Remote IO Modules

-- Networking

Axel Chou

Course Content

15 mins	1. Internet Overview
30 mins	2. Ethernet Networking & TCP/IP
15 mins	3. 15 minutes break
15 mins	4. ADAM-5000/TCP introduction
30 mins	5. ADAM-5000/TCP live demo & hands on
15 mins	6. 15 minutes break
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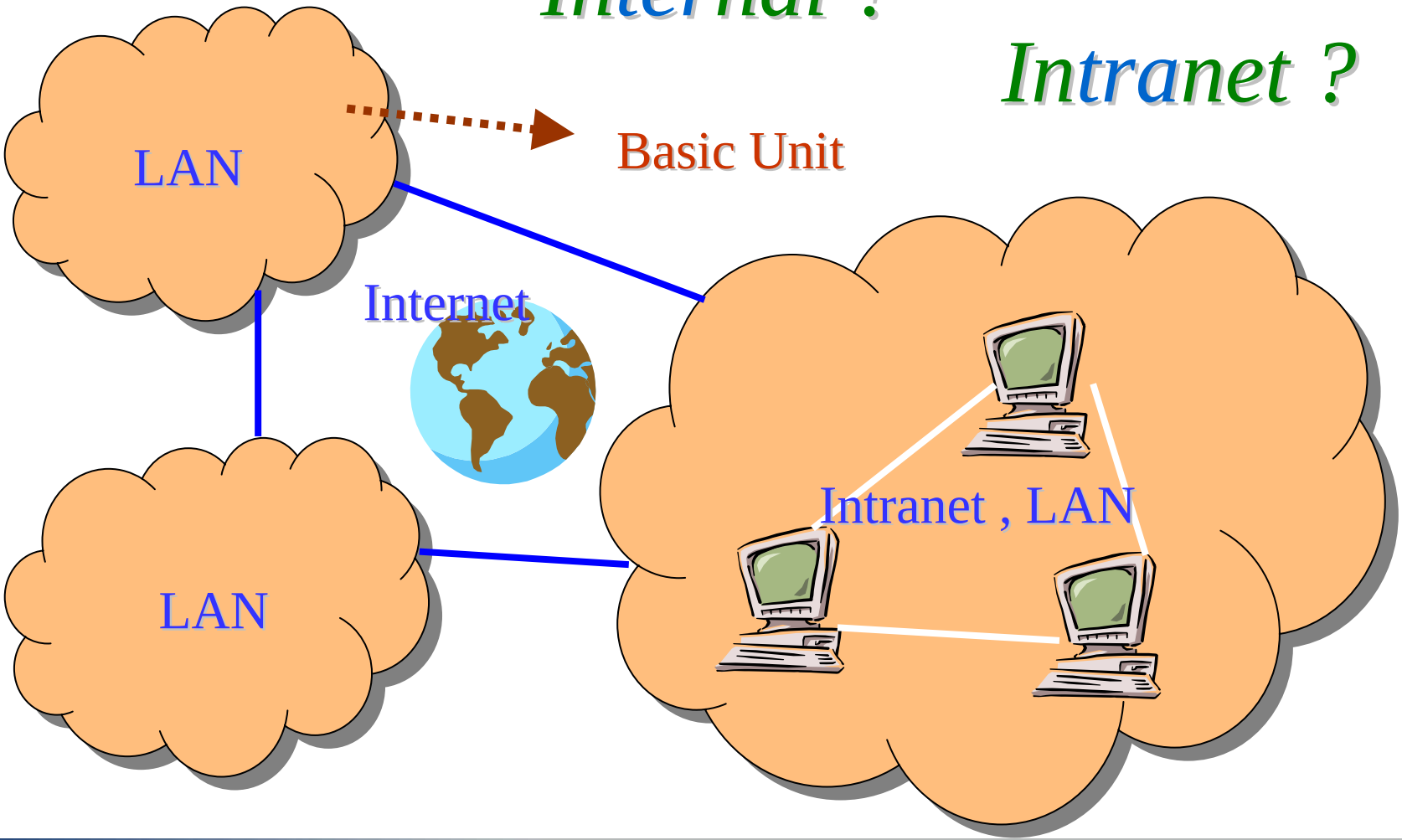
1. Internet Overview

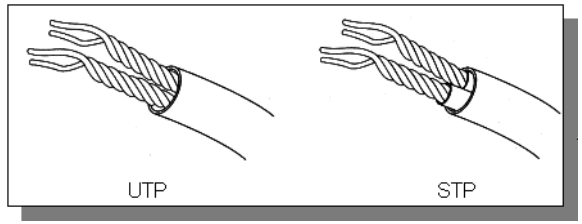
Internal ?

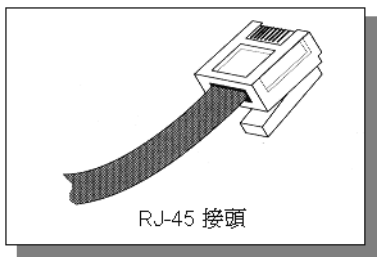
Intranet ?

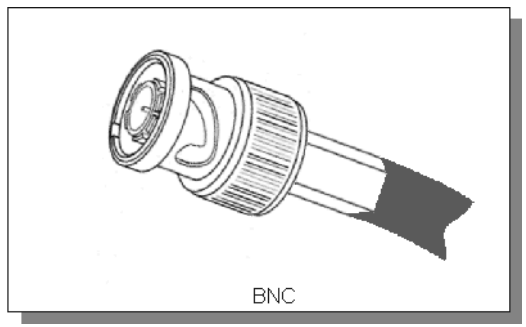


Internetworking Material

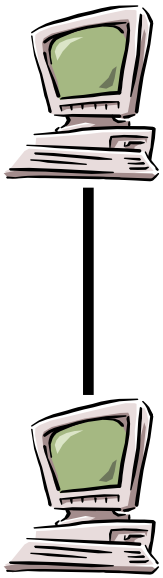
1. Network Interface Card
2. Cable
3. Connector



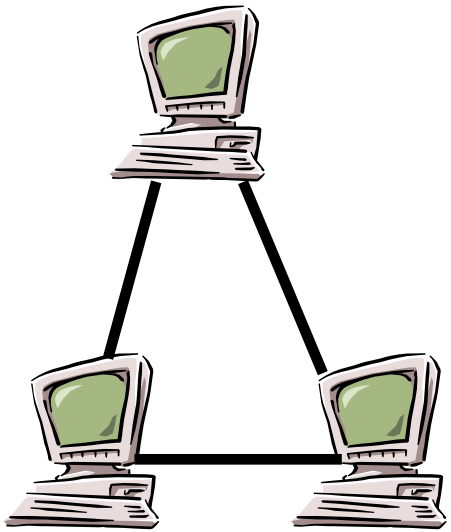




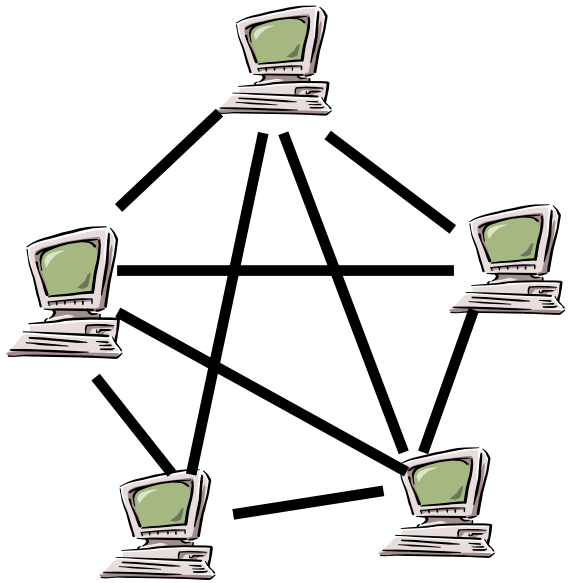
Cable Connecting



Cable = 1

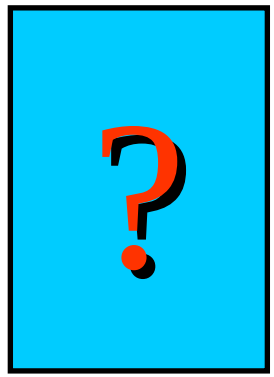


Cable = 3



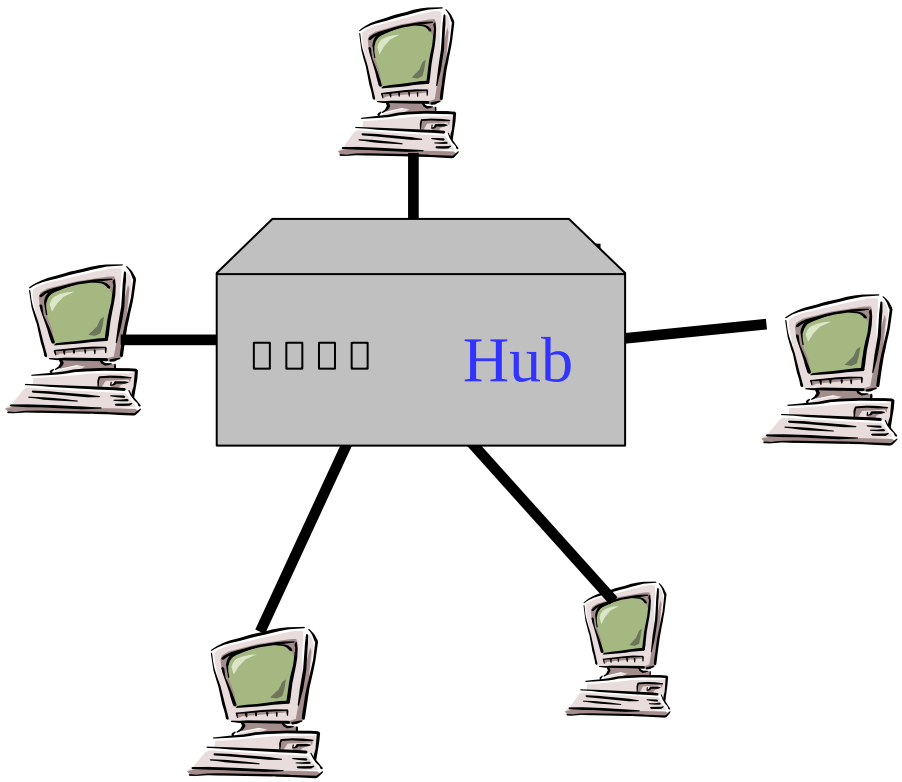
Cable = 10

25 X



Cable = 300

Star Topology



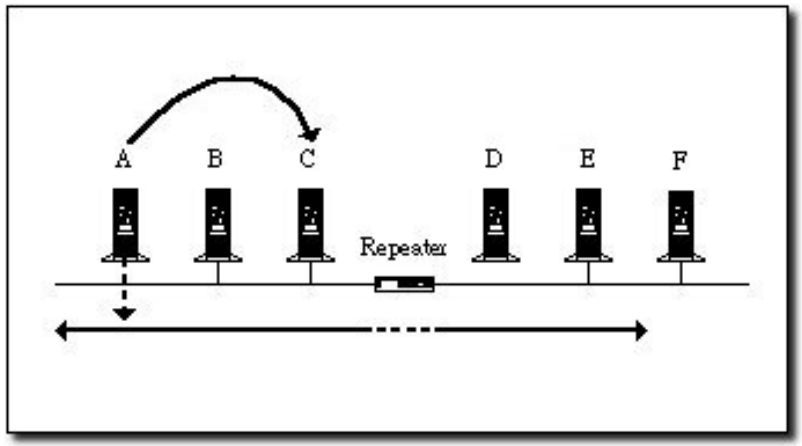
Passive HUB :

