The “Folded Daisy-Chain” System Explained

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BACKGROUND

Home, office, industrial, automotive, aerospace, marine and scientific device communication systems often utilizing multi-drop serial differential networking standards such as RS-485 or CAN bus. A significant example is “building automation systems” for Heating Ventilating and Air Conditioning (HVAC).

The RS-485 and CAN bus standards utilize controlled impedance, balanced differential signaling methods to connect multiple devices together on an electrical bus. Two conventional wiring systems are in common use.

The conventional “DAISY-CHAIN” system:

As shown in figure 1 interconnects one device to the next in a long wiring chain. The DAISY-CHAIN method has a lower purchase cost since interconnect hubs are not required. The DAISY-CHAIN method can be difficult to debug when wiring errors or system faults occur since devices are in one long series chain where a break or short anywhere may cause an entire system failure.

The conventional “HOME-RUN” system:

As shown in figure 2 a central Active Hub provides an active buffer at each port of the hub that connects directly to a device. Active Hub systems are simpler to diagnose wiring problems with but require up to twice as much power as DAISY-CHAIN systems and cost significantly more.

A 3rd option is the Folded Daisy-Chain System:

We believe the Folded Daisy-Chain System was first invented by Kellee Crisafulli in 1998. This method offers the advantages of both DAISY-CHAIN and HOME-RUN systems.
See figures 3 to better understand the basic concept of the Folded Daisy-Chain.
The basic “Trick” is that a single cable provides one twisted pair from hub to device and another twisted pair from the device back to the hub. The Hub must route from port to port to complete the daisy chain. Each end of the daisy-chain can now be terminated inside the hub eliminating termination problems. While not core to the Folded-Daisy Chain concept the SnapBus Folded Daisy-Chain Hubs also include an Active Repeater to buffer the signal through each Hub greatly increasing the maximum total system wire length.

The CelsioniX® website documents the history of the Folded Daisy-Chain and CelsioniX® SnapBus products™ using the Folded Daisy-Chain system.
http://www.celsionix.com

Fig. 1 Conventional DAISY-CHAIN RS-485 wiring

Note 1: **Each device uses ONE twisted pair per cable for the RS-485 signal.**
Conventional RS-485 Daisy-Chains are wired sequential one to next.
A central wiring hub cannot be used in this configuration.

Note 2: Isolating broken wires is difficult, the system stops working without any idea where the problem is.

Note 3: Easy to forget terminating resistors or add too many resistors which may cause system errors

Note 4: Maximum total cable length is 4000ft between the two terminators.

