CONTEMPORARY CONTROLS®

ARCNET Tutorial

What is ARCNET?

- Attached Resource Computer NETwork
- Token-Passing Local Area Network (LAN)
- Originally 2.5 Mbps data rate
- 255 Nodes or Stations
- Variable Packet Length
- Bus or Distributed Star Wiring
- Unicast or Broadcast Messages
  - One to one or one to all

What is ARCNET?

- Coaxial, Fiber Optic, Twisted-pair Cabling
- Over 11 Million Installed Nodes
- Originally developed by Datapoint Corporation as an office network
- Chip sets available from SMSC
- ANSI/ATA 878.1-1999 Standard
- Ideally suited for an industrial network

What are ARCNET's Benefits?

- Broad Acceptance
- Large Installed Base
- Deterministic Performance
- Simple to Install
- Low Cost per Node
- Robust Design
- Multiple Cable Media Support
- Multi-master Communication

Where is ARCNET Used?

- HVAC
- Motor Drives
- Power Generation
- Data Acquisition and Control
- Manufacturing Information Systems
- Office Automation
- Shipboard Automation

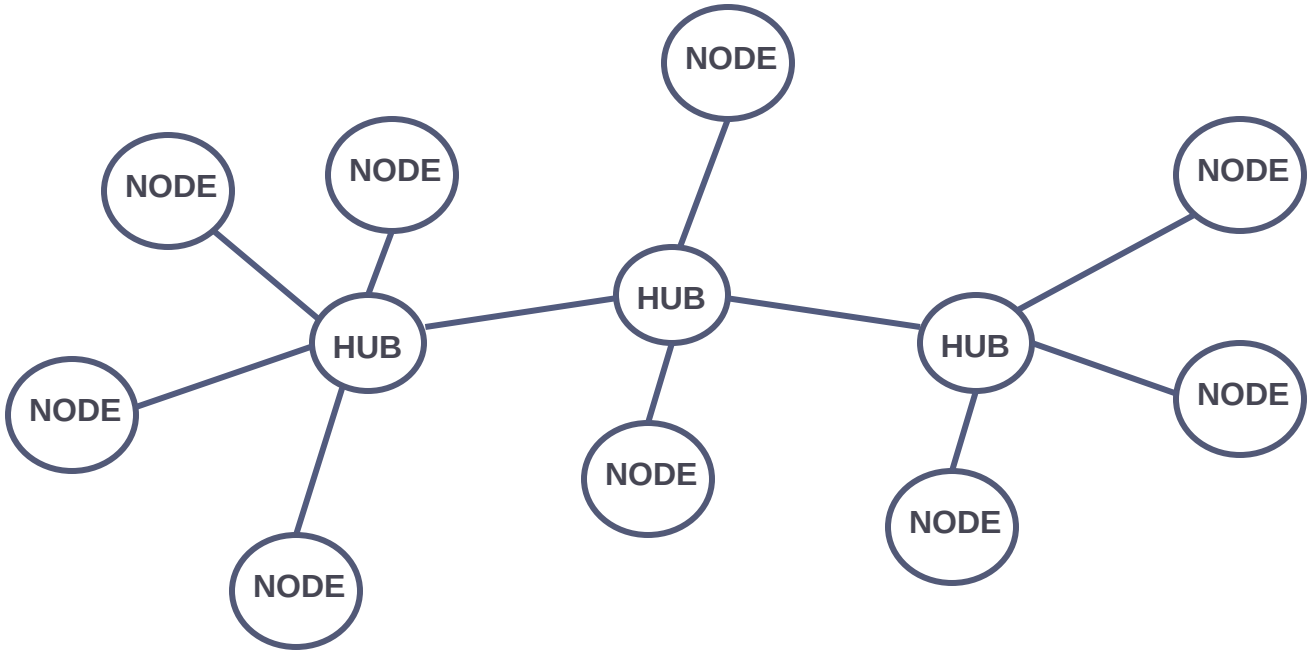
Where is ARCNET Used?

- Printing Press Controls
- Telecommunications
- Gaming Machines
- Vehicular Navigation
- Security Systems

Any application where real-time performance, high security and robust design is important.

How Does ARCNET Work?

- Distributed Star topology requires the use of hubs



How Does ARCNET Work?

- OSI Reference Model

Application
Presentation
Session
Transport
Network
Data Link
Physical

ARCNET defines the bottom two layers of the OSI model

ARCNET Protocol

- Only Five Simple Commands
  - ITT - Invitation to transmit
  - FBE - Free buffer enquiry
  - PAC - Packet
  - ACK - Acknowledgement
  - NAK - Negative acknowledgement

ARCNET Protocol Features

- Deterministic Token Passing
- Packet Flow Control
- Error Detection
- Auto Reconfiguration
- Variable Packet Size
- Supports Various Transceivers & Media
- Supports Various Software Drivers
- Up to 255 Nodes Per Network

ARCNET Protocol Features

- Token Passing - Transmitting on the network is only permitted when a node has the token
- Every node can transmit once during each token rotation

☆ Benefits:

  - Every node has a guaranteed response time to transmit
  - Deterministic behavior

ARCNET Protocol Features

- Auto-Reconfiguration - Network is automatically reconfigured when a node joins or leaves the network
  - Token pass is automatically reconfigured
    - Typical time 20 - 30 ms
  - Supports live node insertion and deletion
- Variable Packet Size
  - From 1 to 507 bytes per packet

