides a resource of device information
- Governed by board of directors made up of industry members
 - ◇ Includes sponsor members and elected representatives
 - ◇ All members have a vote



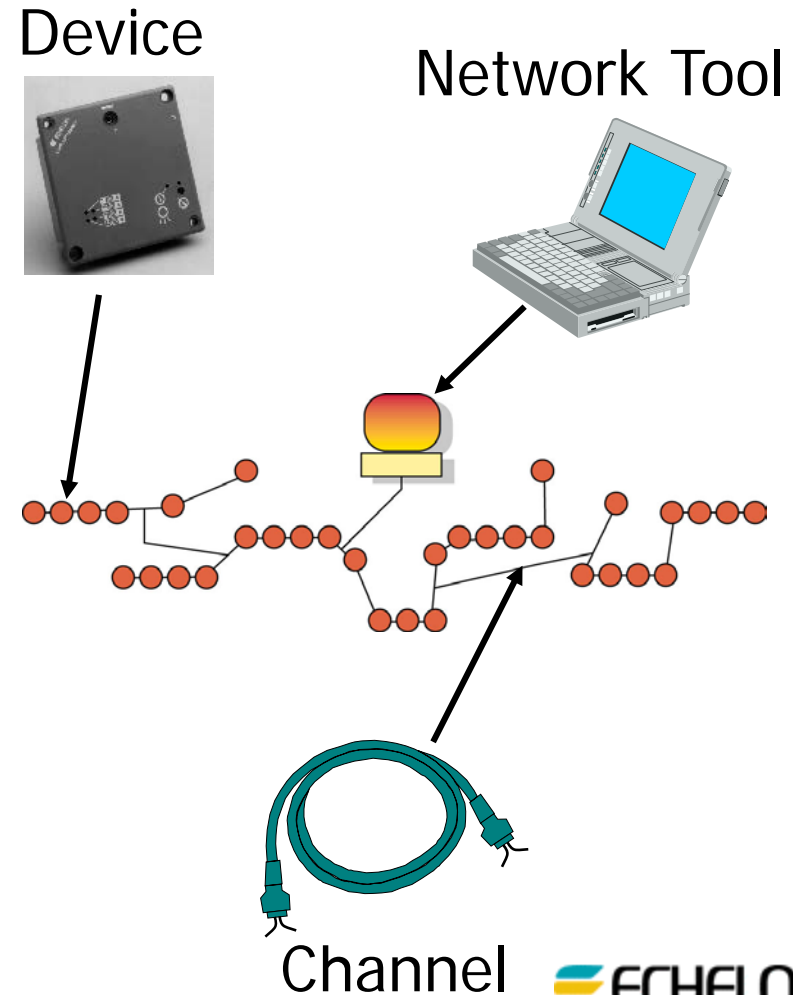
Networking Technology

- Allows integration of device information across network of any size including the internet
- Requires the assignment of a logical identity for each device called the Domain/subnet/node address
 - ◊ Assigned by the network management tool
- Allows message packets to be isolated or forwarded by intelligent LonWorks routers