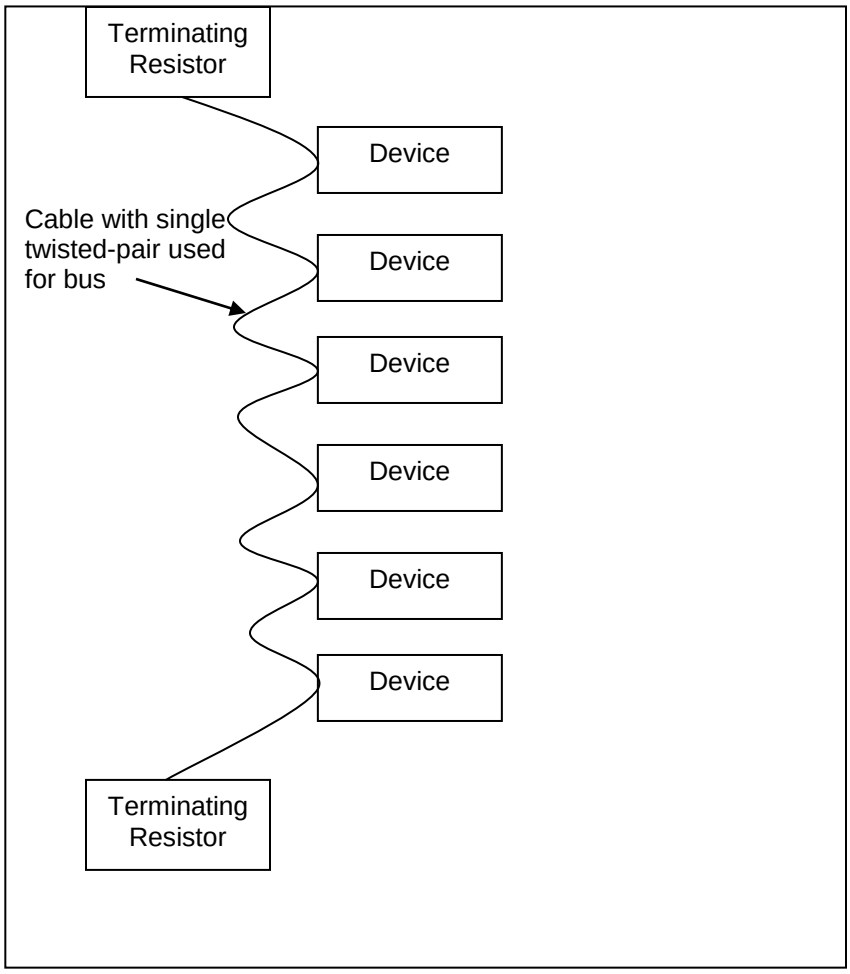

Fig. 2 Conventional Active HUB RS-485 wiring

Note 1: **Each device uses ONE twisted pair per cable for the RS-485 signal.**
The Hub provides both an electrical and physical HOME-RUN connection for each device.
(HOME-RUN meaning all devices run back home to the HUB)

Note 2: Isolating broken wires is much easier than with a daisy chain system.

Note 3: Terminating resistors can be built into the hub and device, eliminating the need to add resistors.

Note 4: Maximum cable length is 4000ft between any port and device.

Note 5: Each hub port provides an active electrical buffer to repeat the information to the port.

Note 6: More expensive than a daisy-chain system

Note 7: Uses twice as much power as a daisy-chain system.