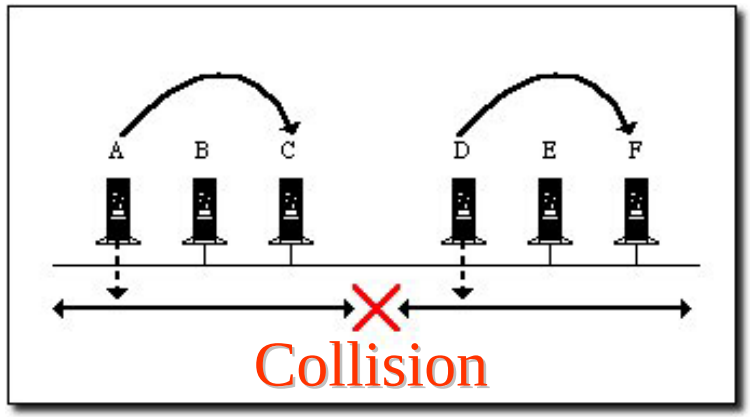
Connect the port each other

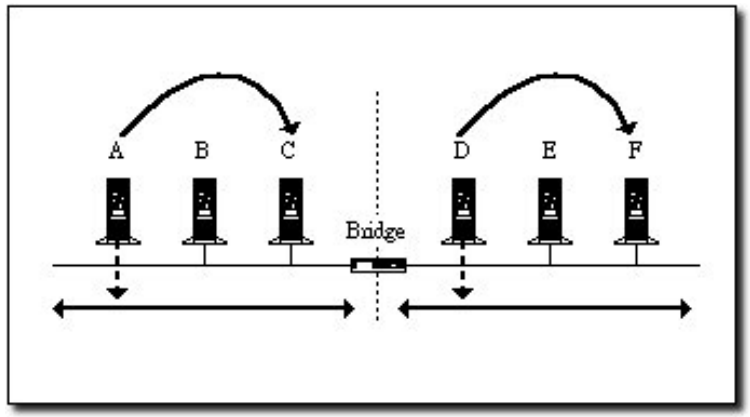
Active HUB :

Add Repeater function to elongate the cabling

Repeater , Bridge







Hub , Switch

ADAM-6510 : Hub (Active) → Multi-port Repeater

ADAM-6520 : Switch → Multi-port Bridge

& More smart to prevent collision

Important in constructing *high speed* network

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2. Ethernet Networking & TCP/IP

What is Ethernet?

1. Logical BUS topology
2. Most popular LAN topology, another is Token-Ring
3. Follow the IEEE 802.3
4. Use Broadcast
5. Recognize each other by MAC ID (48bit node ID)

2. Ethernet Networking & TCP/IP

Ethernet & Token Ring

Category	IEEE 802.3	IEEE 802.5
Topology	Bus	Single Ring
Physical	Star, Bus	Star
Media	Optic fiber, Twisted Pair, Coaxial Cable	Twisted Pair
Band Width	10 Mbps	4 or 16 Mbps
Communication	CSMA/CD	Token Passing
Frame	1518 bytes	4500 (4 Mbps) 18000 (16 Mbps)
Node number	1024	260
Node interval	2.8m (minimum)	100m (maximum)
Network Length	2.8km	depends

CSMA/CD (Carrier-Sensing Multiple Access with Collision Detection)

2. Ethernet Networking & TCP/IP

Ethernet Data Frame

Preamble	Destination	Source	Message Type	Data	Frame check sequence
8 bytes	6 bytes	6 bytes	2 bytes	46-1500 bytes	4 bytes

- The most basic data format in the Ethernet

What is *Protocol* ?

What is *TCP/IP* ?

What is *TCP/IP* ?

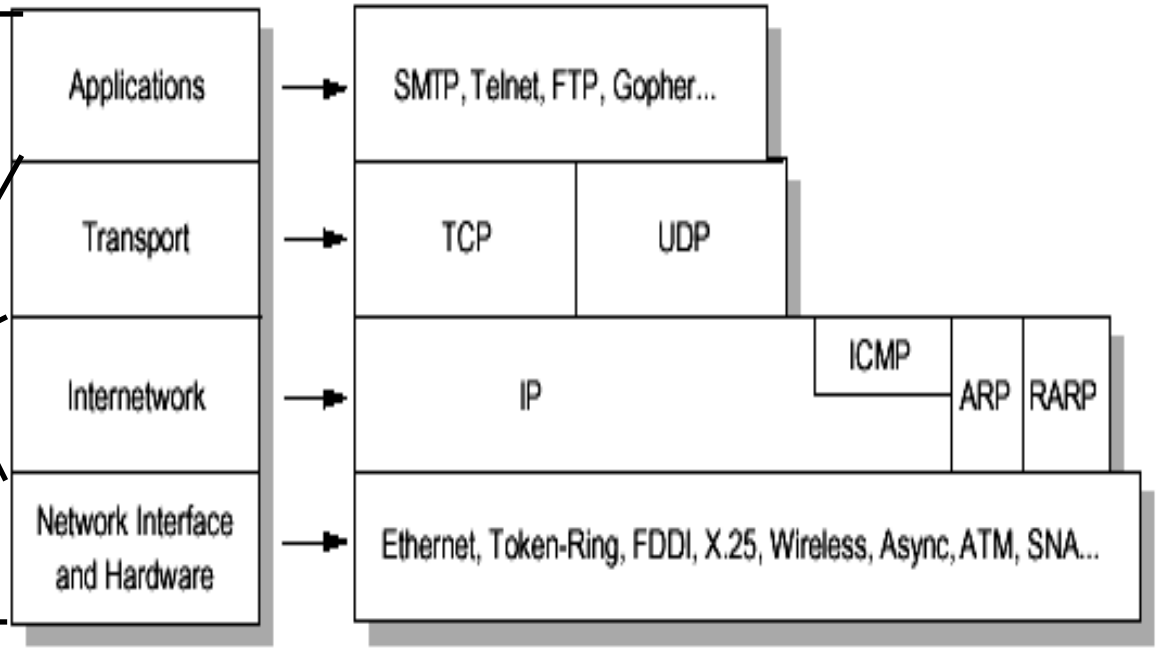
- It is a total name of a series of Protocol

System	Protocols
TCP/IP	**TCP,IP,UDP,ICMP,ARP,SNMP,SMTP**
NetWare	IPX,SPX,NPC …
AppleTalk	DDP, RTMP, AEP, ATP, ZIP …
DECnet	DPR, NSP, SCP…
OSI	FTAM, MOTIS, VT, CMIS/CMIP, CLNP
XNS	IDP, SPP, PEP

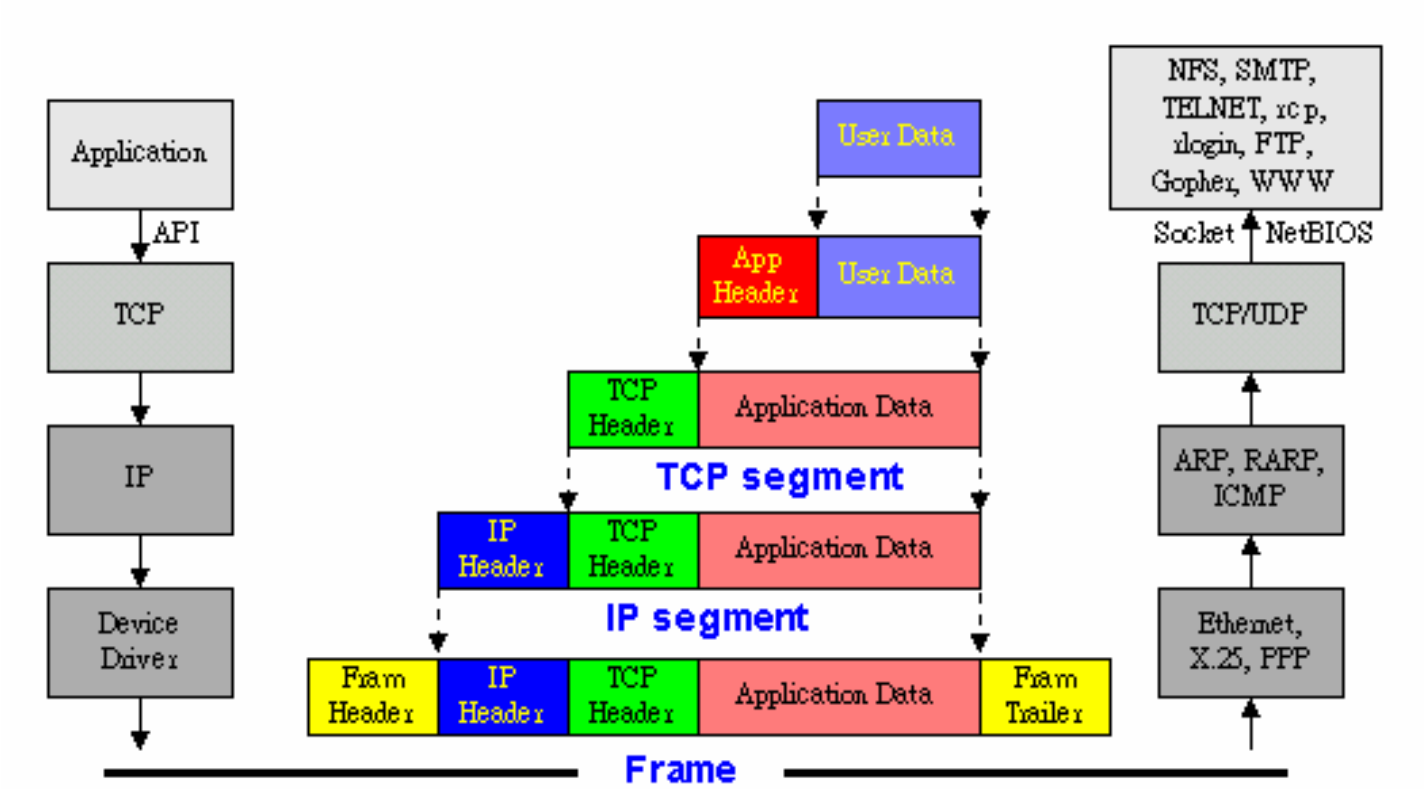
2. Ethernet Networking & TCP/IP

The TCP/IP protocol family & OSI

OSI	Internet Protocol Suit
Application	Application
Presentation	
Session	
Transport	Transport
Network	Inter-network
Data Link	Network Interface & Hardware
Physical	



TCP/IP Data Flow



Who define *TCP/IP* ?