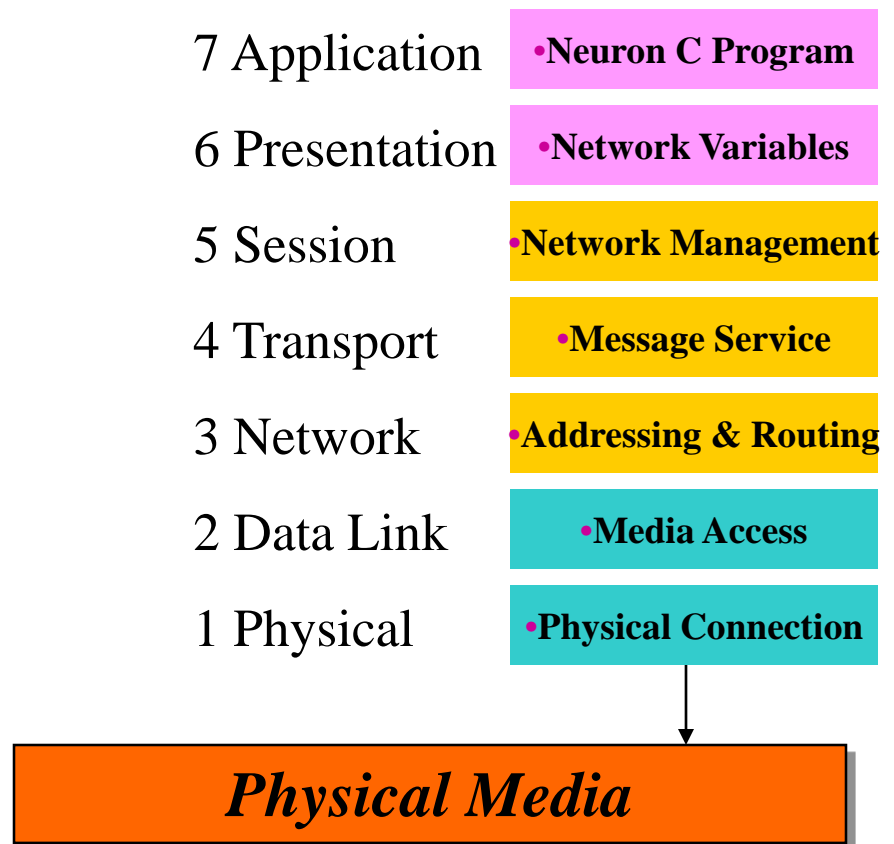
LONWORKS Network Elements

- Channel
 - ◇ Media to which devices are connected
- Device
 - ◇ Actuator, sensor, controller, or combination
 - ◇ LonMark Certified
- Network Tool
 - ◇ Installation tool
 - ◇ Human machine interface (HMI)



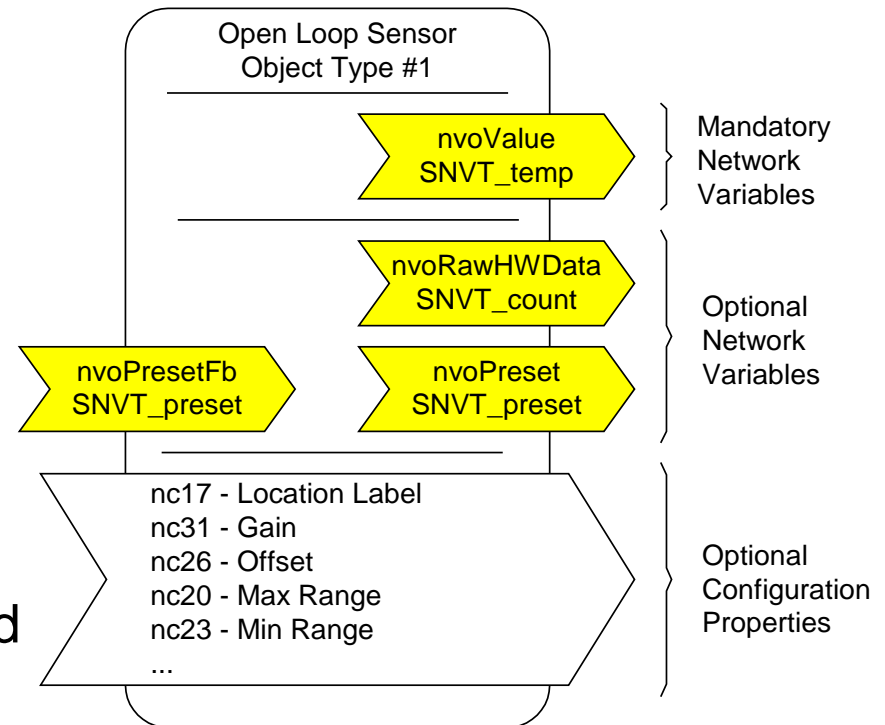
LonTalk Protocol

- Globally recognized standard ANSI/EIA 709.1
- Designed for control applications – not data applications
- Includes all 7 layers of the ISO standard model for network communication
- Implemented on the neuron chip or equal processor
- Is media independent
- Is an open and published standard available to anyone