ARCNET Protocol Features

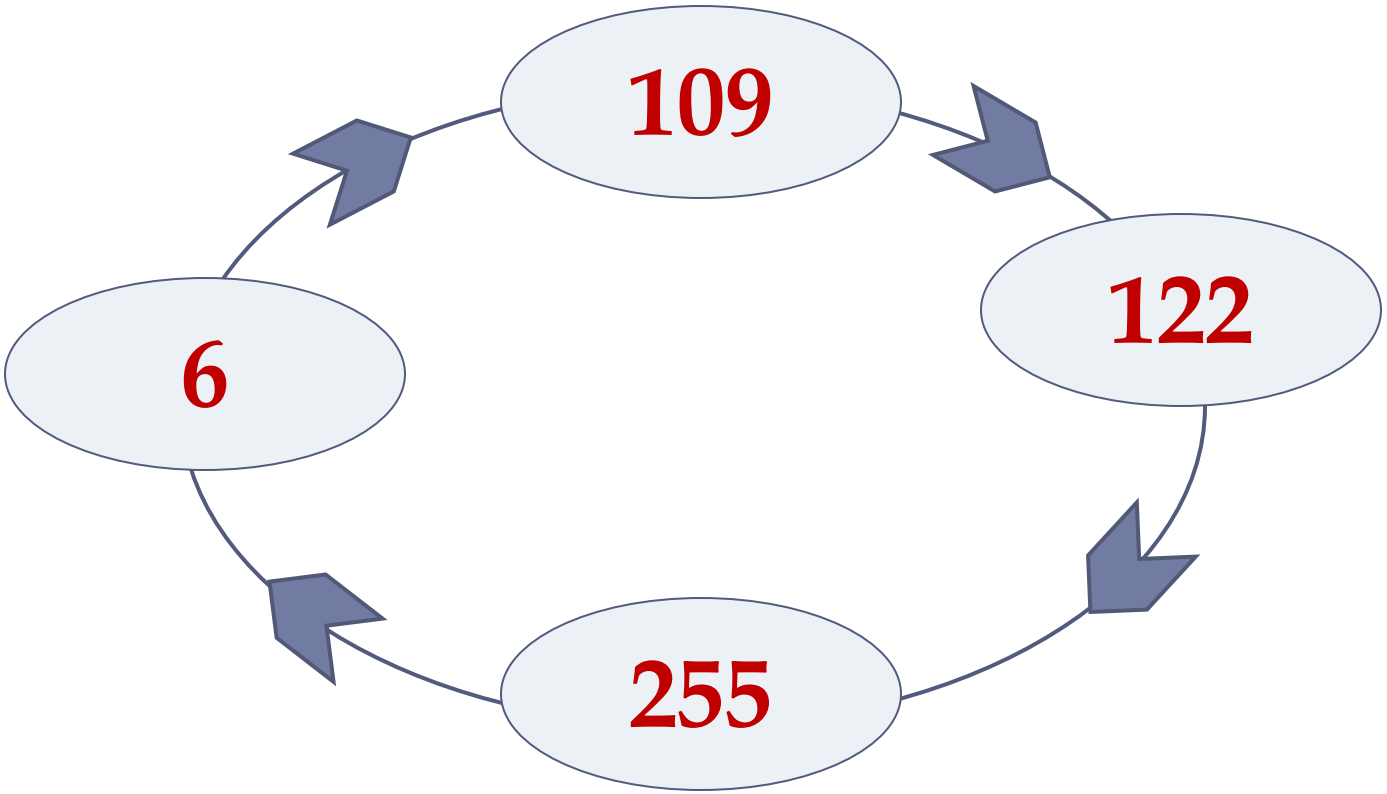
- Packet Flow Control - Transmitter checks receiver to make sure it is ready to receive a packet
  - Reduced software overhead
  - Increased bandwidth
  - No lost packets due to input buffer overruns