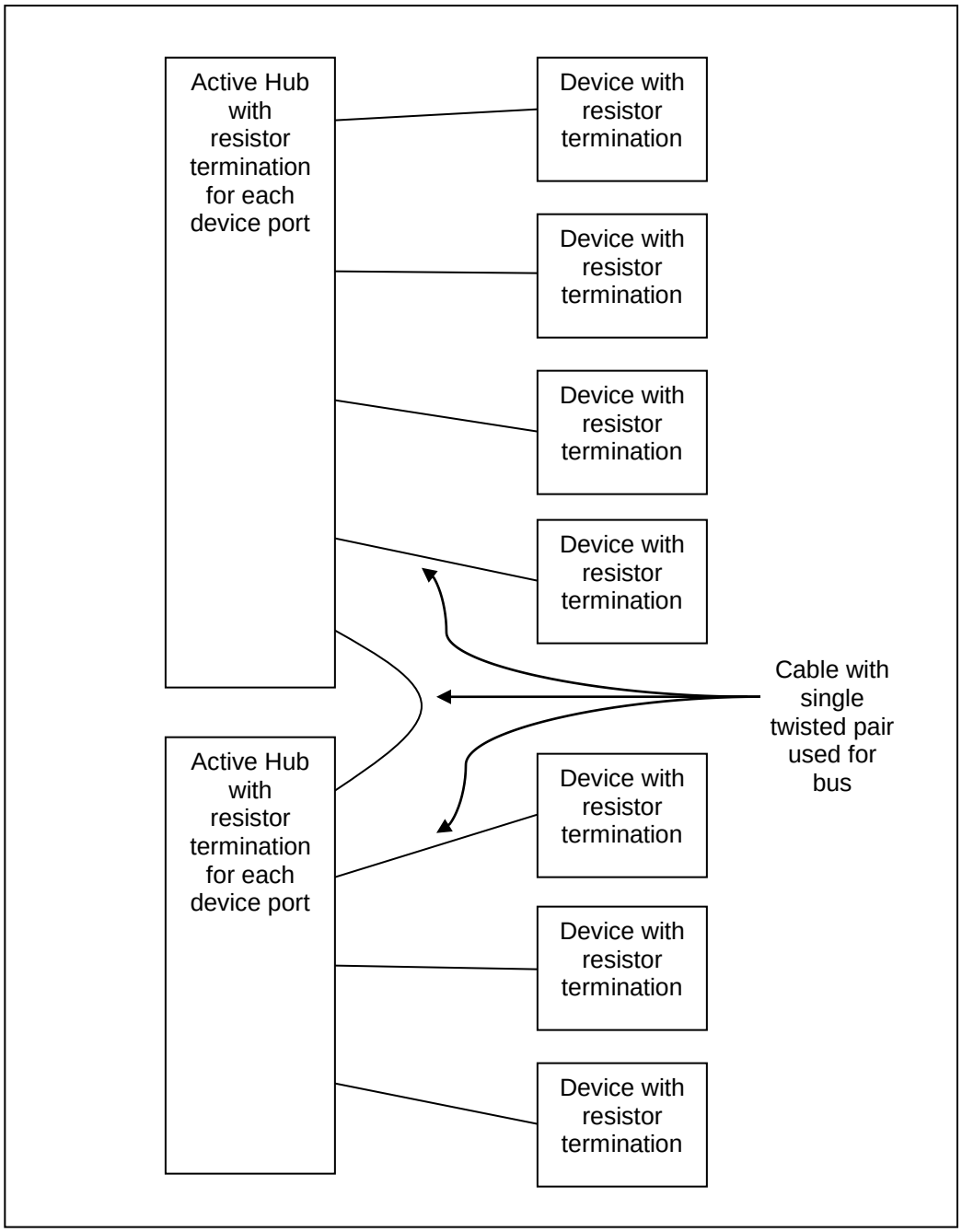

Fig. 3 "Folded Daisy-Chain" Passive Repeater Hub

Note 1: **Each device cable uses TWO twisted pairs per cable for the RS-485 signal.**
The Hub provides an electrical DAISY-CHAIN by essentially folding the daisy-chain inside the cables.
The Hub provides a physical STAR or HOME-RUN connection to the devices

Note 2: Isolating broken wires is much easier than with a conventional daisy chain system.
All wires are one place and can be easily unplugged and moved to find a broken wire.

Note 3: Terminating resistors can be built into the hub, eliminating the need to add resistors.

Note 4: Maximum cable length is 2000ft between of cable connected to all ports combined.

Note 5: Each hub port is electrically daisy chained from one to the next without a buffer.

Note 6: Less expensive than an Active Hub system

Note 7: Uses about half as much power as an Active Hub system.