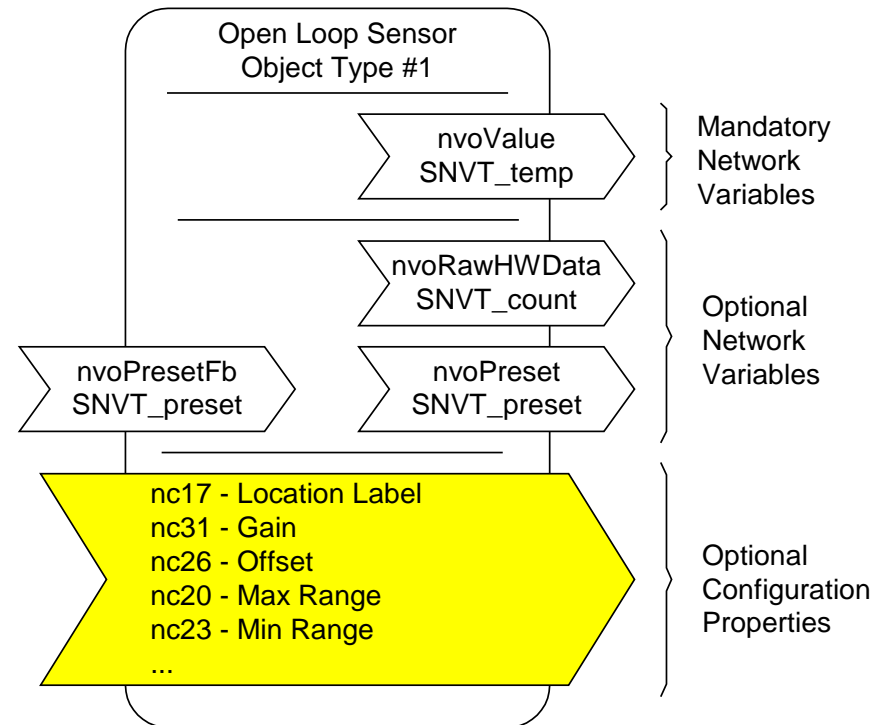
Network Variables

- The dynamic data sent or received by network devices
- Signal-type independent – temperature, pressure, volume, flow, etc.
- SNVT's are standard network variable types as defined by the LonMark organization
 - ◇ Known and documented structure, size, range, etc.
- UNVT's are manufacturer defined
 - ◇ Tools may require resource files to document data format