ARCNET Protocol Features

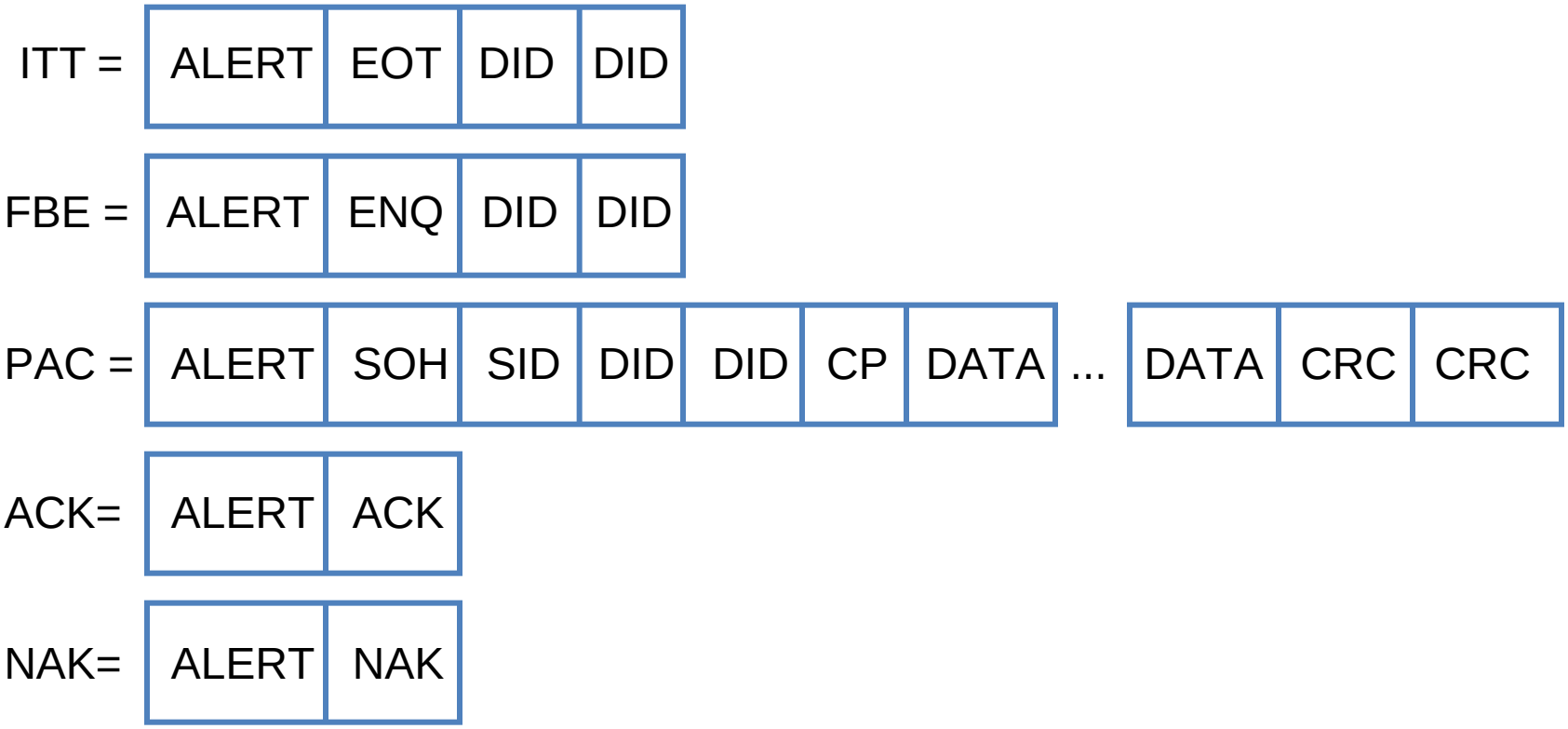
- Error Detection - 16 bit CRC checks each packet
  - Corrupted packets automatically rejected
  - Transmitter is aware of the error
  - Reduced software overhead
  - Better CPU utilization

