UNIVERSITY OF NAIROBI

COMPUTER NETWORK CONCEPTS AND PRINCIPLES

ARCNET

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(JULY 2003)

HISTORY

Datapoint Corporation introduced ARCNET, classified as a local area network (LAN), as office automation in the late 1970s. ARCNET is coined from two words i.e. ARC & NET. ARC in full is attached resource computer and NET is from the word network. So ARCNET in full means attached resources computer network.

ARCNET's use as an office automation network has diminished but continues to find success in the industrial automation industry because its performance characteristics are well suited for control. It is very robust, fast and provides deterministic performance. In addition, it can span long distances thus making it a suitable fieldbus technology. The term fieldbus is used in the industrial automation industry to signify a network consisting of computers, controllers and devices mounted in the "field". ARCNET is an ideal fieldbus that delivers a message in predictable time fashion because of its token-passing protocol that it uses.

ARCNET packet lengths vary from 0 to 507 bytes with little overhead and high data rate, typically 2.5 Mbps, yields quick responsiveness to short messages needed by feldbus. It has a built-in CRC-16 (cyclic redundancy check) error checking and supports several physical cabling schemes including fiber optics. The data link protocol is self-contained in the ARCNET controller chip. Network functions such as error checking, flow control and network configuration are done automatically without software intervention. In terms of the International Organization of Standards OSI (Open Systems Interconnect) Reference Model, ARCNET provides the Physical and Data Link layers of this model. In other words, ARCNET provides for the successful transmission and reception of a data packet between two network nodes. A node refers to an ARCNET controller chip and cable transceiver connected to the network. Nodes are assigned addresses called MAC (medium access control) IDs and one ARCNET network can have up to 255 uniquely assigned nodes.

Deterministic Performance

The key to ARCNET's performance and its attractiveness as a control network is its token-passing protocol. In a token-passing network, a node can only send a message when it receives the "token." When a node receives the token it becomes the momentary master of the network for very short time before passing it to next node. The length of the message that can be sent is limited and, therefore, no one node can dominate the network before it relinquishes control of the token. Once the message is sent, the token is passed to another node allowing it to become the momentary master. By using token passing as the mechanism for mediating access of the network by any one node, the time performance of the network becomes predictable or deterministic. Industrial networks require predictable performance to ensure that controlled events occur when they must and ARCNET provides this predictability.

Logical Ring

A token (ITT—Invitation to Transmit) is a unique signaling sequence that is passed in an orderly fashion among all the active nodes in the network. When a particular node receives the token, it has the sole right to initiate a transmission sequence by passing it to its logical neighbour. This neighbour, physically located anywhere on the network, has the next highest address to the node with the token. This token-passing sequence continues in a logical ring fashion serving all nodes equally. Node addresses must be unique and can range from 0 to 255 and are independently assigned with regardless of the physical location on the network. Address 0 is reserved for broadcast messages.

Directed Messages

In a transmission sequence, the node with the token becomes the source node and any other node selected by the source node for communication becomes the destination node. The selection of the destination node is done by away of the source node sending out a Free Buffer Enquiry (FBE) to find if the destination node is in a position to accept. The destination node responds by returning an Acknowledgement (ACK) meaning that a buffer is available or by returning a Negative Acknowledgement (NAK) meaning that no buffer is available. Upon an ACK, the source node sends out a data transmission (PAC) with either 0 to 507 bytes of data (PAC). If the destination node as evidenced by a successful CRC test properly received the data, the destination node sends another ACK. If the transmission was unsuccessful, the destination node does nothing, causing the source node to timeout. The source node will, therefore, infer that the transmission failed and will retry after it receives the token on the next token pass. The transmission sequence terminates and the token is passed to the next node. If the desired message exceeds 507 bytes, the message is sent as a series of packets—one packet every token pass. This is called a fragmented message. The packets are recombined at the destination end to form the entire message.

Broadcast Messages

ARCNET's broadcast messages can be sent to all nodes with one transmission by specifying Node 0 as the destination address. Nodes that have been enabled to receive broadcast messages will receive such messages. Node 0 does not exist on the network and is reserved for this broadcast function. No ACKs or NAKs are sent during a broadcast message making broadcast messaging fast.