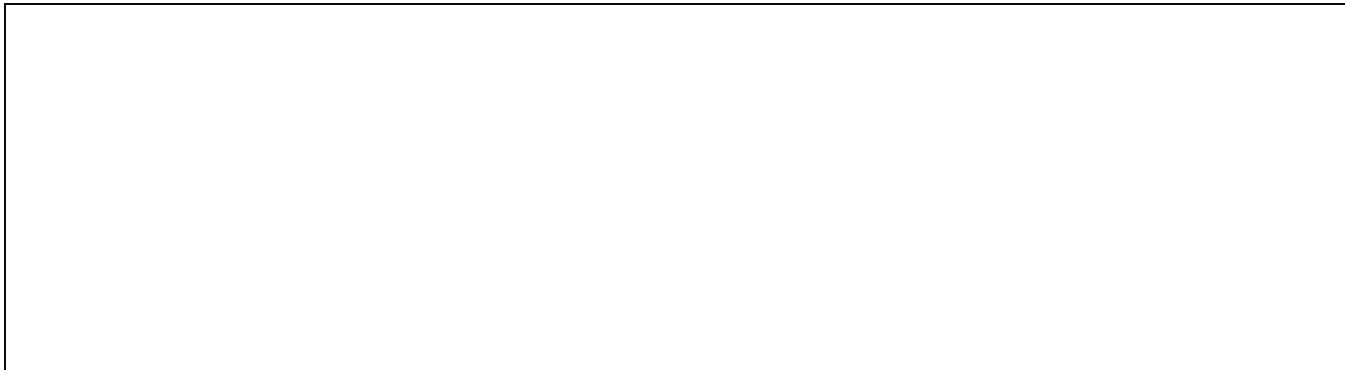


Configuration Properties

- Define device behavior such as setpoint, high limits, throttle, etc.
- SCPT's are standard configuration property types as defined by the LonMark association
 - ◇ Known and documented structure, format, range, etc.
- UCPT's are manufacturer defined
 - ◇ Tools may require resource files to present values in a meaningful way.

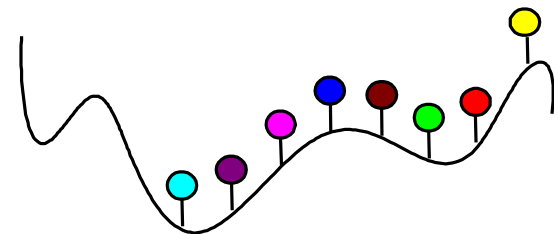
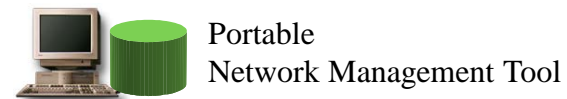
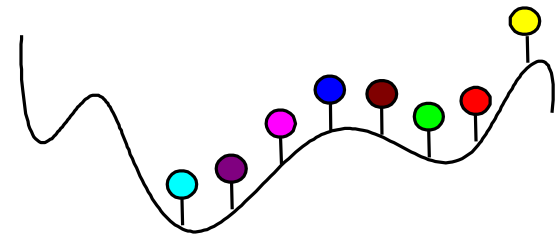


LonWorks Architectures



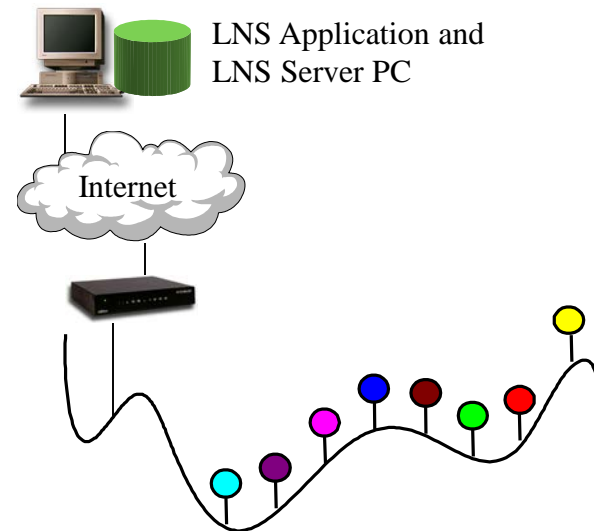
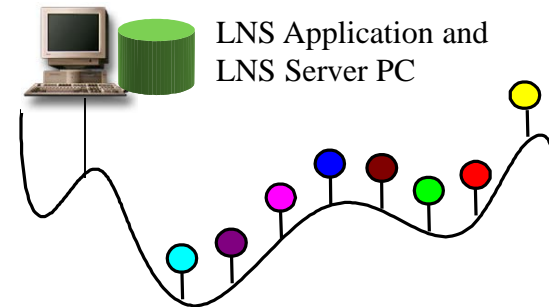
Simple Device Network

- Devices communicate with each other directly
- No network tool required after commissioning the devices
- Tool is required to perform network maintenance such as adds/moves/changes or device replacement