2. Ethernet Networking & TCP/IP

Who define *TCP/IP* ?

Public

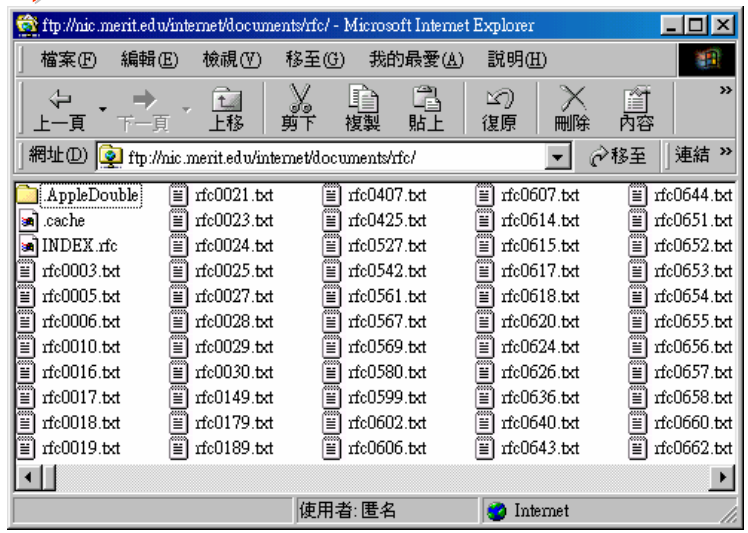
- ISOC (Internet Society)
  - IAB (Internet Activities Board)
    - IETF (Internet Engineering Task Force)
    - IRTF (Internet Research Task Force)

Process

Proposal Standard → Draft Standard → Standard → RFC

(Request for Comments)

ftp://nic.merit.edu/internet/documents/rfc/



Internet Protocol (IP)

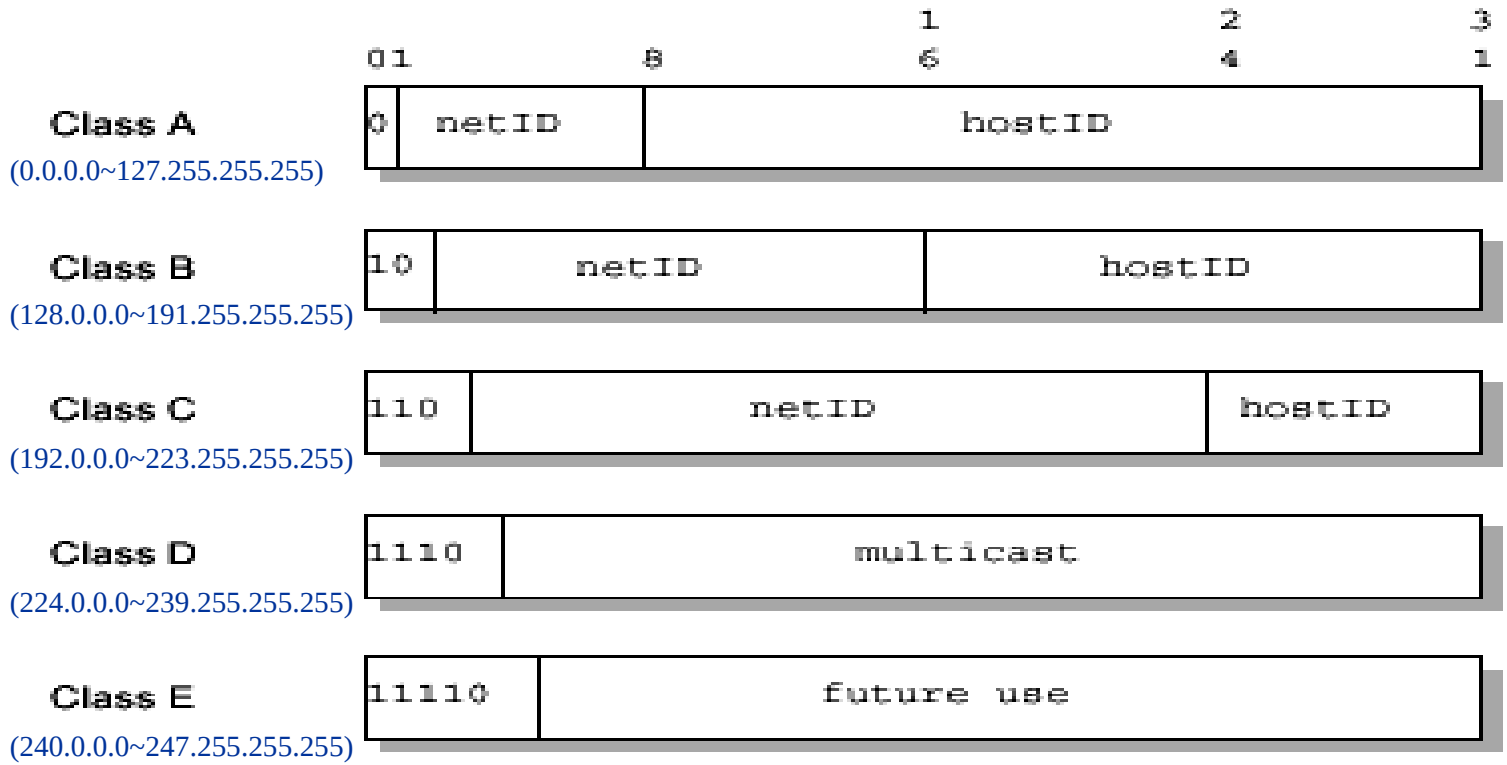
2. Ethernet Networking & TCP/IP

IP Addressing

An Octet

172.18.2.23 =

10101100.00010010.00000010.00010111



RFC document for IP ：RFC-791、RFC-1122、RFC-815、RFC-1700

Net Mask

- To separate the Net ID and Host ID by simple logic operation

- A Class : 255.0.0.0
  B Class : 255.255.0.0
  C Class : 255.255.255.0

- AND (IP , Net Mask)= Net ID
  AND (IP, (NOT Net Mask)) = Host ID

2. Ethernet Networking & TCP/IP

For example

172.18.2.23 =

10101100.00010010.00000010.00010111

→ Class B

Class B Net Mask = 255.255.0.0

=(11111111.11111111.00000000.00000000)

Net ID = 172.18.0.0

Host ID = 0.0.2.23

Special IP Address

Broadcast Address =

172.18.255.255

LAN Broadcast Address =

255.255.255.255

Loopback Address (Local Host) =

127.0.0.1

2. Ethernet Networking & TCP/IP

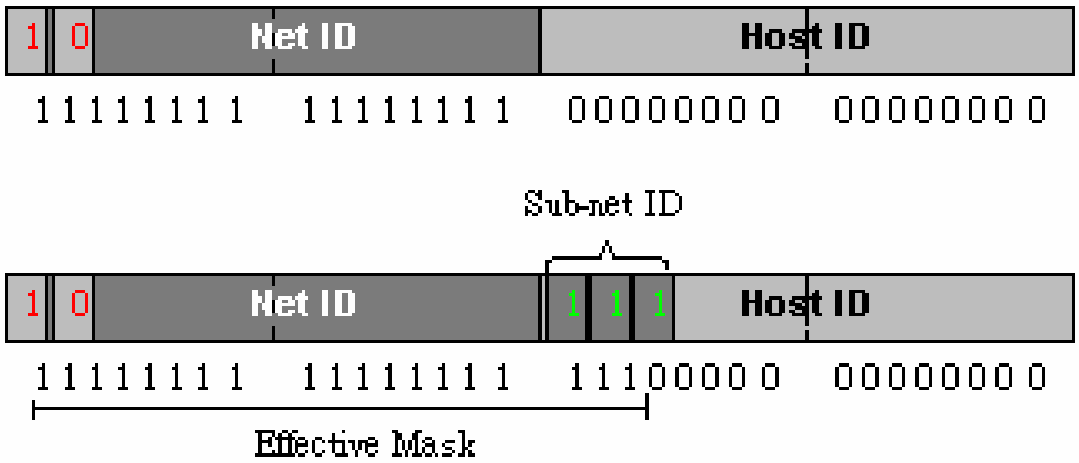
X.0.0.0
X.255.255.255

127.X.X.X

Class A	No. of NetID = 2^(8-1) – 1 = 127
	No. of HostID = 2^24 – 2 = 16,777,214
Class B	No. of NetID = 2^(16-2) = 16,384
	No. of HostID = 2^16 – 2 = 65,534
Class B	No. of NetID = 2^(24-3) = 2,097,152
	No. of HostID = 2^8 – 2 = 254

2. Ethernet Networking & TCP/IP

IP Subnets



11111111.11111111.00000000.00000000 => Net Mask

OR

00000000.00000000.11100000.00000000 => 8 Subnets

Result:

11111111.11111111.11100000.00000000 => 255.255.224.0

2. Ethernet Networking & TCP/IP

Private IP and Public IP

Transmission Control Protocol (TCP)

&

User Datagram Protocol (UDP)

TCP Characteristics

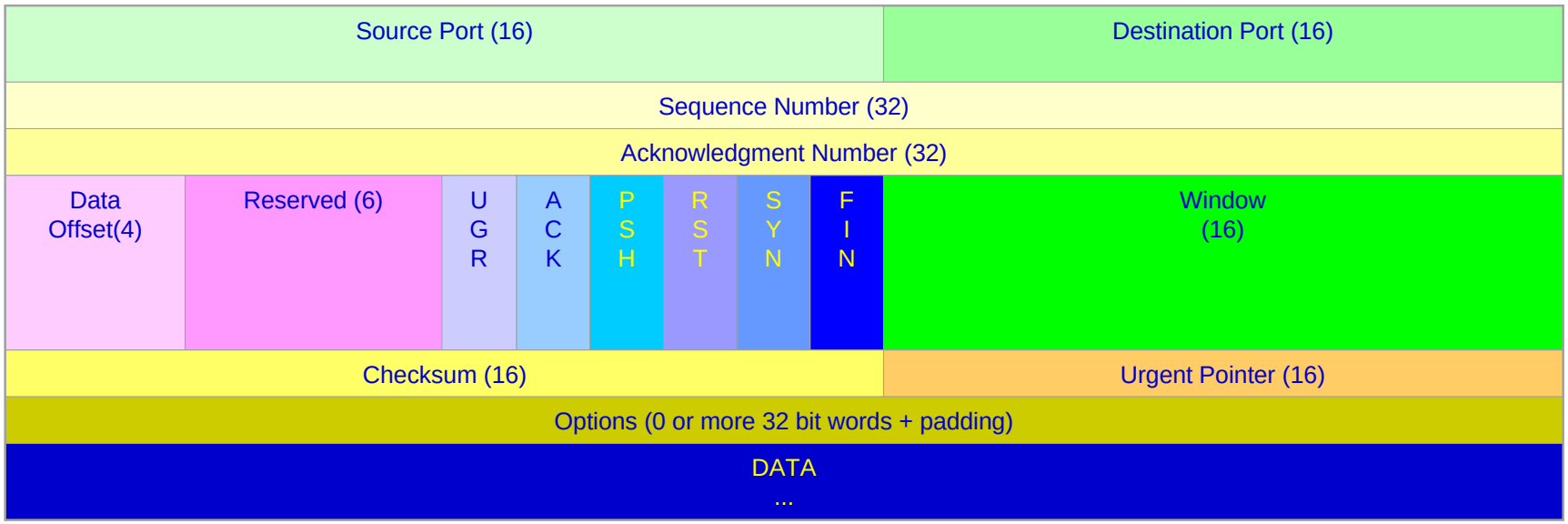
- **Notably error**
- **Recovery,**
- **Flow control**
- **Reliability.**
- **Connection-oriented protocol**
- **Most of the user application protocols, such as Telnet and FTP, use TCP.**