Automatic Reconfigurations

ARCNET reconfigures the network automatically if a node is either added or deleted from the network. Any new node joining the network has to jam the network with a reconfiguration burst that destroys the token-passing sequence. Consequently the token is lost; all nodes cease transmitting and begin a timeout sequence based upon their own node address. The node with the highest address will timeout first and begin a token pass sequence to the node with the next highest address. If that node does not respond, it is assumed not to exist. The destination node address is incremented and the token resent. This sequence is repeated until a node responds. At that time, the token is released to the responding node and the address of the responding node is noted as the logical neighbor of the originating node. All nodes repeat the sequence until each node learns its logical neighbor. At that time the token passes from neighbor to neighbor without wasting time on absent addresses. If a node leaves the network the reconfiguration sequence is slightly different. When a node releases the token to its logical neighbor, it continues to monitor network activity to ensure that the logical neighbor responded with either a token pass or a start of a transmission sequence. If no activity was sensed, the node that passed the token infers that its logical neighbor has left the network and immediately begins a search for a new logical neighbor by incrementing the node address of its logical neighbor and initiating a token pass. Network activity is again monitored and the incrementing process and resending of the token continues until a new logical neighbor is found. Once found, the network returns to the normal logical ring routine of passing tokens to logical neighbors. With ARCNET, reconfiguration of the network is automatic and quick without any software intervention.

Unmatched Cabling Options

ARCNET is the most flexibly cabled network since it can support bus, star and distributed star topologies. In a bus topology, all nodes are connected to the same cable. The star topology requires either passive or active a hub to concentrate the cables from each of the nodes. The distributed star (all nodes connect to an active hub with all hubs cascaded together) offers the greatest flexibility and allows the network to extend to greater than four miles (6.7 km) without the use of extended timeouts. Media support includes coaxial, twisted-pair and glass fiber optics.

NIMS & HUBS

Network Interface Modules

Each ARCNET node requires an ARCNET controller chip and a cable transceiver that usually reside on a network interface module (NIM). NIMs also contain bus interface logic compatible with the bus structure they support. These network adapters are removable and are, therefore, termed "modules." ARCNET NIMs are available for all the popular commercial bus structures. NIMs differ in terms of the ARCNET controller they incorporate and the cable transceiver supported.

ARCNET Controllers

The heart of any NIM is an ARCNET controller chip that forms the basis of an ARCNET node. Datapoint Corporation developed the original ARCNET node as a discrete electronics implementation, referring to it as a resource interface module or RIM. Standard Microsystems Corporation (SMSC) provided the first large - s c an l e integration (LSI) implementation of the technology. Since then, other chip manufacturers were granted licenses to produce RIM chips.

TOPOLOGIES.

Topology refers to an arrangement of cables, Network interface modules and hubs within a network. Of the existing topologies, ARCNET has several choices:

i) **Point –to – Point**: Is the simplest of network with NIM effectively terminating to the other hence services of a hub not required.

ii) **Star:** This connection requires a hub with each NIM connecting to a point or port in the hub that satisfactorily terminates the connected NIM.

The advantage of this: Since only one NIM is connected to one port on the hub, faults/failure of cable can easily be isolated and do not whatsoever affect the rest of the network.

iii) **Distributed Star (Tree)**: Implementation is courtesy of employment of several active hubs. This topology accommodates both hub-to-hub connections making it the most

flexible in ARCNET LANs. A 'home run' cable links two or more active hubs supporting a cluster of connected nodes.
The advantage of this choice: Distributed Star topology reduces cabling costs as each node connects to a local hub. Each node is isolated from another.

iv) **Bus:** This configuration calls for employment of transceivers. Using Coaxial cable and BNC; Twisted Pair cable several NIM can be accommodated on the ARCNET LAN without using a hub. Termination is made at both ends by installation of resisting terminators to check stray signals.