ARCNET Logical Ring

- Token passes from low to high address

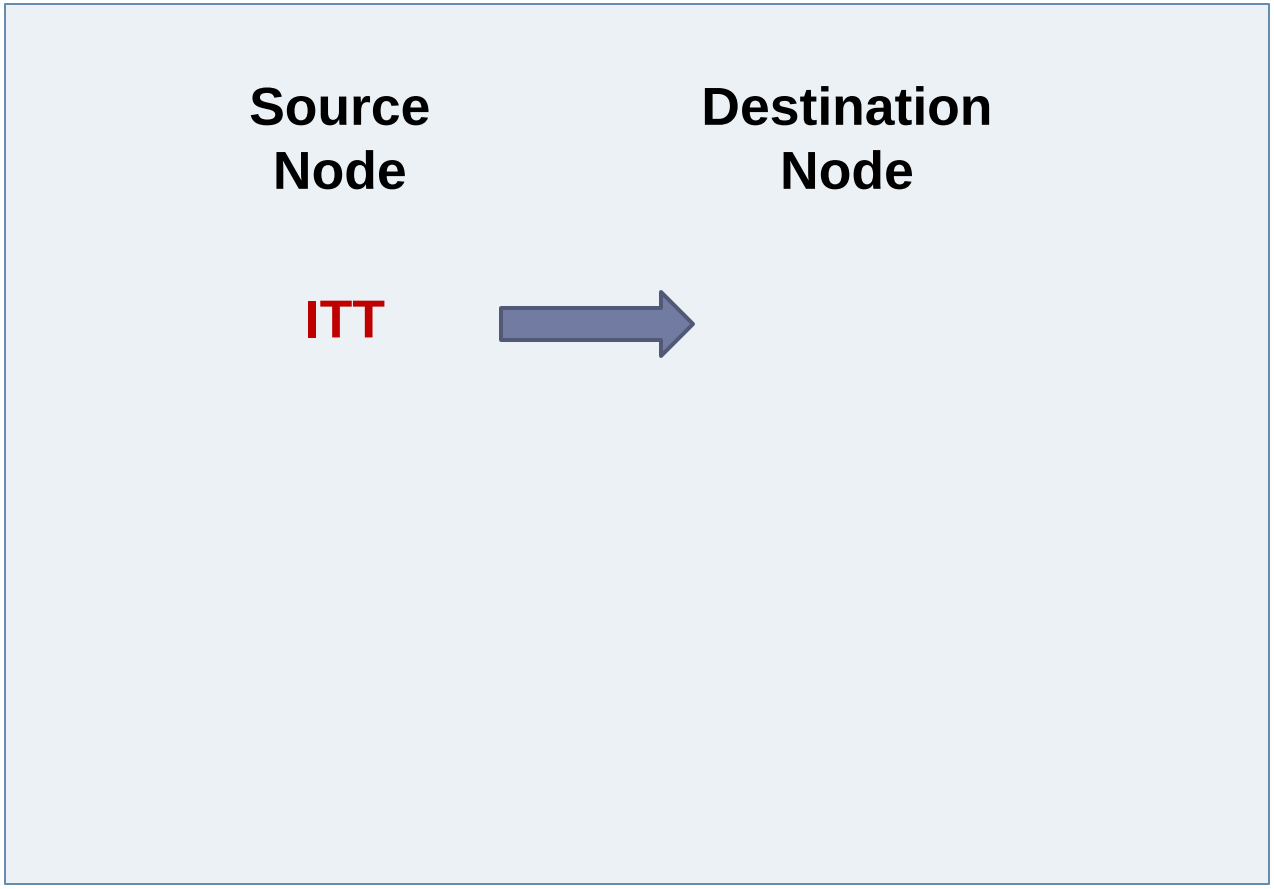


ARCNET Frames

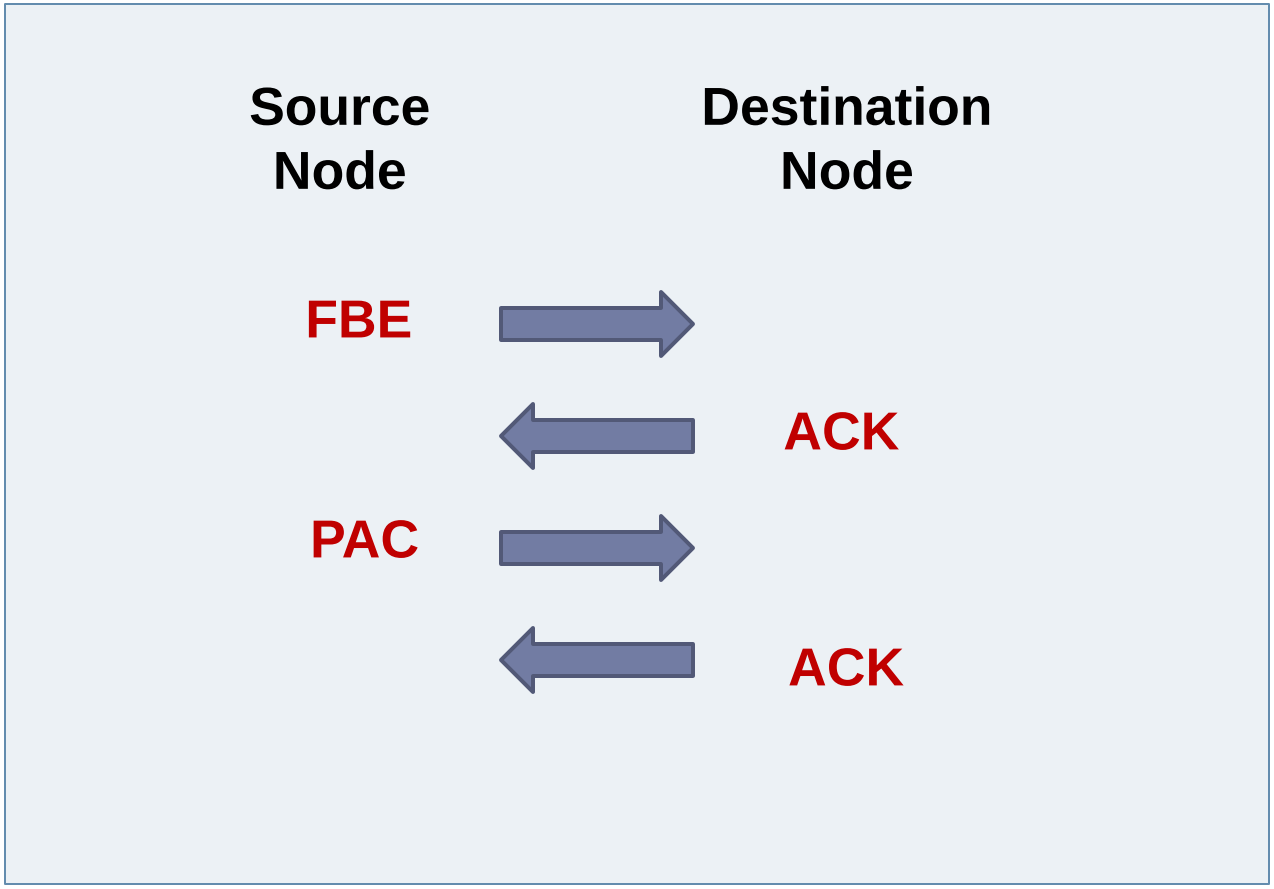


Only PAC has a variable length frame

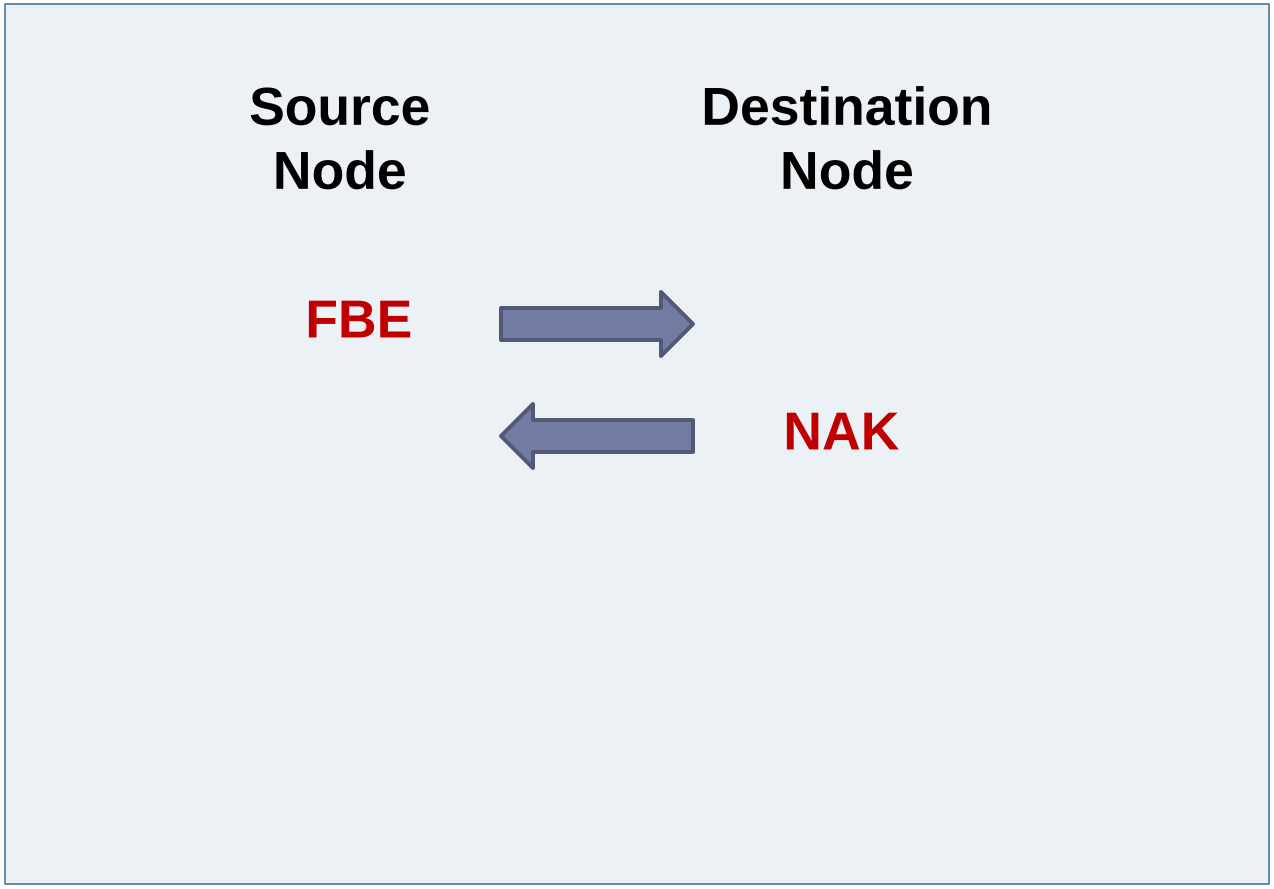
Token Pass