UDP Characteristics

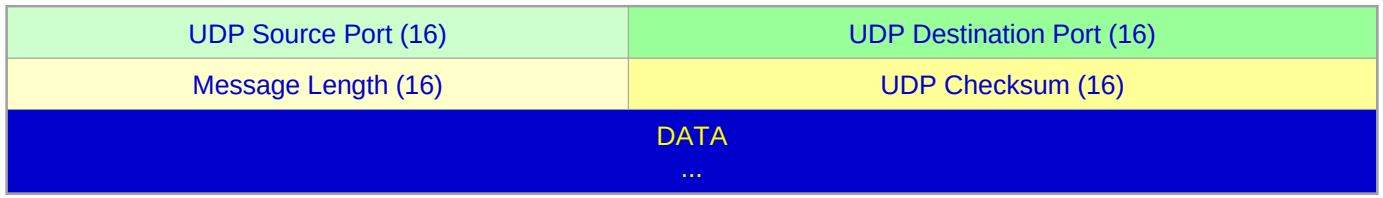
- **Connectionless data transformation**
- **Simple and quick**
- **Good to use in the time concerning process, which timing is much more important than reliability**

2. Ethernet Networking & TCP/IP

TCP segment

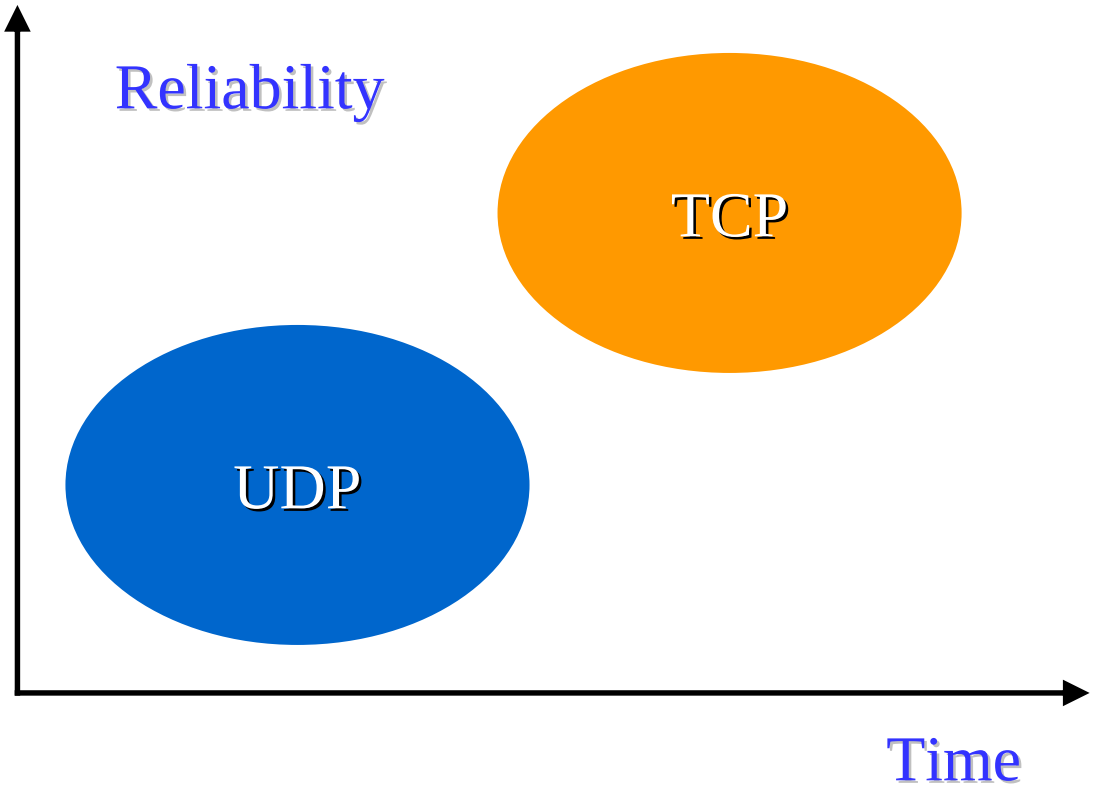


UDP segment



2. Ethernet Networking & TCP/IP

Comparison



RFC document

TCP

RFC-793、RFC-1122、
RFC-813、RFC-879、RFC-896

UDP

RFC-768

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Specifications (1)

- **CPU:** ARM 32-bit RISC CPU
- **Memory:** 4 MB Flash RAM
- **Operating System:** pSOS
- **I/O Capacity:** 8 slots
- **Even Response Time:** ≤ 5 ms

Specifications (2)

- **Isolation:**
  - ✓ Ethernet Communication: 1500 V DC
  - ✓ I/O Module: 3000 V DC
- **Comm. Protocol:** Modbus/TCP, TCP, UDP, IP
- **Status Indicator:**
  - ✓ CPU, Power (3.3V, 5V),
  - ✓ Communication(Link, Active, 10/100Mbps, Tx, Rx)

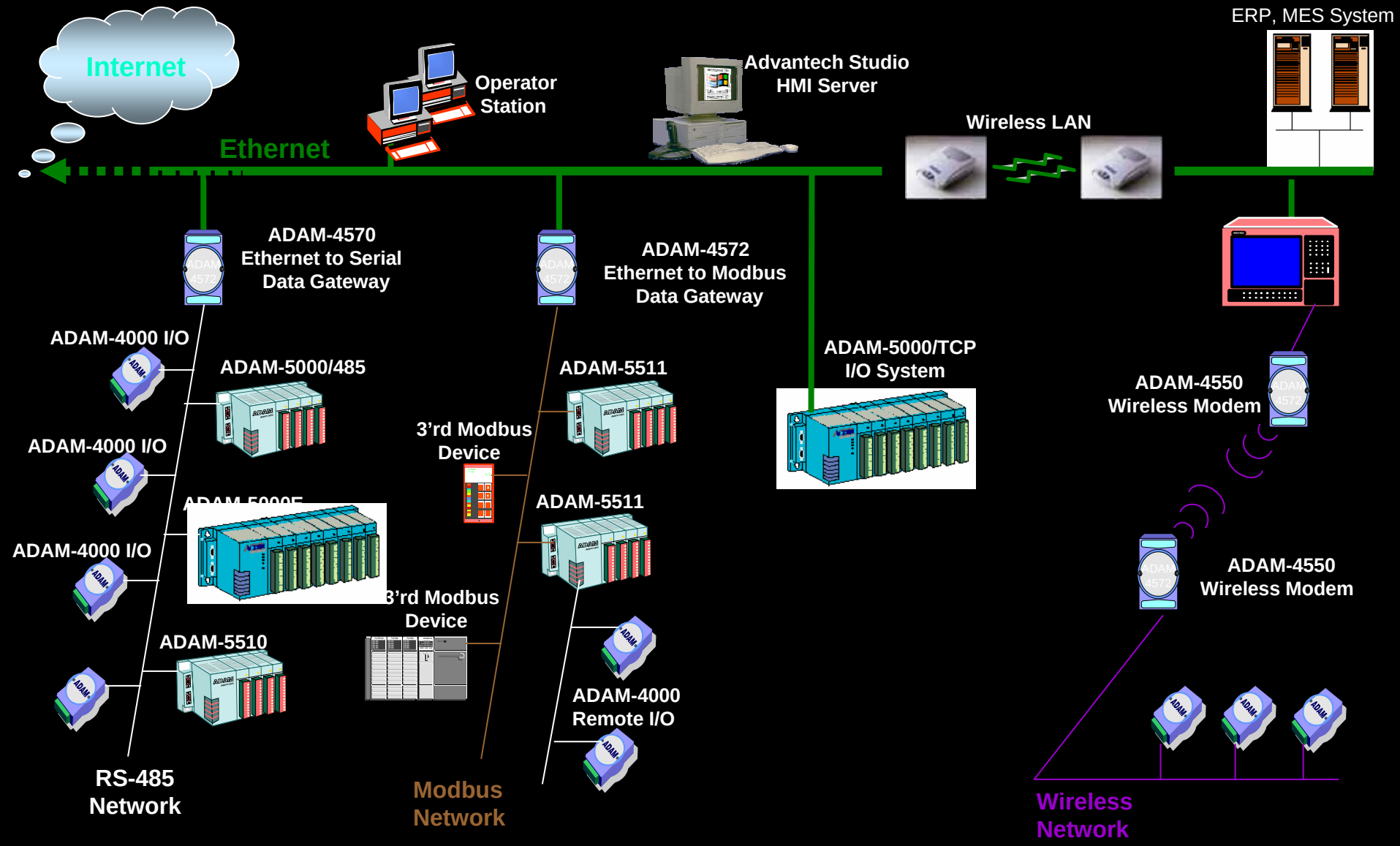
Features (1)

- Network Communication
  - ✓ Directly link to Ethernet
  - ✓ 10/100 Base T Auto-switch high speed communication port
- Modbus/TCP Protocol
  - ✓ For easy integration
  - ✓ Allowed 8 host PCs Access concurrently
- High Hardware Capacity
  - ✓ Supports all ADAM-5000 IO module
  - ✓ 8 slots for any mixed module
  - ✓ Diagnostic LEDs