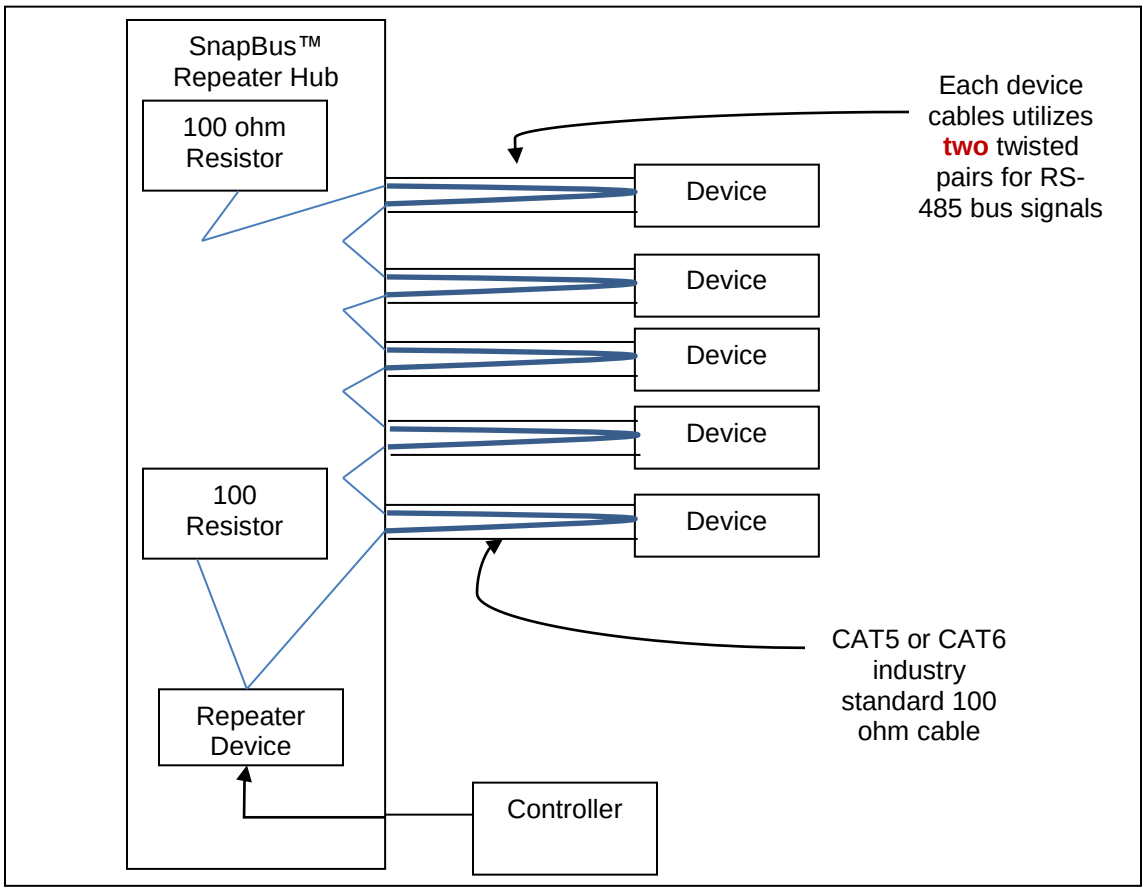

Fig. 4 Folded-Daisy-Chain RS-485 wiring showing a device connection using two terminals. Note: Wiring adapters can be provided to make this task simple.