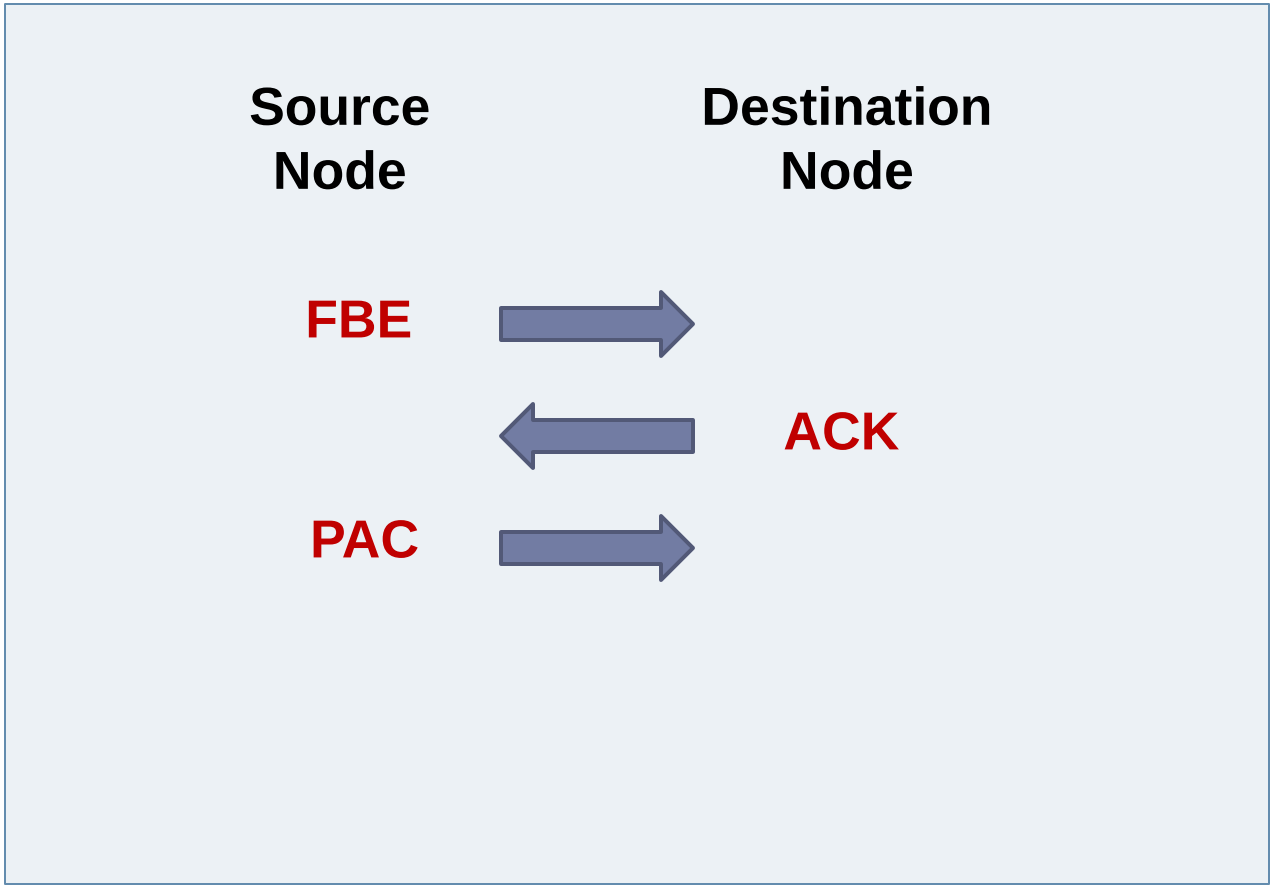
Packet Transmission



Receiver Unavailable



Failed Packet Transmission

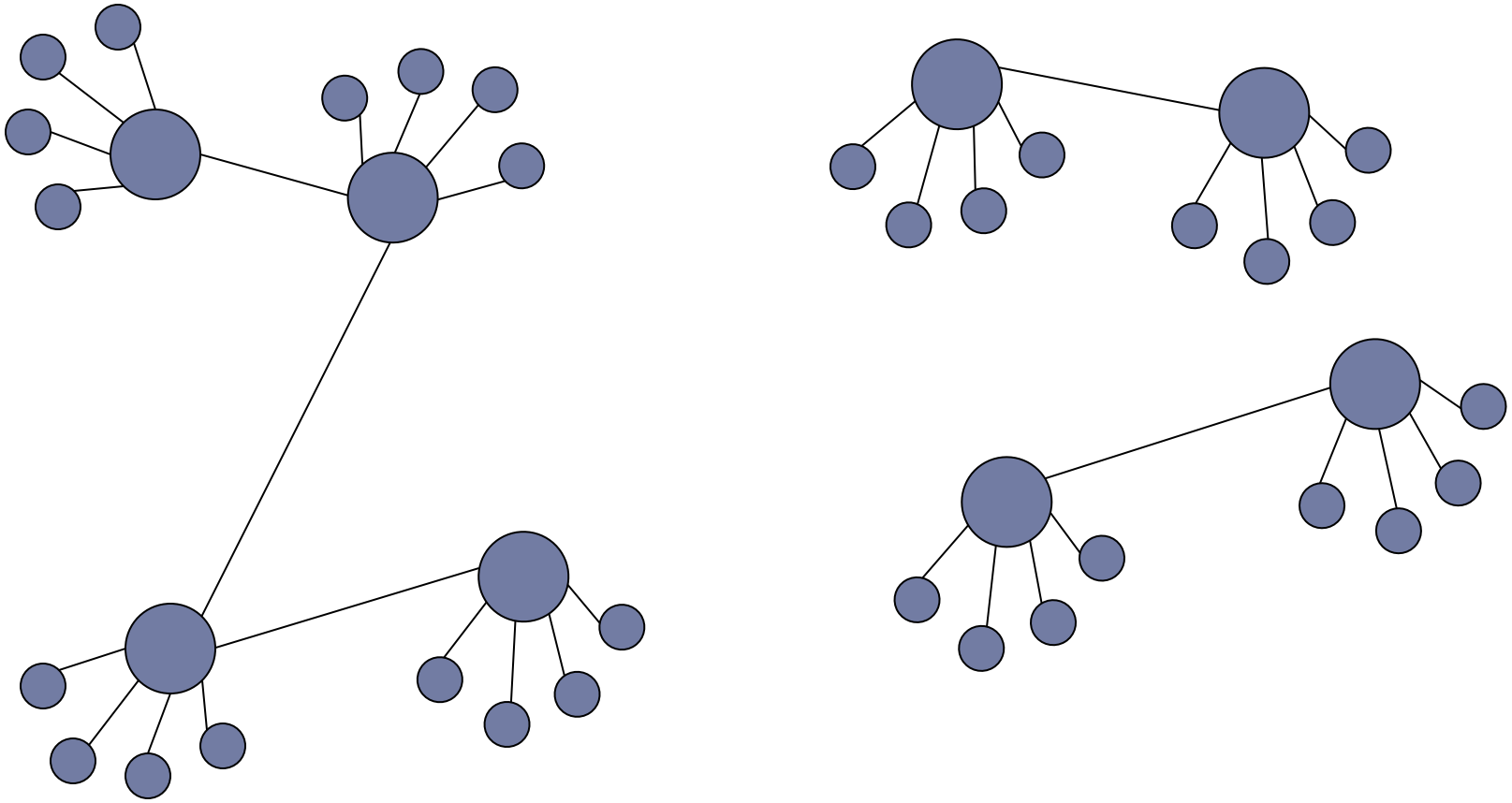


ARCNET Message Timing in Microseconds (2.5 Mbps)

ITT	15.6	(invitation to transmit)
Tta	12.6	(turnaround time)
FBE	15.6	(free buffer enquiry)
Tta	12.6	(turnaround time)
ACK	6.8	(acknowledge)
Tta	12.6	(turnaround time)
PAC	33.2	+4.4 μsec/byte
Tta	12.6	(turnaround time)
ACK	6.8	(acknowledge)
Tta	12.6	(turnaround time)

141 μsec + 4.4 μsec/byte
Minimum Message: 141 Microseconds

If You Cut ARCNET...