Advantage: No hub is required:
Disadvantage: If one node fails, the entire network fails as well.

v) **Star/Bus**: Calls for employment of an active hub to bridge a bus topology to a star one, whereby the active hub acts as a terminator and a repeater for the network. The passing terminator on one end is removed and the end connected to a port on the active hub. The other port on the connected active hub can be used for other bus/star connections.

vi) **Daisy Chain**: Requires two connectors or a single connector with redundant connections per NIM. This configuration is best implemented by use of RJ-11 connectors where the unused connectors at each end of the daisy chain are used with RJ-11 style terminators.

vii) **Multidrop**: A multidrop allows a short "drop" from the 'T' connection.
The absence of effects and limitations of drop cable renders this topology irrelevant.

viii) **Ring: ARCNET** does not support ring/loop connections because:
- Unreliable operation-result from implementation of a loop.
- Unreliable operation-result from violation of star topology by introduction of loops.

TRANSCIEVERS

Transceiver Options: The type of transceivers to be implemented depends on the topology and selected transmission media.

- Usually a suffix is appended to the model number of the product to identify which transceiver exists with that product. This practice is utilized on both active hub and network interface modules.

i) **Coaxial Star**:
In a star topology, ARCNET cabled with RG-62/u coaxial cable (with BNC Connectors) with each NIM connecting directly to an active or passive hub.
Advantage: Coaxial offers good performance, good noise immunity, low propagation delay, low signal attenuation, sufficient ruggedness and low cost.
Coaxial star provides longest coaxial distance and simplified troubleshooting

ii) **Coaxial Bus**:
In bus configuration, ARCNET is cabled with RG-62/u coaxial cable using BNC tee connectors in combination with passive terminators at each cable end. Although hubs are not required, cabling options are restricted and troubleshooting is much more difficult.
The minimum distances between adjacent nodes must be adhered to. The configuration is employed when reliable coaxial cable configuration is required in a hubless system and shorter distances are involved.

iii) **Twisted Pair Star**:

Unshielded twisted pair wiring such as IBM Type 3 can be used. BALUNs are required at both the hub and NIM to use this cable. Some twisted pair NIMs and hubs have internal BALUNs, so external BALUNs are not needed. Twisted –pair is convenient to install. However, its attenuation exceeds coaxial, its noise immunity is less, and its maximum length between a node and a hub is lower. RJ-11 connectors are often used with this cable.

iv) **Twisted Pair Bus**:

The convenience of twisted-pair wiring can be used in a bus configuration without the use of BALUNs. Dual RJ-11 jacks are provided so modules can be wired in a 'daisy-chain' fashion even though electrically they are connected as a bus. Distances are limited as well as node count. Passive terminators are inserted in unused jacks at the far end of the segment. For small hubless systems, this approach is attractive.

v) Glass Fiber Optics:

Duplex glass, multimode fiber optic cable uses either SMA or ST connectors and is available in three sizes measured in microns: 50/125, 62.5/125 and 100/140. Larger core sizes launch more energy allowing longer distances. The industry appears to have selected 62.5/125 as the preferred size. This core size, operating with 850 nm transceivers, provides long distances, reasonable cost, immunity to electrical noise, lightning protection and data security. Glass fiber optic cable is used in hazardous areas and interbuilding cabling on campus installations or whenever metallic connections are undesirable. Connectors can be either SMAs or STs. The STs look like a small BNC and are more tolerant to abuse than SMA. ST connectors have become more popular than the traditional SMA connector has.

For very long distances up to 14km, single mode fiber optics operating at 1300nm is recommended. Cable attenuation is much less at 1300nm than at 850nm.

vi) **DC coupled EIA-485**.

One popular cabling standard in industrial installations is EIA-485. A single-pair supports several nodes over a limited distance. Screw terminal connections or twin RJ-11 jacks are provided so that the modules can be wired in a 'daisy-chain' fashion. EIA-485 offers a hubless solution, but with limited distance and low common mode breakdown voltage.

vii) **AC coupled EIA-485** – The EIA-485 transformer coupled option provides the convenience of EIA-485 connectivity, but with a much higher common mode breakdown voltage. Distances and node count are reduced from the DC coupled EIA-485 option. The AC coupled option is insensitive to phase reversal of the single twisted-pair that connects the various nodes but may not operate over the full range of data rates of the newer ARCNET controllers.