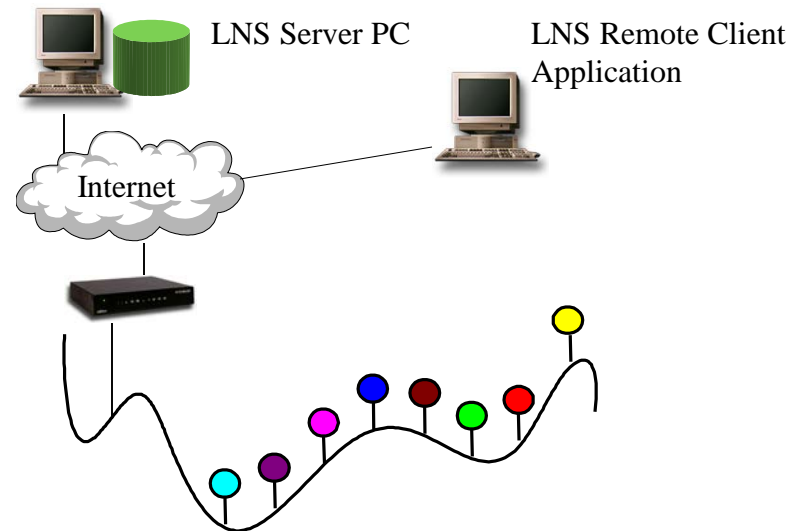
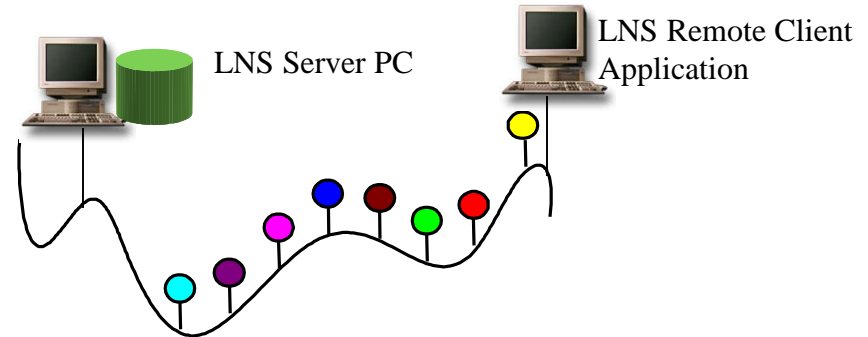
Local Client Applications

- LNS database resides on same PC as the network tool
- LNS communicates to devices via network interface hardware and/or software
 - ◇ *Twisted Pair, Powerline, IP*



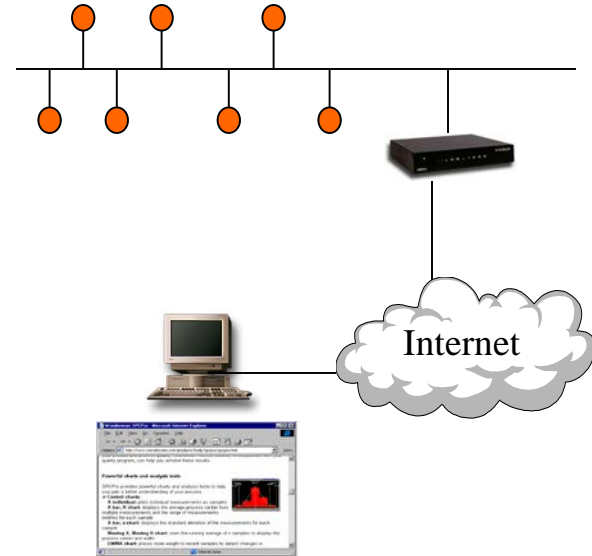
Remote Client Applications

- Remote client is an application that runs other than on an LNS Server PC
 - ◇ LNS Database is accessed over the network media or over IP
- It can be attached to any LONWORKS channel, including a LONWORKS/IP channel
- Requires the LNS Server application running at the PC where the LNS database resides
 - ◇ *The LNS Server application supports up to 100 clients and 255 LNS databases opened simultaneously*