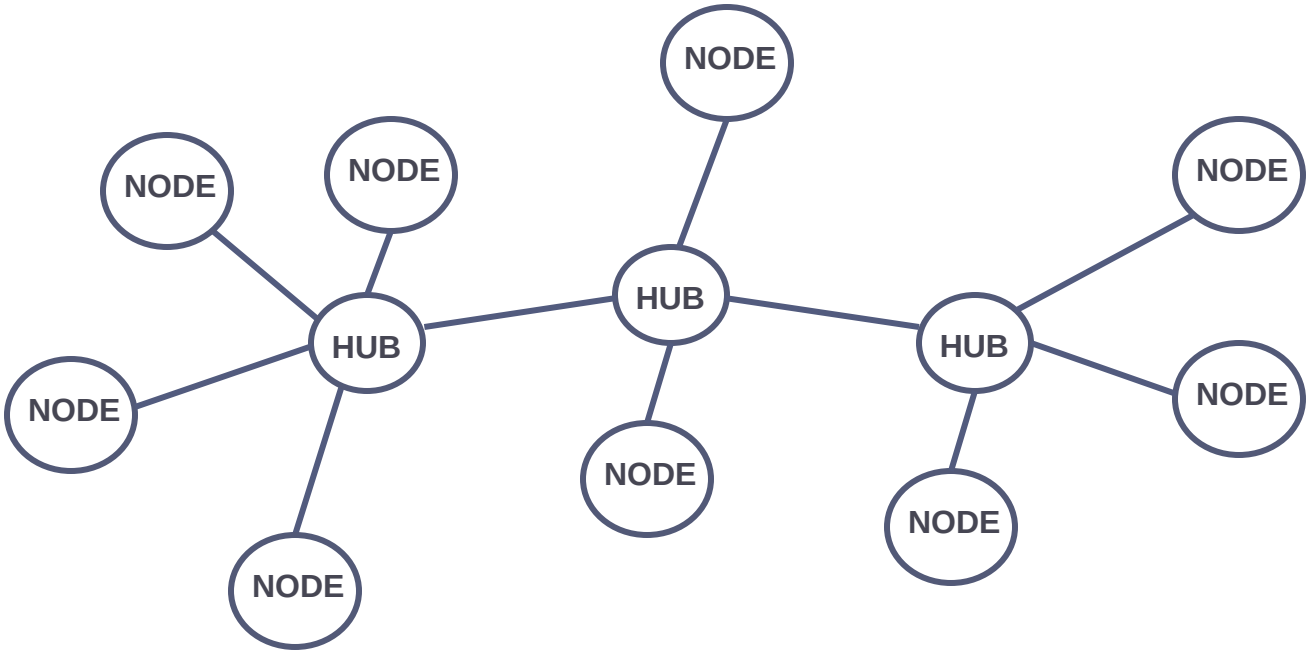
...You Just Get Two ARCNETS Within Milliseconds

ARCNET Cabling

- Flexibility
  - Distributed Star Topology Requiring Hubs
  - Hub-less Bus Topology
  - Coaxial Cable
  - Twisted Pair
  - Fiber Optics

Traditional ARCNET

- Coaxial Cable In a Star Topology
  - Either a star or distributed star topology
  - Utilize active or passive hubs



Traditional ARCNET

- Coaxial Star
  - Original method of communication
  - RG-62/u coaxial cable
  - BNC connectors
  - Only two transceivers per segment
  - Segment length up to 2,000 feet
  - Requires the use of a hub to go beyond two stations

We call this –CXS.

Traditional ARCNET

- Coaxial Bus
  - Lower cost hub-less network
  - RG-62/u coaxial cable
  - Up to eight NIMs per bus segment
  - Segment length limited to 1,000 feet
  - BNC connectors and Tees
  - Requires end of line terminators

We call this –CXB.

Traditional ARCNET

- Twisted-Pair Star
  - Requires active hubs for network expansion
  - Only 328 foot segment length
  - RJ-11 connectors
  - Utilizes BALUN's to convert from coaxial cable to twisted-pair

We call this –TPS.

Traditional ARCNET

- Twisted-Pair Bus
  - Modified circuitry of coaxial bus implementation
  - Supports eight nodes
  - Reduction in segment length to 400 feet
  - RJ-11 or RJ-45 connectors
  - Requires end of line terminators

We call this –TPB when using RJ-11 connectors and –TB5 when using RJ-45 connectors.

Traditional ARCNET

- Fiber Optics
  - 850 nm wavelength with ST connectors
  - 62.5/125 duplex multimode fiber cable
  - 6000 foot segment length
  - Large networks can be achieved by cascading hubs
  - ARCNET controller chips may need to be set to extended timeouts

We call this –FOG.