CABLE:

Once the topology and transceiver are specified, the cable can be selected. There are basically three choices in cabling: coaxial, twisted-pair and fiber optic. Each type has its advantage and when using active hubs all three types of cabling can be mixed within one network – an example of ARCNET's extreme flexibility.

i) **Coaxial Cable**:
This was the original cabling in ARCNET systems, with RG-62/u being the preferred model for its adaptability with RG-62/u coaxial transceiver and exhibits less attenuation yielding greater distances. Coaxial is relatively inexpensive and provides the highest propagation factor compared to all other media.

ii) Twisted-pair
Twisted-pair cable is inexpensive and convenient to user and easy to terminate though it exhibits greater attenuation and therefore limited distance capability. Its compatible with several transceivers though IBM type 3 is the most recommended.

iii) **Fiber Optic**:
Offers the greatest distance bur requires more attention to its application. It comes in a variety of cables and cable pairs. Fiber optics span the greatest distance with a low propagation factor. Its installation should be evaluated to ensure that it is within ARCNET limits.

NB: All cable installations must comply with the ISO – OSI ordinance.

iv) **Coaxial Cable:** <u>Good Price Vs Performance</u>

The original ARCNET called for coaxial cable as the formal medium between hubs and NIMs. Transceivers were developed to remove hubs but the coaxial cable remained.

The two transceivers:

1. Coaxial cable for distributed star systems
2. Coaxial bus for hubless systems.

<u>P1 and P2 Signaling:</u>

ARCNET controllers develop two signals, P1 and P2; where P1 and P2 are negative signals of 100nanoseconds in duration with P2 following P1 when operating at 2.5mbps data rate.

ARCNET controllers transmit a signal when logic 1 is transmitted, with logic 0 rendering the line idle as no pulses are sent.

<u>Star Vs Bus:</u>

The coaxial star transceiver and the coaxial bus transceiver both receive P1 and P2 signals and generate dipulse signals. However, the star transceiver represents a low impedance at all times while the bus transceiver represents high impedance when idle allowing for multiple transceivers to be attached to a common bus.

TWISTED-PAIR – INEXPENSIVE AND SIMPLE TO USE.

Twisted-pair in ARCNET is quite inexpensive and easy to use as well as top terminate. It is actually a very popular cabling technology. Compared to the coaxial cable, it has a higher attenuation and modular jacks and plugs are used to interconnect segments. Due to high attenuation, it is used over short distances.

It can be used with convention coaxial star transceivers if a BALUN is used between the cable and the transceiver. Some products are found to eliminate the need for external BALUN. When using BALUN, only star and distributed star topologies are supported. No phase reversal of the wiring is ever allowed.

Twisted-Pair Bus.

Twisted-pair bus transceivers are used for hubless systems. Modular jacks are used and a bus connection is required, therefore two jacks that are internally wired together are provided on each NIM. The successive NIMs receive field connections in a daisy-chain fashion. The remaining end jacks are then plugged with passive terminators and modular plug terminator is available for this use. The daisy cable too should not invert signals and must be at least six feet long for reliable operation.

Hubs are used to extend twisted pair segments by use of a ‘twisted-pair star’ hub port in place of the passive terminator at one end of the segment. The last port on the NIM is connected to the twisted-pair star port on the hub using an ‘inverted’ modular plug cable.

Data Rate Selection.

ARCNET NIMs communicate at a usual speed of 2.5 mbps. Newer operations like COM20019, COM20020, COM20022 and COM20051 ARCNET are able to support other speeds.

Lower data rates facilitate longer bus segments but variable speed hub electronics are required to service these rates. Data speed at 19kbps is possible with 20019 controllers and as high as 10mbps are achieved with 20022 controllers.

On systems with dipulse transceivers. Data rates should not be changed since the transceiver is tuned to 2.5mbps and can only operate at that rate.

Back-plane mode.

