

How many Drives can be daisy chained or on ring topology?

For a slave point of view the first limitation is the possible IP address configurable in the device.

Class A: network from 1.0.0.0 to 126.0.0.0 (on 8 bits)

Class B: from 128.1.0.0 to 191.255.0.0 (on 16 bits)

Class C: from 192.0.1.0 to 223.255.255.0 (on 24 bits)

Class D: multicast, from 224 to 231

So in reality of the network, the limitation will be not really in the address possibilities, but more in the slave's number which can be configured in the Master PLC.

On this we don't have the information, but it will depend of the type of master PLC. This information need to be check in the PLC.

The second point will be the passband of the network. More you will increase the number of device on a network, more data will be exchange. Maximum data that can be used depend of network passband.

For our Drives on we can have 100Mbits/s (full duplex).

Like describe below, the maximum number of configurable device and also the network passband, will allow a very high number of devices on daisy chain or ring topology. This is right for Star, daisy chain or Ring topology.

Nevertheless for daisy chain or ring topology an third important factor which is the "latency" must be check and will reduce the number of maximum device on that network topology (daisy chain and ring)

The Network latency is increased as a result of data passing through each node in the ring before reaching its destination. On our Drives with dual port card, this port acts as an Ethernet Switch. The latency through an Ethernet is directly proportional to the packet size, due to the store and forward architecture. The total latency can be calculated by this formula

Total latency = (packet size x 8) / rate + forwarding delay.

The forwarding delay in the switch is normally small, constant and independent of packet size. A typical figure for Ethernet switch is around 4µs. So the switch latency for a 64-byte packet will be approximately 9.12µs compared to a 125,44µs delay when a 1518 byte is forwarded. Those examples show you the latency for data passing through only one device on this daisy chain or ring network.

On Drives:

Frame length for reading data trough Ethernet is 66 bytes (with an answer 77 bytes)

Frame length for I/O scanner (10 words) trough Ethernet is 93 bytes (with an answer 85 bytes)

Connection to webserver could be more than 250bytes frames during the connexion.

Rule on a single daisy chain network

In theory, there is no defined limit for maximum drives in daisy chain.

During the validation period, 8 drives in daisy chain were tested without problem.

In this configuration we have high response time due to the integrated switch in each card. The limitation concerning the number of drive is the time propagation of the switch (like describe before).

For practical point of view (especially for industrial network), there is rule for the wiring of daisy chain topology: the network will operate only as fast as the slowest device that is connected to the network.

For industrial network, we expect to have latency less than 5 milliseconds.

And in order to improve network traffic latency, the numbers of devices in a single daisy chain should be limited to 32 devices. Limiting a single scan chain to 32 devices the time for a round trip of a packet through the daisy Chain is expected less than 5 milliseconds (with 32 devices plugged on a scan daisy chain).

Rule on a ring network

The rule will be the same, in theory, there is no defined limit for maximum drives in daisy chain.

In this configuration we have high response time due to the integrated switch in each card. The limitation concerning the number of drive is the time propagation of the switch (like describe before).

For practical point of view (especially for industrial network), there is no rule for the wiring of ring topology: the network will operate only as fast as the slowest device that is connected to the network.

For industrial network, we expect to have latency less than 5 milliseconds.

In order to improve network traffic latency the numbers of devices in a ring topology should be limited to 32 devices. Limiting to 32 devices the time for a round trip of a packet through the ring is expected less than 5 milliseconds (with 32 devices plugged on this ring).

Conclusion

Most influent value factor for the number of device on daisy chain or on ring topology will be the latency.

In industrial network, we expect to have latency less than 5 milliseconds.

To achieve this maximum latency value, we recommend putting 32 devices maximum in daisy chain or in a ring topology. If more devices must be configured on daisy chain or ring, the latency must be study on network design phase.

Total distance from the PLC to the last ATV on the daisy chained loop?

The dual port on ATV71 Ethernet card or ATV32 Ethernet card is in fact a switch. So there is no maximum distance to take into account from the PLC to last ATV is daisy chain loop. The distance to take into account is the Max length for a segment. Like describe on next answer, the max length for Ethernet segment (100base TX) is 100m.

So if we take this max number with 32 slaves and one PLC we will have:

$32 \text{ segments} * 100\text{m} = 3200\text{m}$ between the PLC and the last drive in daisy chain (can be use only of this 3200m are composed by 32 segment of 100m separate by drive un daisy chain)

Maximum distance between each ATV

The dual port on ATV71 Ethernet card or ATV32 Ethernet card is in fact a switch. So the wiring rules to respect between 2 ATV in daisy chain are the same than the standard Ethernet network.

See the table below:

Max length for a segment (between 2 ATV in daisy chain) is 100m;

Distance limitations and number of devices per segment

Based upon the 802.3, the distance limits and the numbers of devices in cascade are the following:

Type	Maximum segment length (1)	Maximum segment length (offered by ConneXium devices)	Maximum number of hubs in cascade	Maximum number of switches in cascade
10BASE-T	100 m	100 m	4	Unlimited
100BASE-TX	100 m	100 m	2	Unlimited
1000BASE-T	100 m	100 m	–	Unlimited
10BASE-FL	2000 m	3100 m (2)	11 (fiber ring)	–
100BASE-FX	412 m/2000 m	4000 m with multimode, 32.500 m with monomode (3)	–	Unlimited
1000BASE-SX	275 m	–	–	Unlimited

(1) Based on 802.3, full duplex/half duplex.

(2) Depends on the optical budget and fiber attenuation.

(3) Depends on the optical fiber budget and fiber attenuation, typical specification is 2 km for multimode and 15 km from monomode.