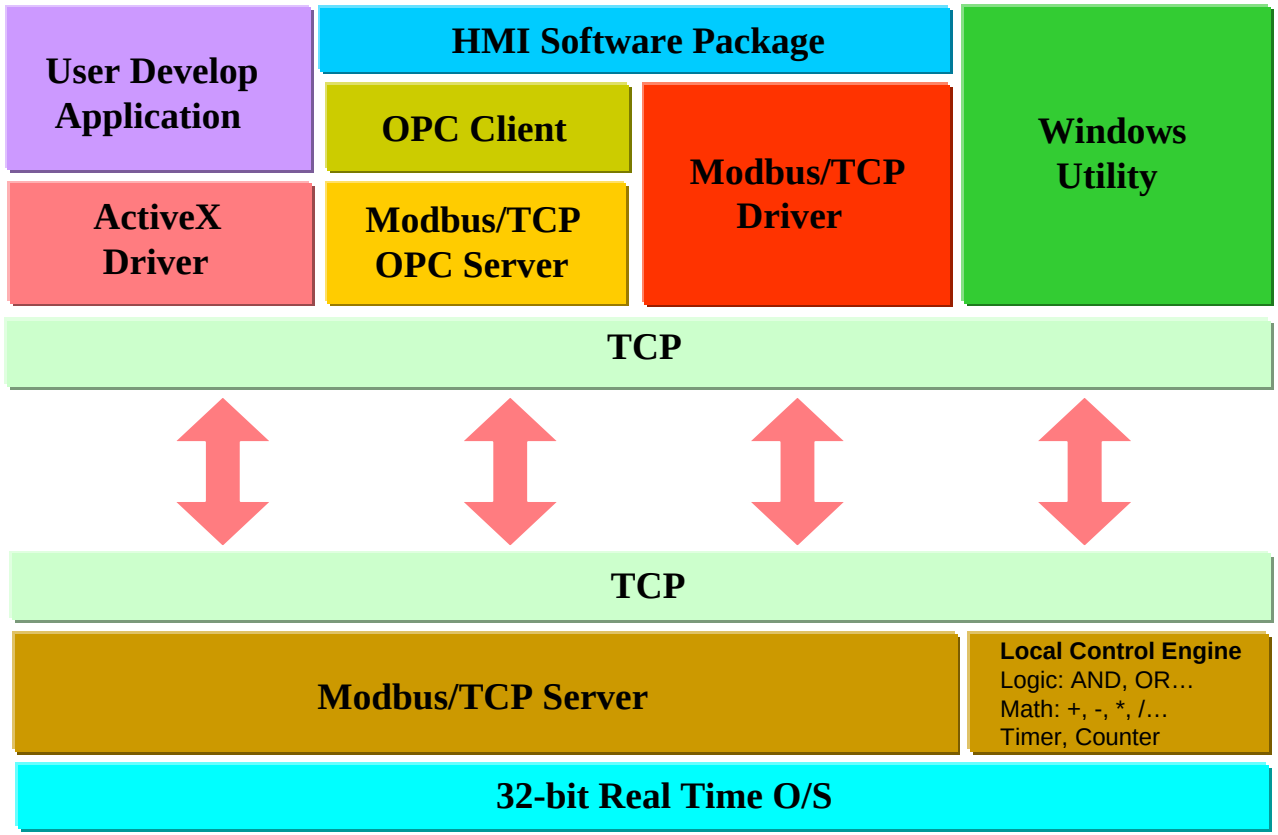
Features (2)

- Completed set of IO modules for total solutions
- Real-time OS and Watchdog timer
  - ✓ Meet the requirements of High Performance and Stability
- Security
  - ✓ Password can be set
- Software Support
  - ✓ Build-in Modbus/TCP server

Positions in Advantech Ethernet Solution Architecture



Software Architecture



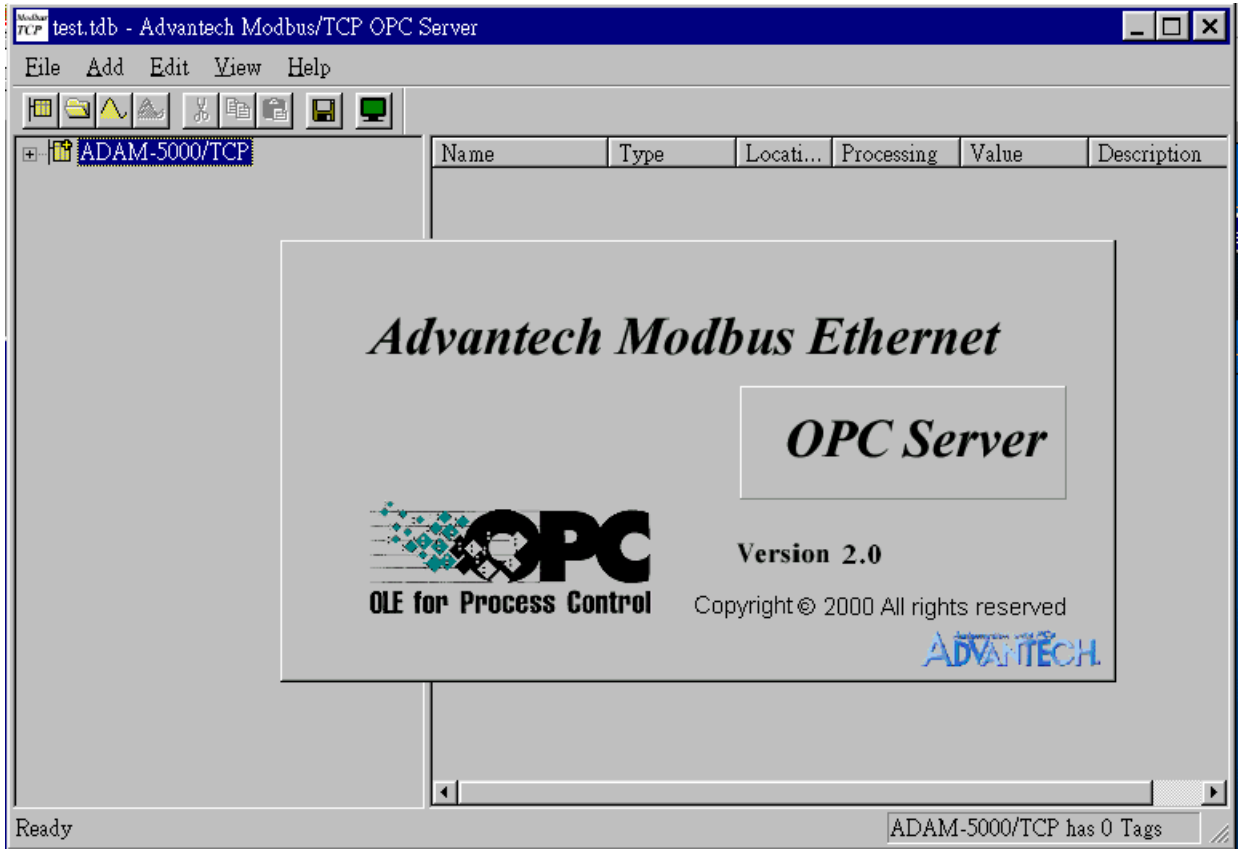
Modbus Basic

- ModBus is recognized as the *de facto* open standard for industrial network.
- When it comes to planning data communication for open, multi-vendor industrial control systems, ModBus is no doubt the first choice of end users and integrators
- ModBus/TCP enables the use of ModBus messaging in an ‘Intranet’ or ‘Internet’ running the TCP/IP protocols.

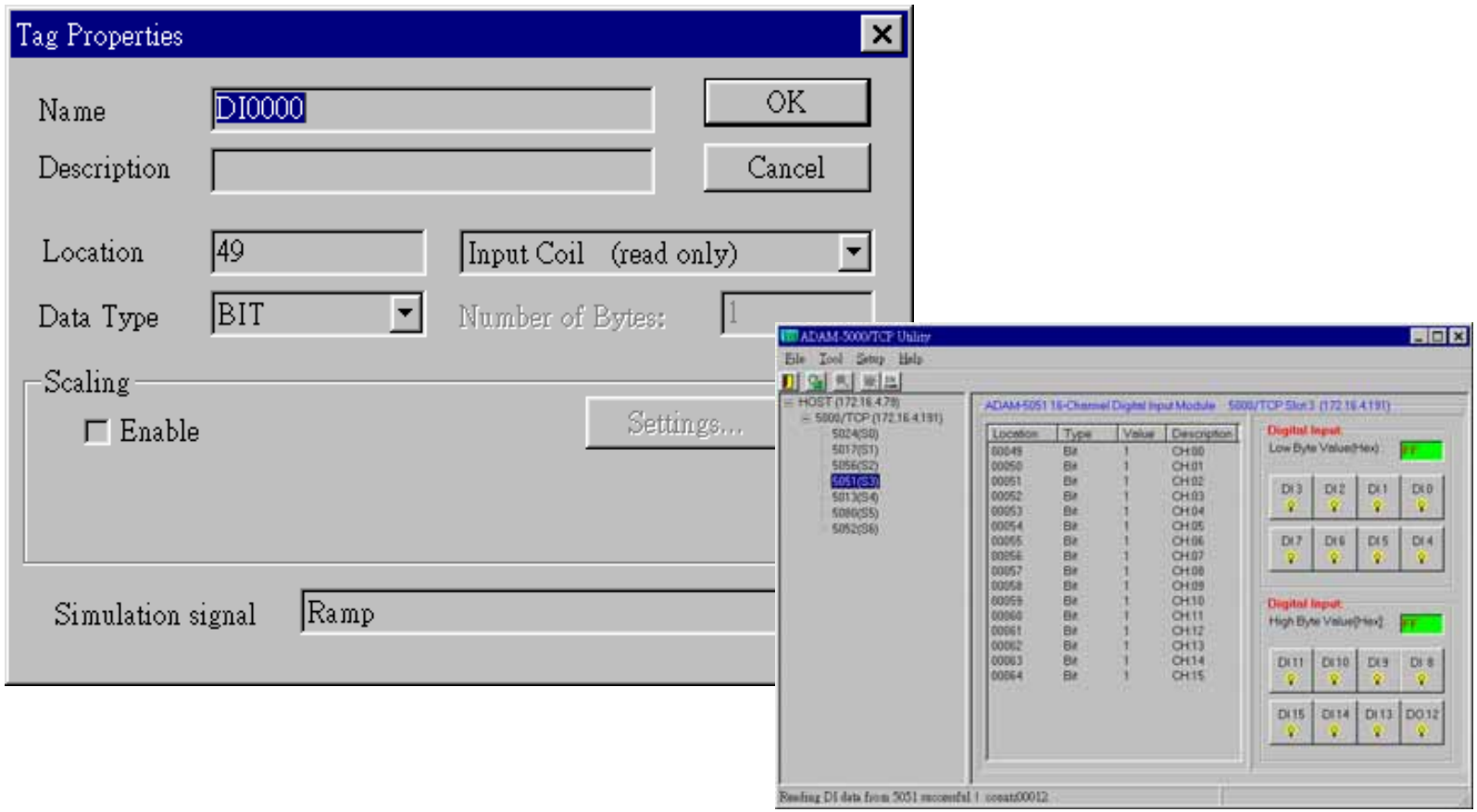
Modbus command

- **0 : Read/Write Coil**
- **1 : Read coil**
- **3 : Read register**
- **4 : Read/Write register**