The COM20019,20020,20022,20051 ARCNET controller family has additional interfaces not available in earlier generation controllers.

The chips default to conventional ARCNET mode upon power up. P1 and P2 signals are generated to develop the required dipulse signals. However, if back-plane mode happens to be programmed into chips, P1 signal is stretched into 200nanosecond signal and P2 becomes clock. The sense of the receiver pin (Rxin) is then inverted so that it may be tied directly to the negative true P1. The bus segment must remain short limiting this configuration to applications of several nodes communicating within one instrument. If the driver and receiver electronics are inserted between the P1 and Rxin signal, the distance can be extended. A logical choice would be EIA-485 since its standard is popular. You will require one additional line signal called TXEN generated by the newer chips. The TXEN is unavailable on earlier ARCNET controllers and is ignored in conventional dipulse mode.

EIA-485

This standard supports multi-master operation and is therefore suitable for use with ARCNET in the either back-plane or non-back-plane modes. Two EIA-485 implementations are supported on ARCNET; DC-Coupled and AC-Coupled. The capabilities of each approach are quite different.

DC-Coupled: With ARCNET, any node can transmit therefore multiple drivers and receivers share a common twisted-pair cable. EIA-485 does not specify a data link protocol and some means must be pointed to ensure only one driver has access to the medium at any one time. The medium provided by ARCNET is Medium Access Control (MAC) and is used to successfully implement the EIA-485 networks. EIA-485 does not specify modulation method or cabling and rules need to be developed for ARCNET based EIA-485 networks. The driver can be located anywhere within the network and therefore a terminator must be supplied at both ends of the cable. The recommended cable is a twisted-pair with characteristic impedance of 100 to 120 ohms. Matching terminators must therefore reside at each end of the segment.

Only one driver is enabled at any one time in an operating network. When no drivers are operational, the twisted-pair may float. Noise and reflections cause various receivers to incorrectly detect data and this creates data errors.

If we decrease the bias to resistance, immunity to refection is improved but this may load drivers excessively. The amount of bias required increases with the number of receivers on the line. Resistance must be distributed over two modules each located at the end of the segment in order to simplify the cabling rates. The common mode voltage experienced by any one node is between +/- 7volts. A good grounding system always ensures that this is met.

AC-COUPLED EIA-485: If your transformer couple the EIA-485 connection, you will achieve a much higher common mode rating. By developing suck an approach, SMSC has achieved a common mode rating of 1000 volts DC. The implementation does not require biasing resistors like the DC coupled approach. All the same, line terminators have to be applied each end of the cable segment. With AC-coupled EIA-485 approach, connections to each node are sensitive to phase reversal since the symbol on the cable reverses polarity on successive logic ‘1s’. This implementation is rated at 13 nodes maximum over 700 feet (213m) of cable.

When you introduce active hubs it is possible to extend bus segments beyond the 700 or 900-foot (213 – 274 m) limit. AC does not obviously operate over all data rates and it is therefore advisable that vendor specification be studied.

Termination

When you use an active hub, you have an advantage in that you do not require a passive termination at each port and unused ports need not be terminated. Only bus segments of either coaxial or twisted-pair cabling require termination. If one end of the bus segment attaches to a port on active hub, no termination is required at that end.

For RG-62/u cable, its advisable you use a 93-ohm terminator attached to a BNC tee connector. For twisted-pair cable, use a matching terminator that plugs into the unused RJ-11 connector at each end of the bus segment. If no RJ-11 connector exists, then a discrete resistor attached to screw terminals or with some NIMs can be used. An on-board terminator can be invoked by inserting a jumper.

APPLYING FIBER OPTICS TO ACHIEVE A ROBUST DESIGN:

The use of fiber optics in ARCNET has increased due to the inherent advantages of using fiber. High data rate can be maintained without Electro Magnetic or Radio Frequency Interference (EMI/RFI). Longer distances can be achieved over that of copper wiring. For the industrial/commercial user, fiber offers high voltage isolation, intrinsic safety and elimination of ground loops in geographically large installations. ARCNET will function with no difficulty over fiber optics as long as some simple rules are followed.