Web Based Monitoring and Control Clients

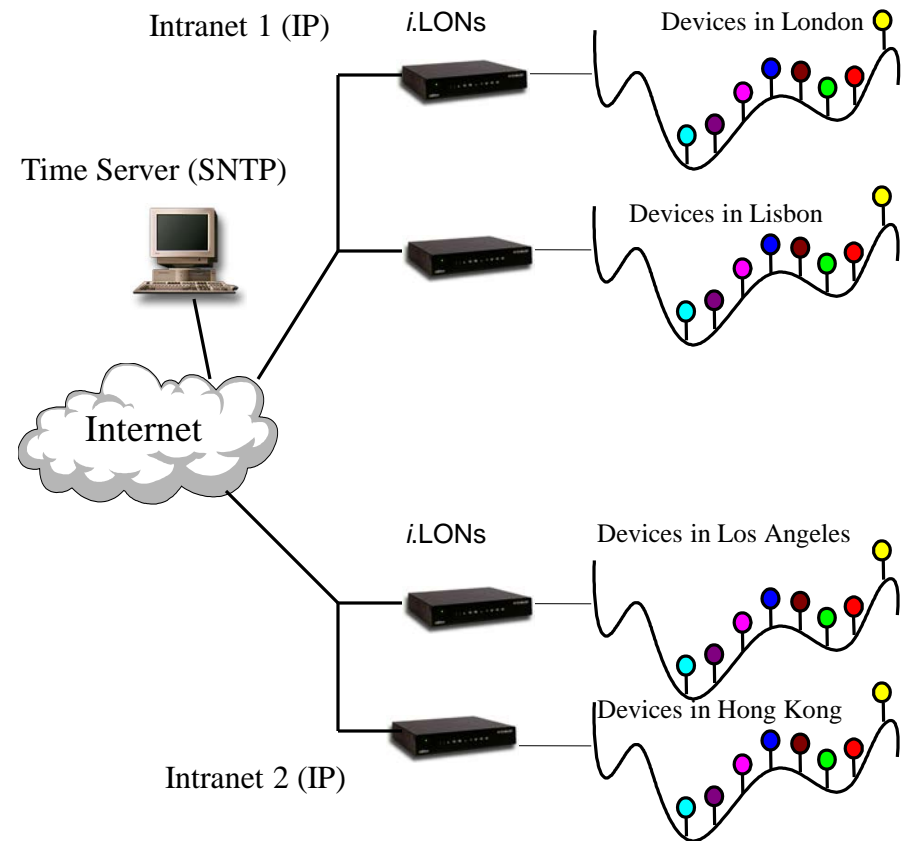
- Any PC that can support a standard web browser interface
 - ◊ *Internet Explorer, Netscape, Etc.*
- Network data served up as HTML web pages from LonWorks webserver device
 - ◊ *ILON100, iLon1000, Plexus, etc...*
- Can perform monitoring and control of network variables but cannot perform network management functions