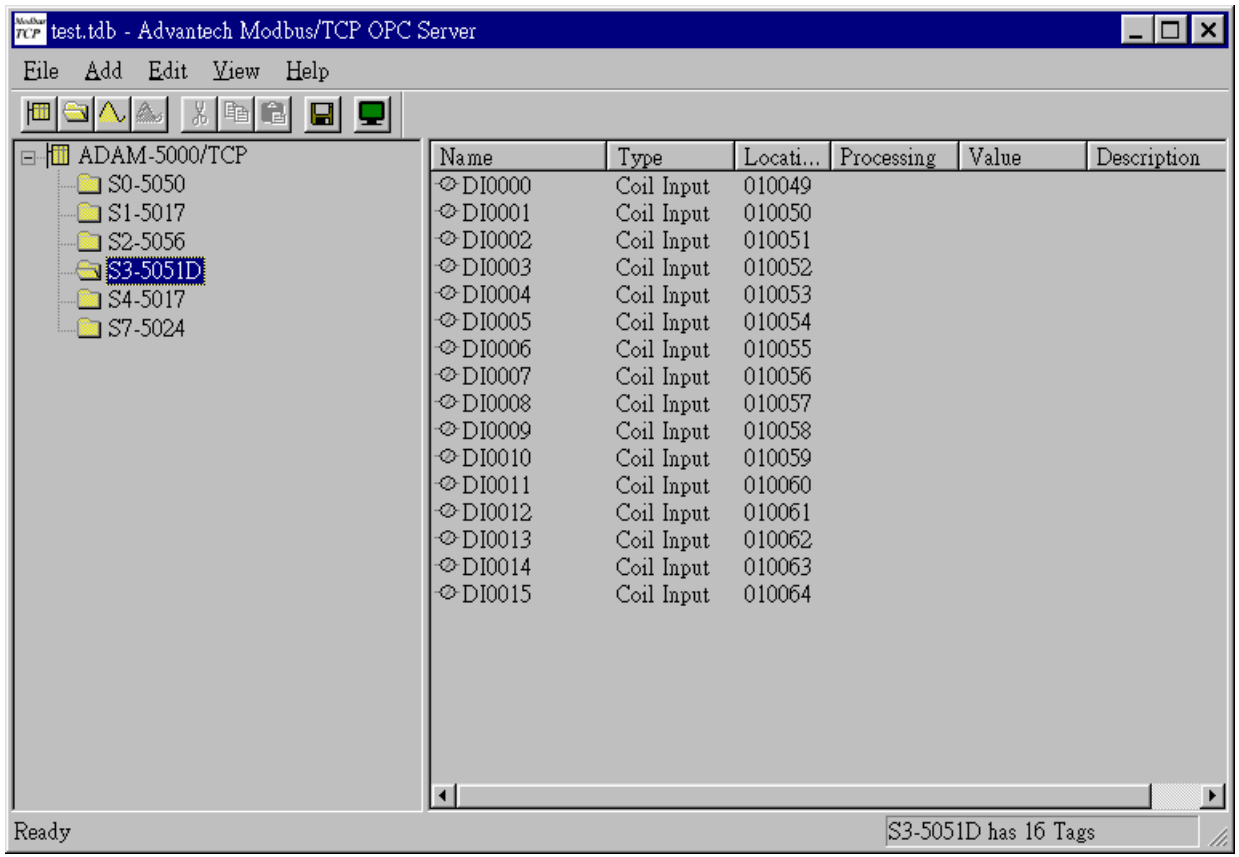
Connecting with OPC server



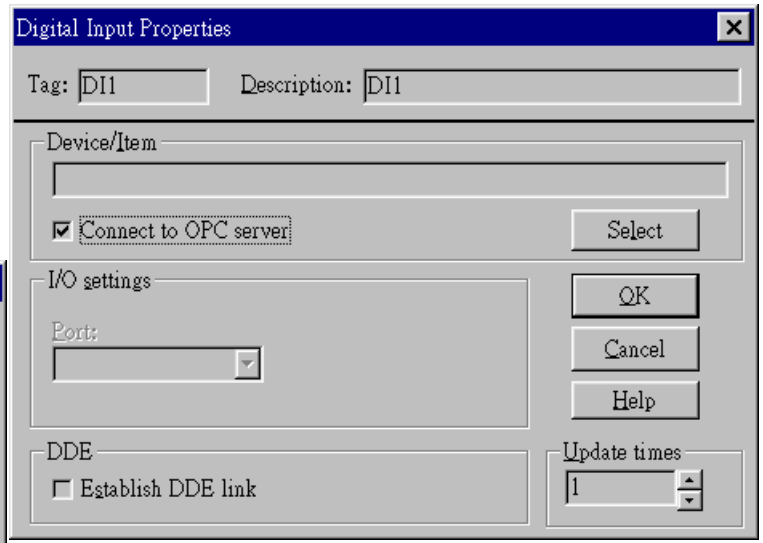
Configure the Tags

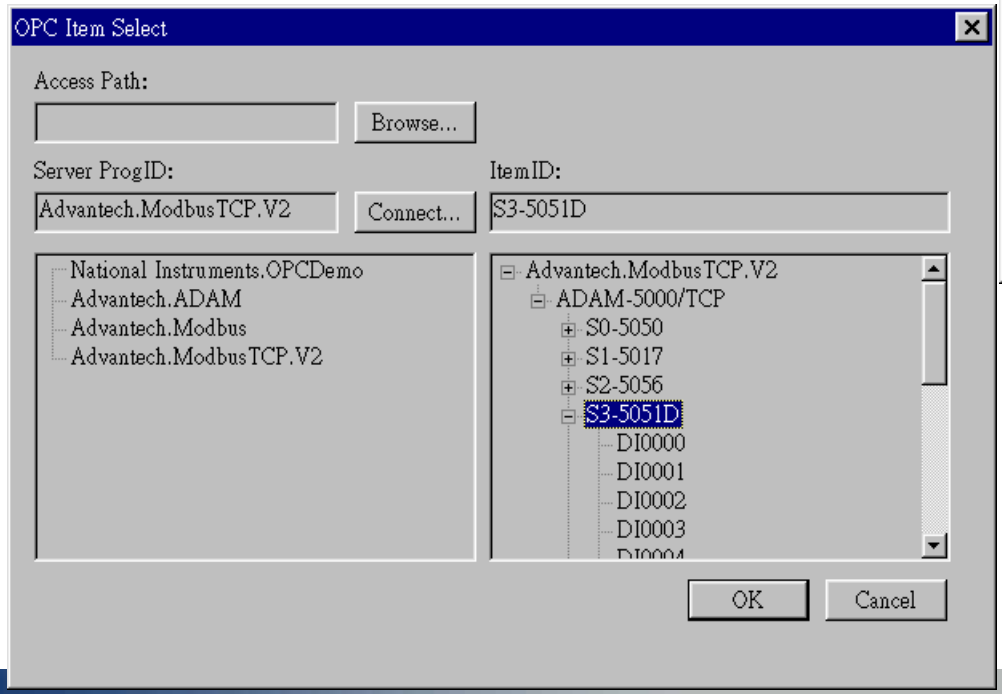


Configuring the OPC Server



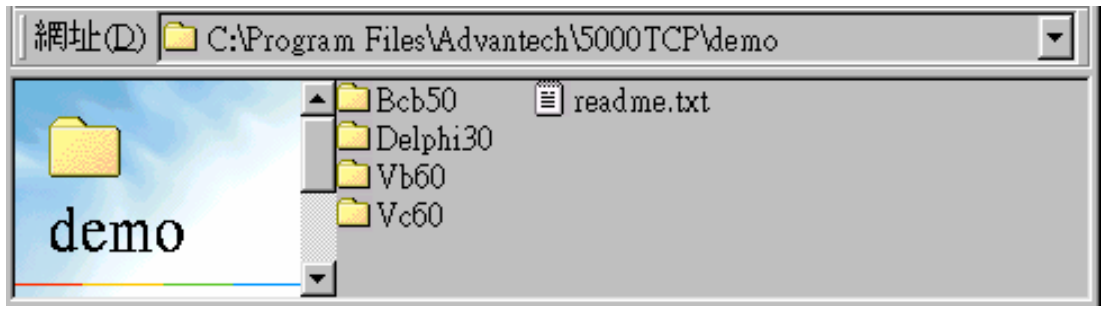
Connect to GeniDAQ





Modbus/TCP DLL Driver

- Support VB, VC++, Delphi, and Borland C
- Serials Example provided



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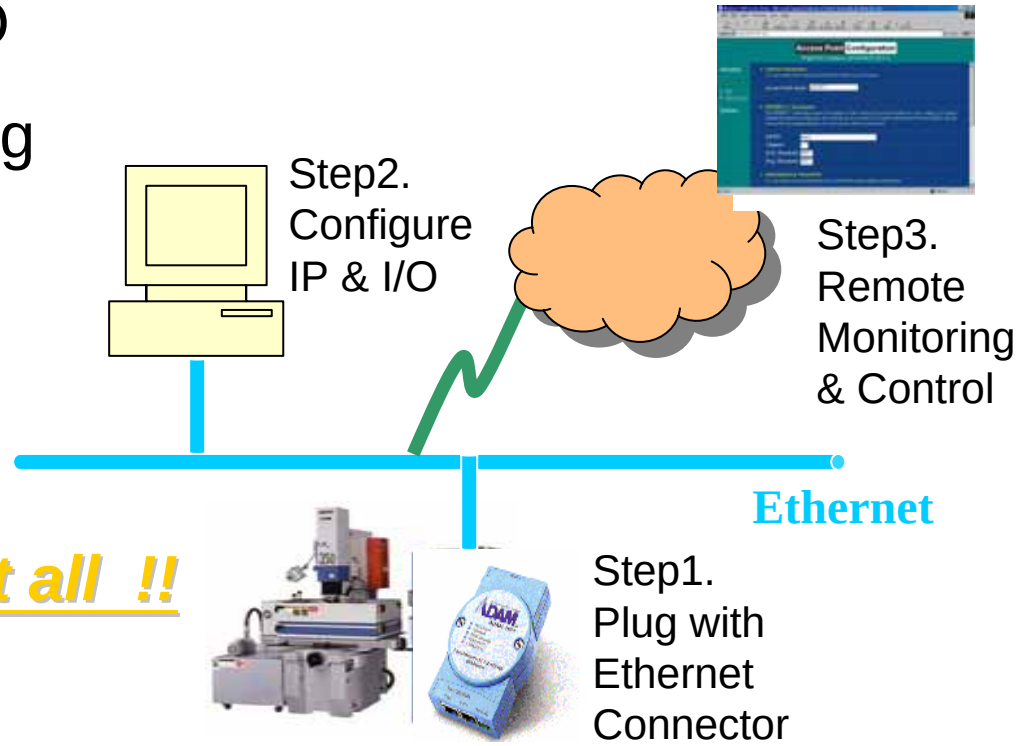
Installation for ADAM-6000 I/O

- Step 1. Plug with Ethernet Connector
- Step 2. Configure IP & I/O
- Step 3. Remote Monitoring & Control



No programming efforts at all !!