TYPES OF FIBER OPTICS CABLING

There are varying types of fiber optics cabling, but basically the larger size fiber (in diameters of 50,62.5,and 100 microns for conventional installations) is recommended, with this size fiber, multi mode operation will be experienced requiring the use of graded index fiber. Transceivers operating at 850nm wavelength offer a good performance/cost tradeoff.

A duplex cable is required since each fiber optic port consists of a separate receiver and transmitter which must be cross connected to the separate receiver and transmitter at the distant end. Only star and distributed star topologies are supported.

For distances beyond 3 km, single mode fiber optics used with 1300nm transceivers is recommended. With this approach, segment lengths up to 14km can be realised.

OPTICAL POWER BUDGET

When specifying a fiber optic installation, attention must be paid to available optical power budget.

The power budget is the ratio of the light source strength to the receiver sensitivity expressed in dB. This value must be compared to the link loss budget that is based upon the optical cable and optical connectors. The link loss budget must be less than the power. The difference is called the power margin, which provides an indication of system robustness.

Transmitter power is typically measured at one meter of cable and therefore, includes the loss due to at least one connector.

Receiver sensitivity also varies so tests should be run to determine the least sensitive receiver.

LINK LOSS BUDGET

The cable manufacture usually specifies the fiber optic cable attenuation for different wavelengths of operation. This figure is used to determine the maximum distance of fiber link. It is necessary to include losses due to cable terminations. Connectors usually create a loss of 0.5 to 1dB.

OVERDRIVE

Overdrive occurs when too little fiber optic cable is used resulting in insufficient attenuation. To correct this condition, a jumper is typically removed in each fiber transceiver to reduce the gain sufficiently to allow for a zero length of fiber optic cable to be installed between a transmitter and receiver.

CALCULATING PERMISSIBLE SEGMENT LENGTHS:

A segment is defined as any portion of the complete ARCNET cabling system isolated by one or more hub ports. On a hubless or bus system, the complete ARCNET cabling system consists of only one segment with several nodes, however a system with hubs has potentially many segments. An ARCNET node is defined as a device with an active ARCNET controller chip requiring an ARCNET device address. Active and passive hubs do not utilise ARCNET addresses, and therefore are not nodes.

Each segment generally supports one or more nodes but in the case of hub-to-hub connections, there is the possibility that no node exists on the segment.

The permissible cable length of a segment depends upon the transceiver used and the type of cable installed.

DATA LINK LAYER:

ARCNET is properly classified as a token bus technology since a token is the primary means of mediating access to the cable.

Each ARCNET node is capable of monitoring all the traffic on the network regardless of destination.

Conventional ARCNET operates at 2.5mbps and much of the timing information presented assumes that speed.

MAIN Basic Symbol Units

These are the elements used to contract basic frames and reconfiguration bursts.

<SD> - Starting Delimiter
    1111111 (6 symbols)
    All ARCNET frames begin with six logic 1s
    This is referred to as Alert Burst.
<RSU> - Reconfiguration Symbol Unit
    111111111 (9 symbols)
<ISU> - Information Symbol Unit.
    110 d1 d3 d4 d5 d6 d7 (11 symbols)
    Each information unit contains 8 bits of data and 3-bit preamble
<SOH> - Start of Header
    Used to identify a packet
<ENQ> - Enquiry 0X85
    Used to identify a request for a free buffer.
<ACK> - Acknowledgement 0X86
    Used to identify acceptance
<NAK> - Negative Acknowledgement 0X15
    Used to identify non-acceptance
<EOT> - End of Transmission 0X04
    Used to identify a token pass to a logical neighbour
<NID> - Next Node Identification
    Used to identify the next node in the token loop (with the token)
<SID>- Source Node Identification
<DID> - Destination Node Identification
<CP> - Continuation Pointer
<SC> - System Code
<…DATA…> - Data
<FCS> - Frame Check Sequence

FRAME FORMAT

There are two frame formats with ARCNET:
-Basic Format: which provides control information between the nodes
-Reconfiguration burst: Is unique to the reconfiguration process

Frames are constructed by putting together basic symbol units.