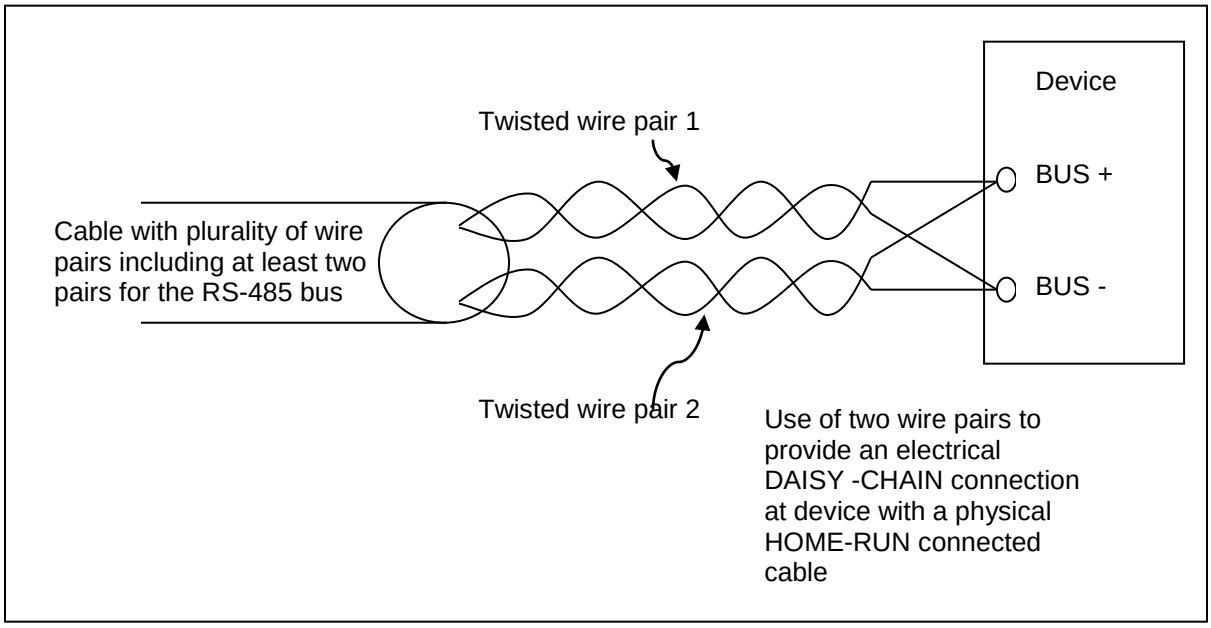

Fig. 5 Folded-Daisy-Chain RS-485 wiring showing a device connection with four connection terminals. The SnapBus system connector can be built into the Device as shown:

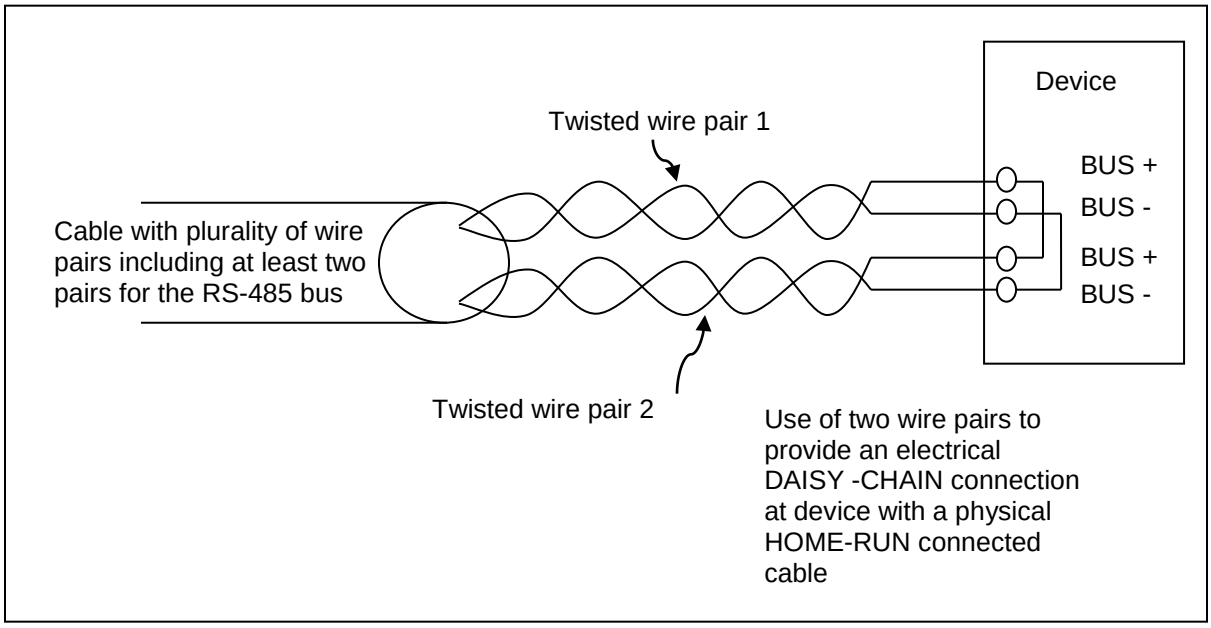

Fig. 6 An Example of Multiple SnapBus™ Repeater Hubs using folded daisy-chain system