Easy Integration of ADAM-6000 I/O

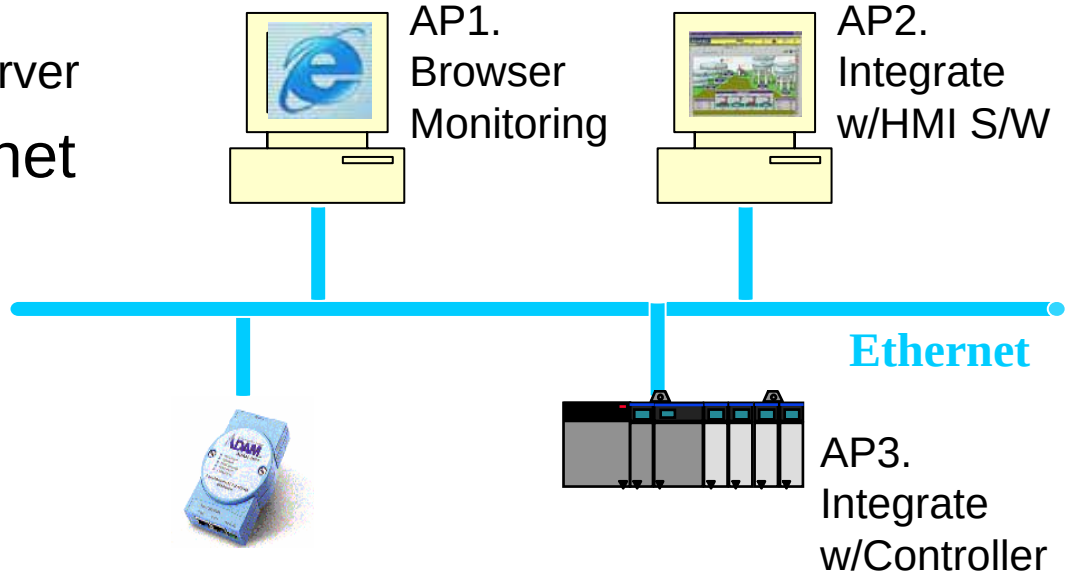
AP1. Internet Explorer Browsing

AP2. Integration w/HMI S/W or User's AP

- via Modbus/TCP Driver
- via ActiveX Component
- via Modbus/TCP OPC Server

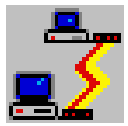
AP3. Integrate with Ethernet Controller

Quick & Easy !!



Bring You Ultimate Ethernet I/O Solution

Common Spec.



Networking

- 10/100 Mbps Ethernet
- TCP/IP, UDP, Modbus/TCP
- Web Page

Environment

- Operating temp.: -10 ~ 70 ^{O}C
- Humidity: 5% - 95%
- Unregulated 10 - 30 V_{DC}
- Protected against power reversal

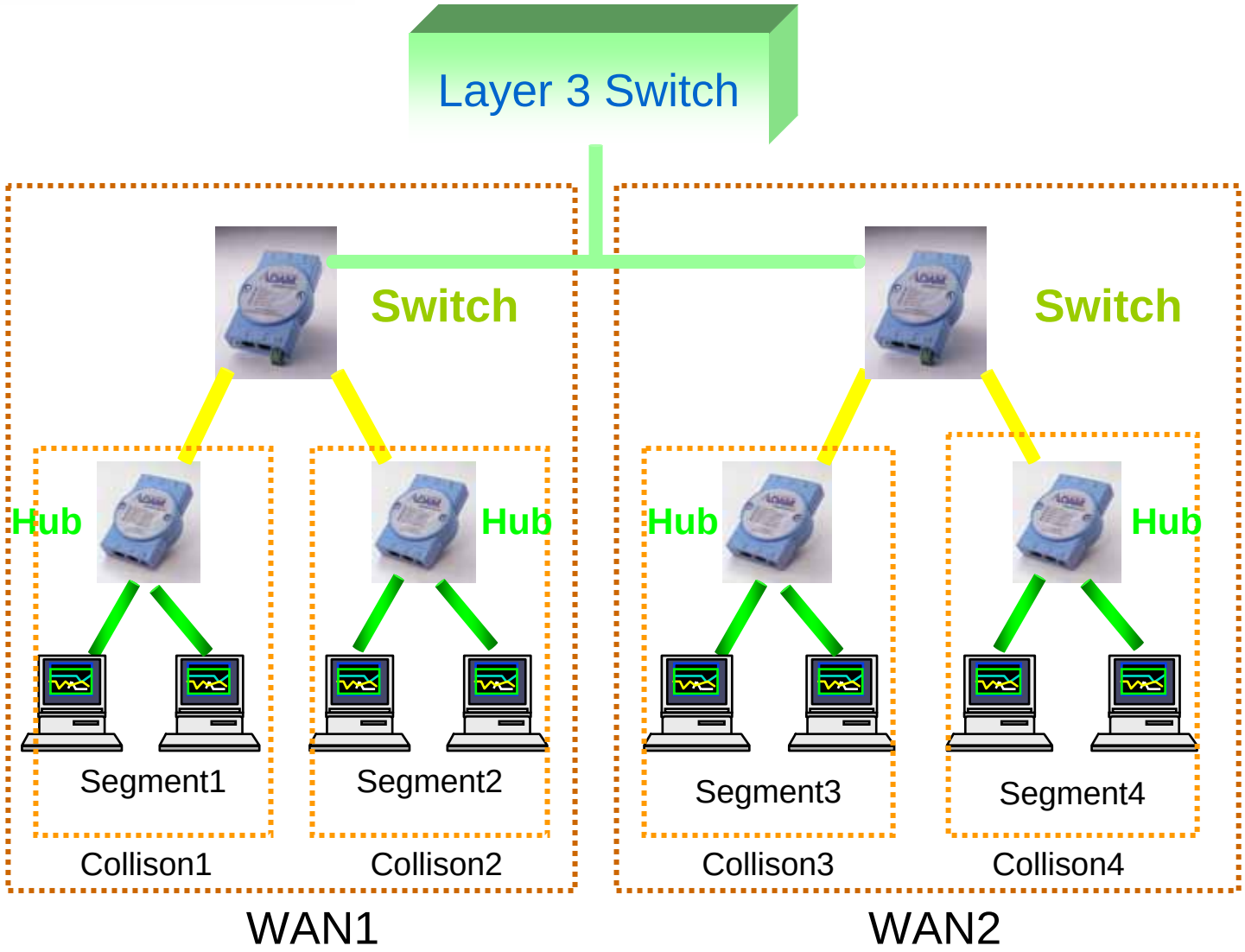
Smart I/O

- DI: Latch, 1KHz Event Counter
- DO: Delay, Pulse Output
- AI: Max/Min/Ave. calculation Multi-channel/Multi-range
- AO: PID Loop