BASIC FRAMES

There are only five frames in the ARCNET data link layer protocol.

a) IIT – Invitation to transmit
b) FBE – Free Buffer Enquiry
c) ACK – Acknowledgement
d) NAK – Negative Acknowledgement
e) PAC – Packet

SYSTEM CODES

The byte immediately following the continuation pointer in every ARCNET packet must be a system code that acts as a protocol identifier. This allows a number of protocols using independent message formats to coexist on a single physical network.

RECONFIGURATION BURST

The reconfiguration burst is a special frame only used in the reconfiguration process. It is a jam signal of sufficient length to destroy any activity occurring on the network ensuring that all nodes are aware that a reconfiguration of the network will take place.

DETERMINISTIC TRANSMISSION TIMES

ARCNET uses token passing as a means of station access to medium. For example, delays for conventional ARCNET operating at 2.5MBPS include:

i) Turnaround Time – This is the time between the end of a received transmission and the start of a response to that transmission.
ii) Medium Propagation – Token Pass to Logical Neighbour. This the time it takes for the transmission of a symbol from one point to the receipt of the same symbol at another point (source node to destination node). It is the time it takes for a symbol to travel from the source node of transmission to the destination node.
iii) Broadcast Delay Time – The time it takes from the end of a transmitted broadcast packet to the start of a token pass.
iv) Response Time – The maximum time a transmitting node will wait for a response.
v) Recovery Time – The time that elapses from the end of a response timeout until the start of a token pass.
vi) Time Activity Timeout – The maximum amount of time that the network can experience no activity.

EXTENDING ARCNET's DISTANCE

Extending Timeouts: - Originally, ARNET was specified to have 6.7km maximum distance limitation which could be achieved with eleven segments of RG-62/u coaxial cable and ten active hubs. The distance constraint has more to do with the time delay. When considering a fiber optic system, a delay budget calculation should be performed to determine if extended timeouts are required.

Besides the response time, extended timeouts affect the idle time (the time a node waits before incrementing the next ID counter during a reconfiguration) and the reconfiguration time (the time a node waits before initiating a reconfiguration burst).

SOFTWARE STANDARDS

OSI MODEL: This model describes the various layers of services that may be required in order for two or more nodes to communicate to one another. ARCNET conforms to the physical layer and the medium access control portion of the data link as defined by IEEE. All the layers above the data link layer collectively are called the protocol stack and the number of services available or used by differing applications vary. The software required to bind a network interface module to a protocol stack is called a driver and many different drivers exist for ARCNET.

Collapsed Stack or Null Stack: The application layer is tied directly to the Data Link layer. It is a popular approach for embedded networking.
Control Link – SMSC developed IEEE 802.2 services that provide logical link control (LLC) above the MAC sub-layer.
NetBios – Used with several peer-to-peer network operating systems and, frequently, the interface to ARCNET systems.
Net BEUI – The NetBios Extended User Interface is both a NetBIOS interface and protocol.
TCP/IP – TCP functions at the transport layer and IP functions at the Network Layer. The Protocols provide ARCNET connectivity to the Internet.
IPX/SPX – Microsoft's version is called NWLink.
NDIS – Network Driver Interface Specification is a driver specification, which allows an ARCNET to bind to NetBEUI, IPX/SPX or TCP/IP or any other protocol for which an NDIS compatible protocol driver has been written.
ODI – Open Data link Interface.

N/B:
When installing ARCNET adapters, it should be ensured that the proper driver is available from the adapter supplier or the equipment OEM who specifies the ARCNET adapter.

Conclusion:

ARCNET Trade Association (ATA):

This was formed in 1987 for the dual purpose of developing working standards for ARCNET and promoting the use of ARCNET as a viable networking technology. Besides endorsing ARCNET NetBIOS, the ATA is working with three standards:

1. ANSI/ATA 878.1 local Area Network: Token Bus
2. ATA 878.2 ARCNET Packet Fragmentation Standard
3. ATA 878.3 Encapsulation Protocol Standard.

Site: ata@arcnet.com or www.arcnet.com

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