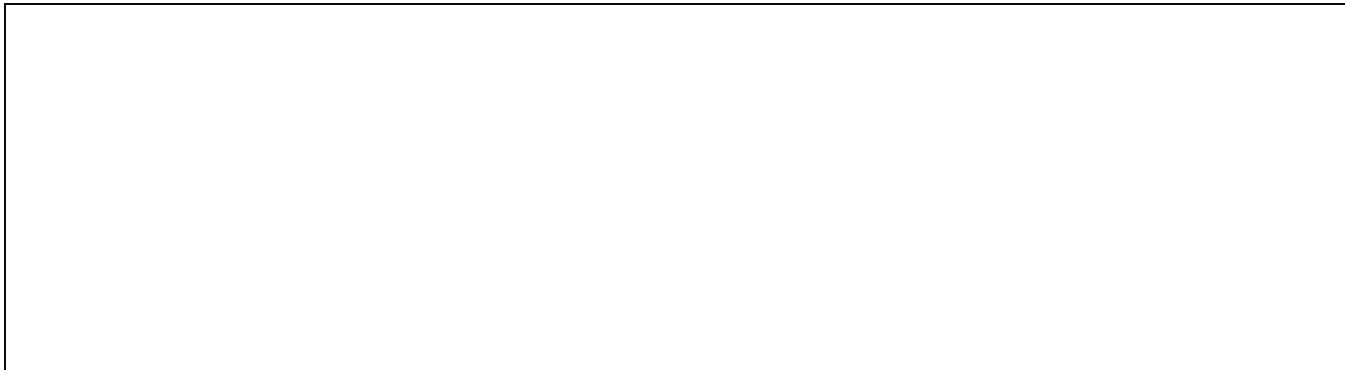
Netscape or
Internet Explorer
running at remote client

Internet/Intranet IP Backbone

- Internet to LonWorks routers (*i.LONs*) can be used to create one network by connecting remote locations over LONWORKS/IP channels
- LNS Server is not required for day-to-day operation
- up to 40 *i.LON* routers per LONWORKS/IP channel
- Time server may be required to synchronize message delivery across wide area networks