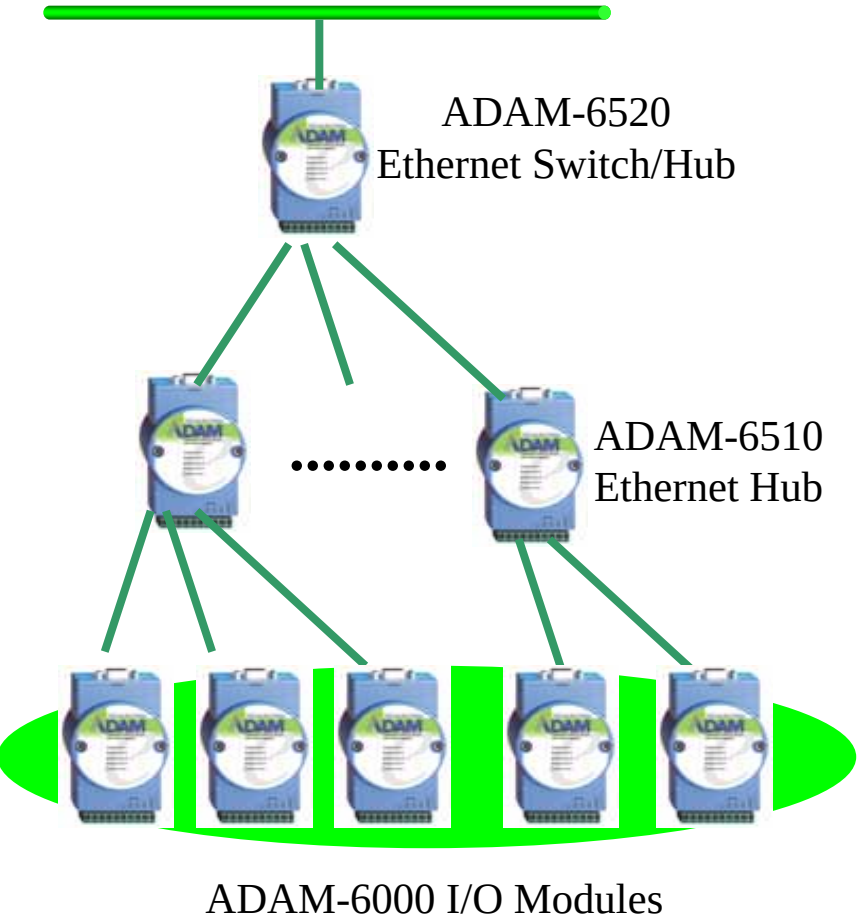
Network Layer

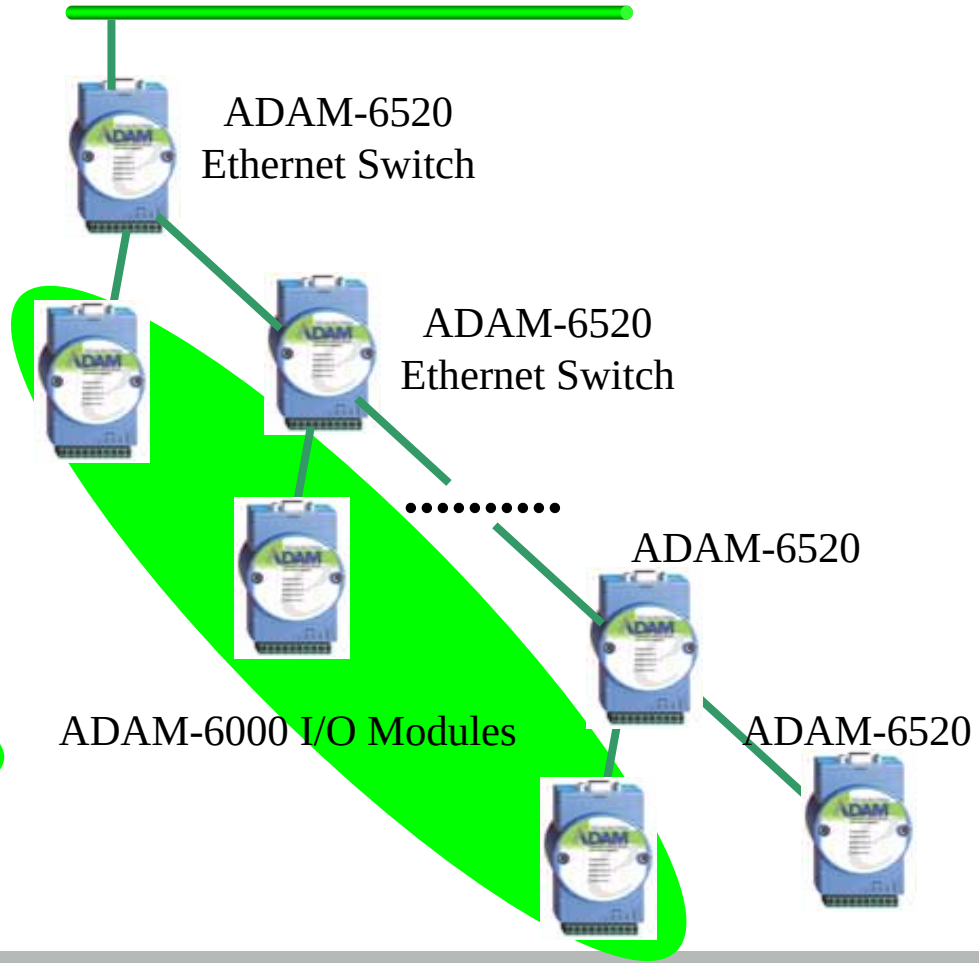
Data Link Layer

Physical Layer



Application Networking Architecture

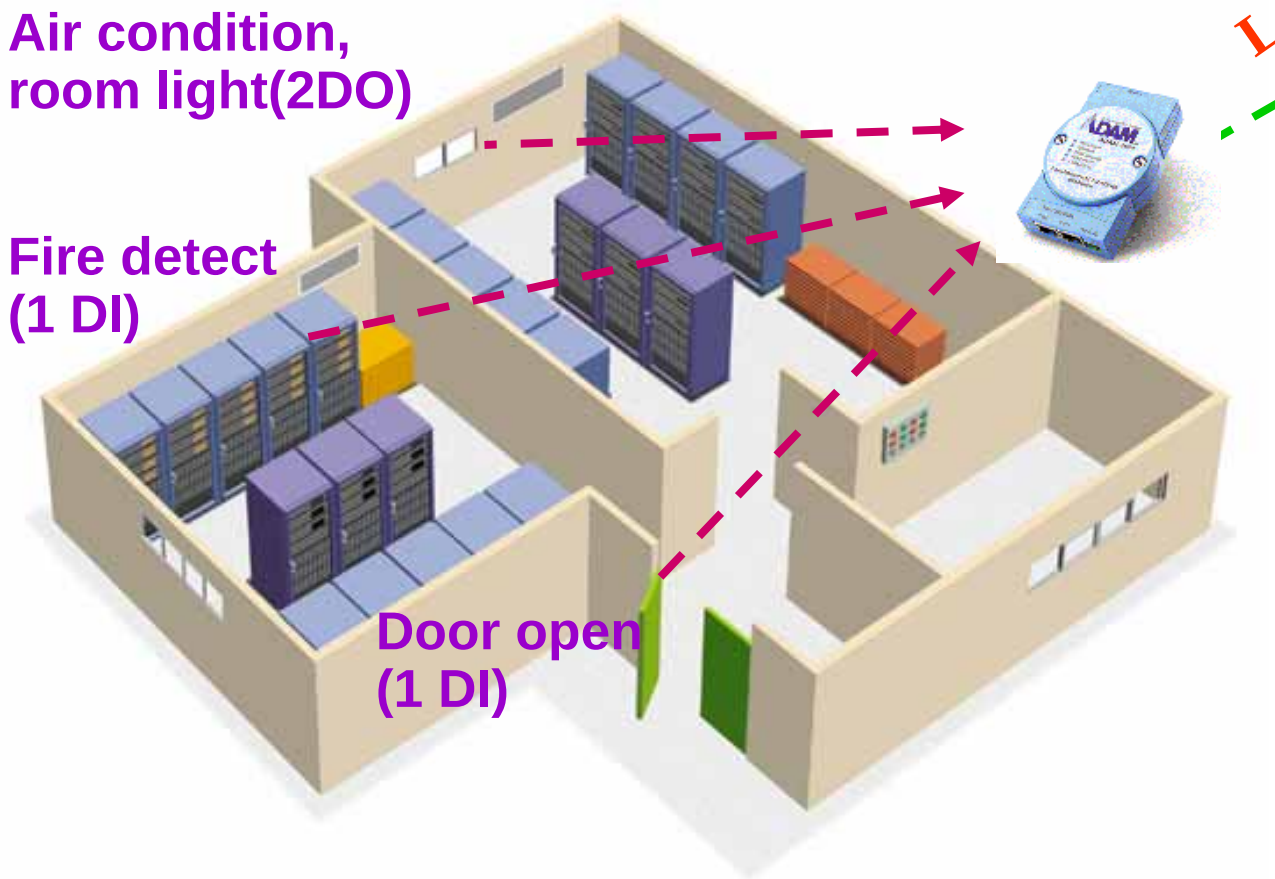




The Benefits of ADAM-6510/6520/6521

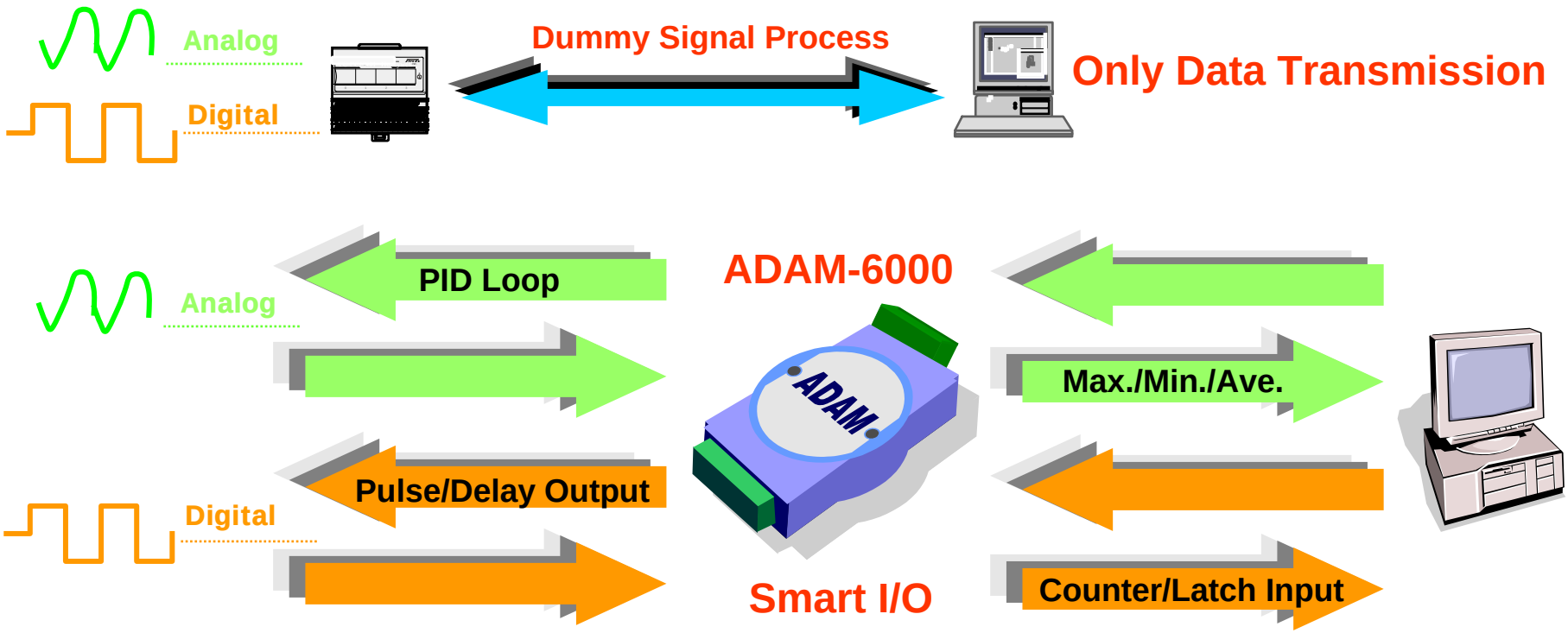
- Wide-range voltage +10 ~ 30 V DC
- 3000 VDC surge protection
- Operating temperature varies from –10 ~ 70 ℃
- DIN rail, panel and piggyback mounting
- 6 LED indicators supplied that aid trouble-shooting

BA/HA Application



ADAM-6051
One for all

Dummy I/O **V.S.** Smart I/O



Customization Web Page

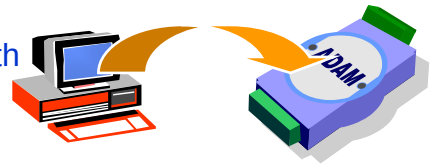
Free Download J2EE SDK

1.

Programming & Pack to JAR file

2.

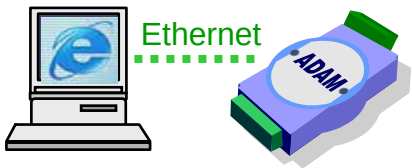
PC with Utility



Download into ADAM-6000

3.

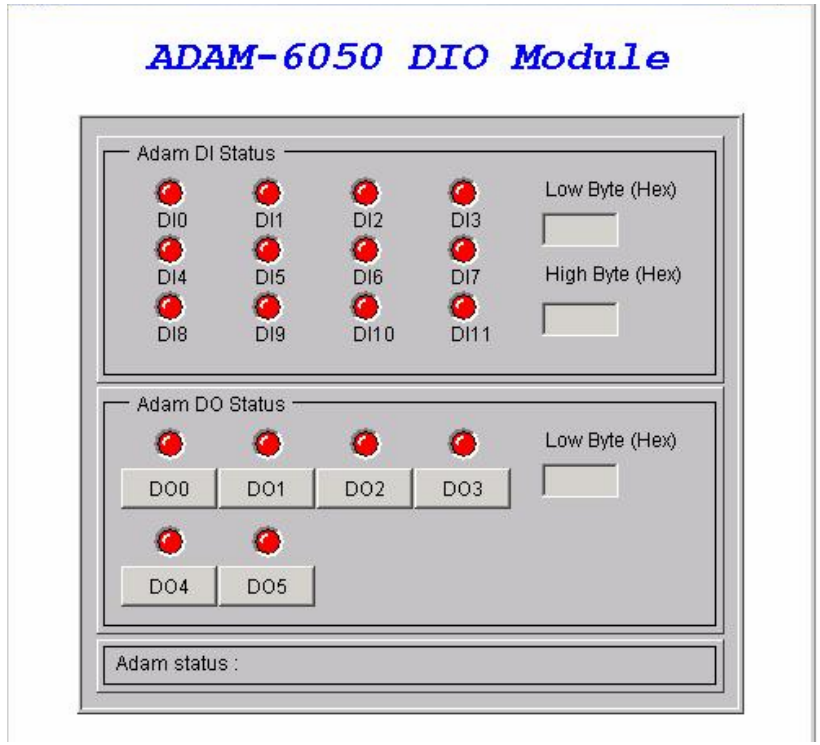
PC with Internet Explorer



Monitor anywhere via new web page

4.

Your own Web Page !



Course Content

15 mins	1. Internet Overview
30 mins	2. Ethernet Networking & TCP/IP
15 mins	3. 15 minutes break
15 mins	4. ADAM-5000/TCP introduction
30 mins	5. ADAM-5000/TCP live demo & hands on
15 mins	6. 15 minutes break
10 mins	7. ADAM-6000 introduction, smart I/O
30 mins	8. ADAM-6000 live demo and hands on
10 mins	9. 5 minutes break Q&A
30 mins	10. Recap and simple test

Needs:

1. **PC (with Ethernet port) , eADAM utility installed**
2. **ADAM-5000/TCP and ADAM-6000 Demo Box**

Objective1:

Read the correct value from modules.

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