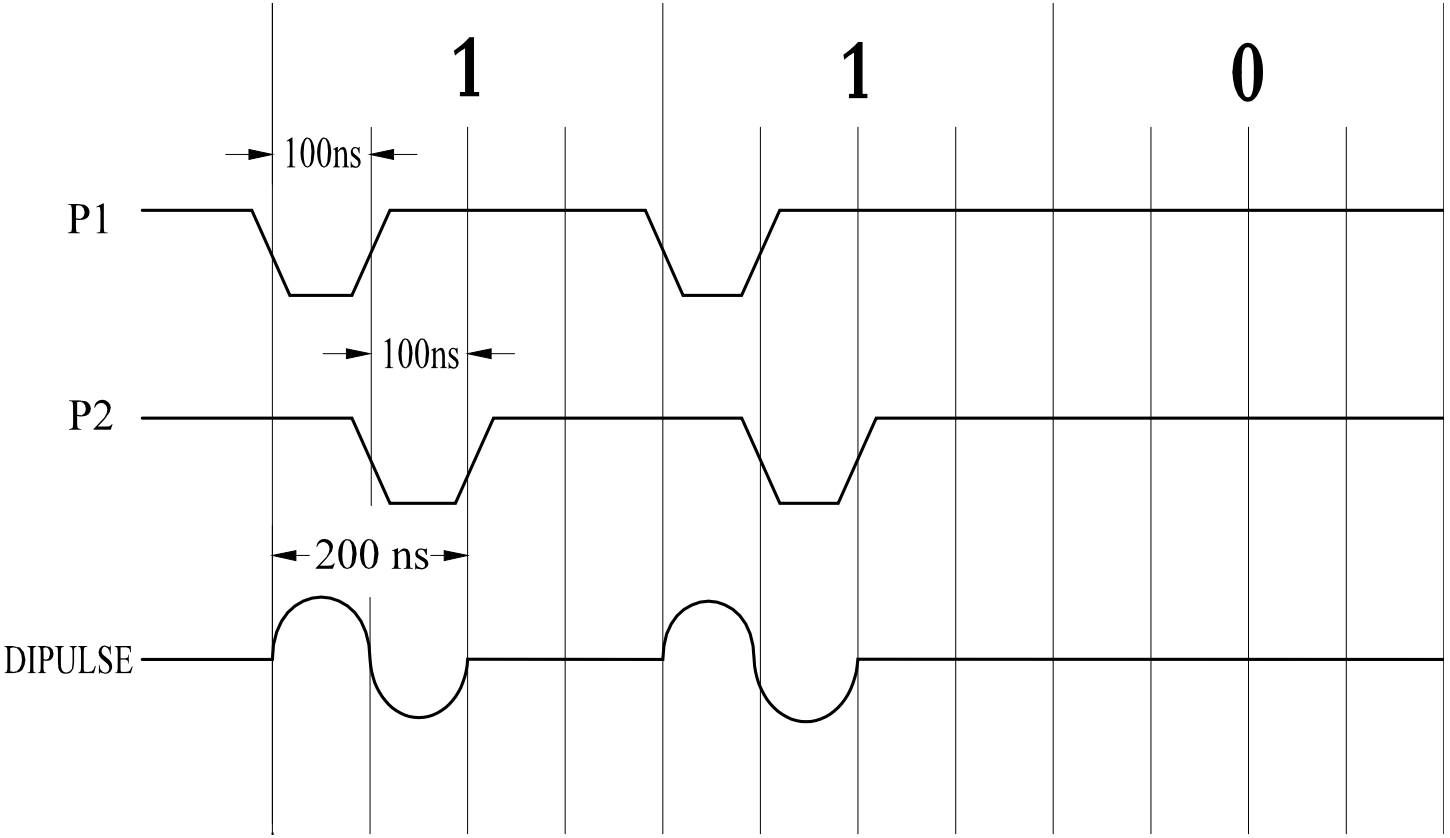
Traditional ARCNET

- Fiber Optics
  - 1300 nm wavelength with ST connectors
  - 62.5/125 duplex multimode or duplex single-mode fiber cable
  - 10,000 m multimode and 14,000 m single-mode

We call this –FG3.

Traditional ARCNET

- Dipulse Signaling at 2.5 Mbps



Newer ARCNET Controllers

- Will default to traditional ARCNET or can be set for additional features
- SMSC 20019; 20020; 20022
  - Wide data rate selection up to 10 Mbps
  - Introduces backplane mode as a lower cost alternative to dipulse signaling
  - Directly supports low cost EIA-485 transceivers
    - AC coupled EIA-485
    - DC coupled EIA-485

COM20020

- ARCNET Communications Processor
  - Direct bus interface to all processors (maps into data memory)
  - Internal 2Kx8 Packet buffer RAM
  - Data rates up to 5Mbps
  - Various media and topology
  - Command chaining
  - Receive all packets mode
  - Built-in diagnostics
  - Industrial temperature range (-40C to +85C)
  - 28 pin PLCC or 24 pin DIP package

COM20022

- High Performance ARCNET Controller
  - 19 Kbps to 10 Mbps
  - 8/16 bit bus
  - DMA channel
  - Programmable Reconfiguration Timer
  - 48 pin TQFP package

Enhanced ARCNET

- DC coupled EIA-485 transceivers
  - Non-return to zero (NRZ) encoding
  - Twisted-pair bus cabling
  - RJ-11 or screw terminals
  - 17 stations per bus segment
  - 900 foot maximum segment length
  - Data rates from 156 kbps to 10 Mbps

We call this –485 for backplane mode and –485D for non-backplane mode.

Enhanced ARCNET

- AC coupled EIA-485 tranceivers
  - Alternate mark inverted (AMI) encoding
  - Twisted pair bus cabling
  - RJ-11 or screw connectors
  - 13 stations per bus segment
  - 700 foot maximum segment length
  - Data rates from 125 Mbps to 10 Mbps

We call this –4000 for backplane mode and –485X for non-backplane mode.

Nework Interface Modules

- We support all the popular bus structures
  - PCX20 series for 8-bit ISA bus
  - PC10420, PC10422 series for PC/104 bus
  - PCI20U series for universal PCI bus
  - USB22 series for USB 2.0 bus

Active Hubs

- MOD HUB series of modular active hubs
  - 2.5 Mbps operation
  - EXP expansion modules
- AI Series of fixed port hubs links and repeaters
  - Data rates up to 10 Mbps
  - Two or three ports

ARCNET Trade Association

- Promotes the Use of ARCNET
- Resource for ARCNET Users
- ANSI Recognized Standards Body
- Establishes Standards
  - ANSI / ATA 878.1-1999
  - ATA 878.2
  - ATA 878.3

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Thank You

Visit our web site at http://www.ccontrols.com/