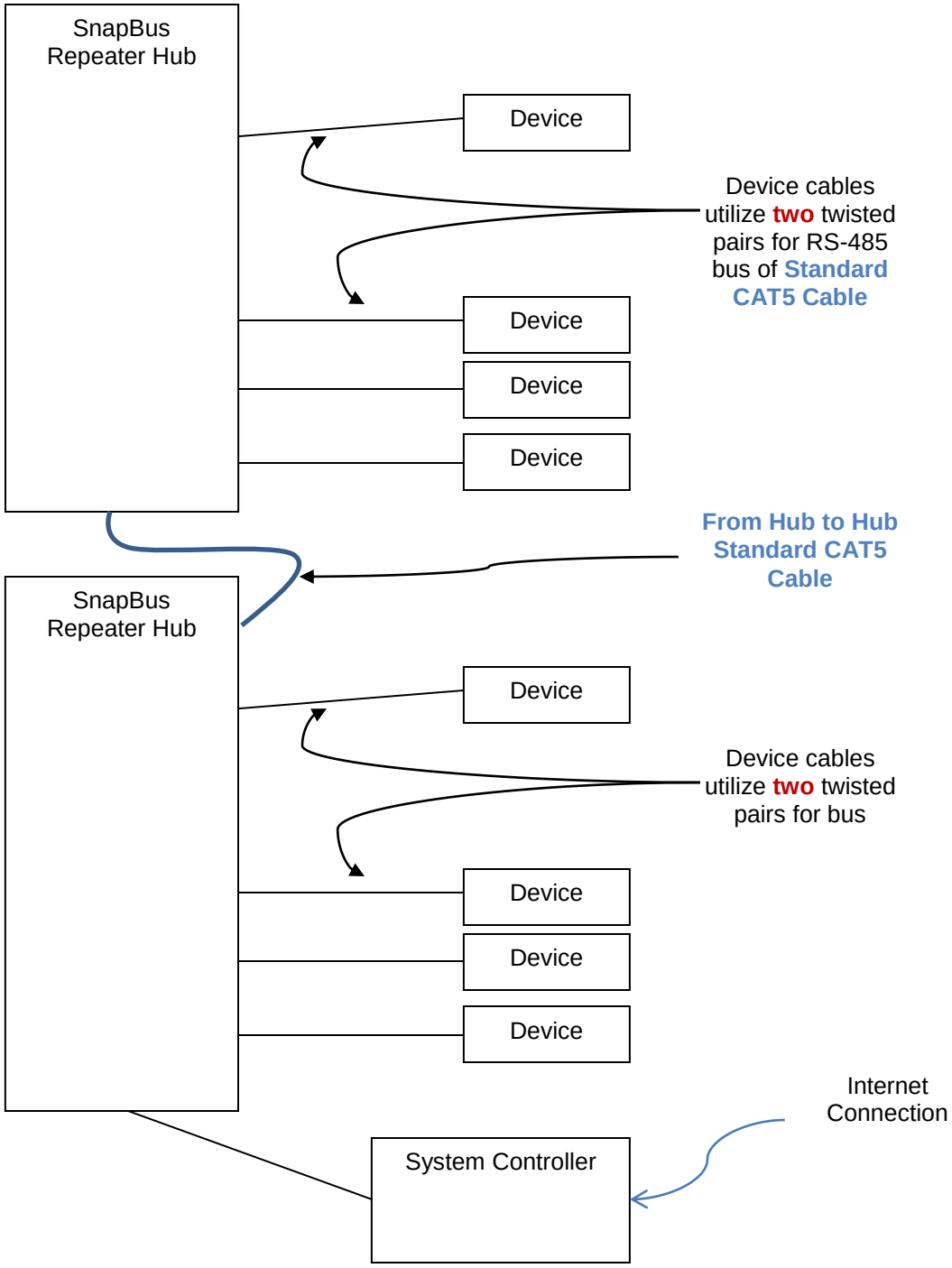

Fig. 7 An example with a cascade of SnapBus Repeater Hubs.