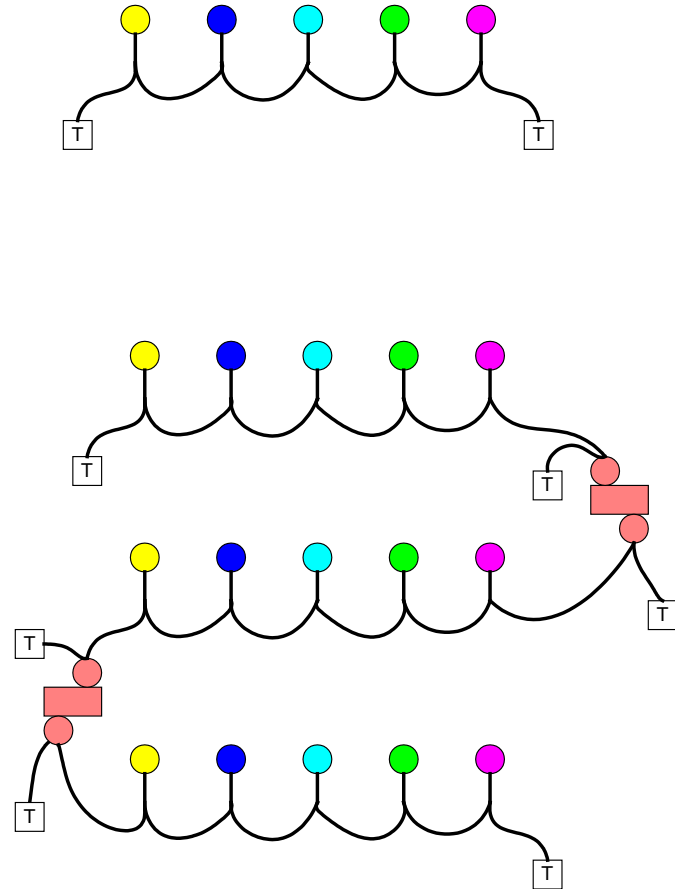


LonWorks Topologies



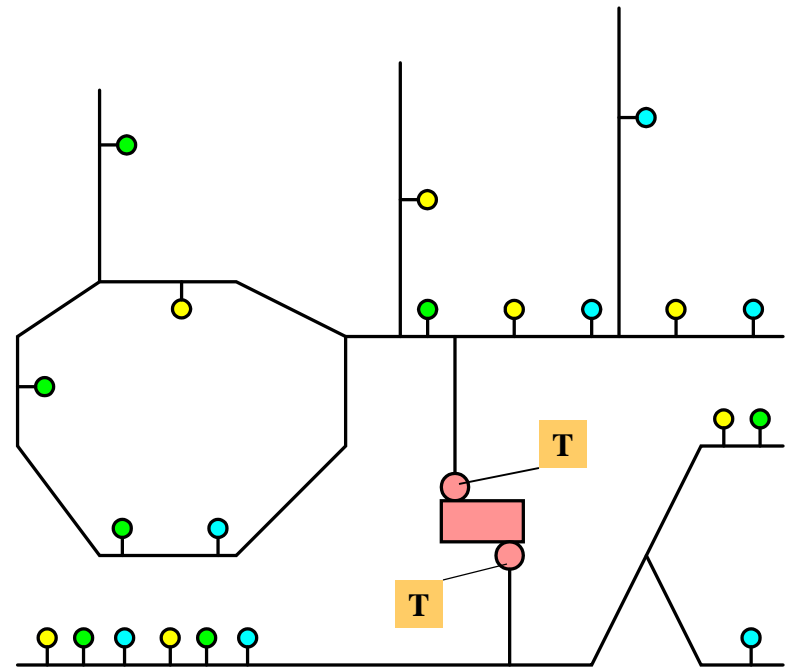
Bus Topology

- A physical routing of the communication channel that includes a distinct beginning and end
- Must be doubly terminated at beginning and end
- Device to device wiring or short stubs
- Easiest to troubleshoot
- Difficult to expand when you need to add more devices



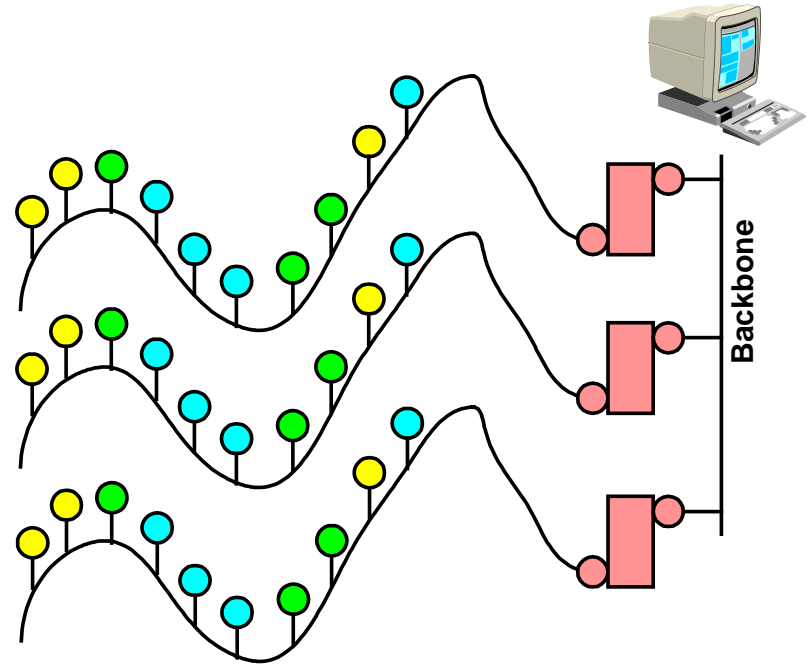
Free Topologies

- A flexible wiring structure of the communication channel that includes a ring, star, loop, or combination
- Can have long stubs to devices and tools, tap in anywhere on the channel
- Difficult to troubleshoot
- Easy to expand
- Easy to exceed media limits
- Requires one terminator installed anywhere on the channel segment



Backbone Topology

- Connects routers to a common backbone channel
- Typically installed in a bus topology and includes mostly routers, network tools, and systemwide control devices
- Can be high speed twisted pair – XF1250
- Can be high speed IP channel
- Reserves bandwidth for network tools



Time for your Questions

