Communication networks

	AS-Interface (ver. 3 and 5)	DeviceNet	FOUNDATION Fieldbus	Profibus-DP
Topology	Not limited	Trunk/drop with branching	Trunk with branching or chicken foot	Trunk/drop
Max distance (Voltage drop may further limit distance)	100 m (328 ft) 300 m (984 ft) with 2 repeaters Additional distance with multiple parallel repeaters. Tuners and terminators available for special extensions.	500 m @ 125 Kbit/s 250 m @ 250 Kbit/s 100 m @ 500 Kbit/s [Based on thick cable. Max spur length 6 m; cumulative spur length 156 m/125 Kb, 78 m/250 Kb, 39 m/500 Kb]	1900 m (6200 ft) 120 m spur5 Using FISCO 1000 m [Max spur length 2-12 devices 120 m, 13-14 devices 90 m, 15-16 devices 60 m]	1200 m @ 94 Kb/s 400 m @ 500 Kb/s 100 m @ 12 Mb/s
Max # devices	31 62 with extended addressing	62	32 theoretical [16 practical maximum]	32 up to 126
Cabling	Unshielded untwisted pair	(2) 2-wire with shield (5-wire bundle)	Shielded twisted pair	Shielded twisted pair
Max power delivery	Current: up to 8 amps Voltage range: 26.5 to 31.6 VDC	Current: up to 8 amps Voltage range: 11 to 25 VDC	Current: up to 500 mA Voltage range: 9 to 32 VDC	Current: up to 8 amps Voltage range: 11 to 25 VDC [Power supplied on separate wire pair from communication signal.]
Hazardous area wiring	Explosionproof and nonincendive devices; conduit, tray cabling and nonincendive wiring	Explosionproof and nonincendive devices; conduit and tray cabling	IS, explosionproof and nonincendive devices; conduit, IS, tray cabling and nonincendive wiring	Explosionproof and nonincendive devices; conduit and tray cabling
Data transfer size	4 bits	1 byte variable up to 8 bytes	2 bytes discrete 5 bytes analog variable	1 byte variable, up to 244 bytes
Bus access method	Cyclic polling	Selectable: cyclic polling, change of state and more (device specific)	Publisher-subscriber method with data transfer. Token passing client-server for calibration and diagnostics.	Token passing for multi-master, cyclic polling for data to master; acyclic for diagnostic and calibration
Transmission rate	167 Kbit/s	125 Kbit/s | 250 Kbit/s | 500 Kbit/s	31.25 Kbit/s | (IEC 61158-2)	9.6 Kbit/s to 12 Mbit/s
Approximate cycle time	3 ms | Varies with # of devices and times scanned [3 I/O per device with 16 devices]	9 ms | 6 ms | 3 ms [3 I/O per device with 16 devices using cyclic polling]	1 second [3 I/O per device with 16 devices assuming use of 50% of macrocycle]	0.5 ms @ 12 Mb/s [3 I/O per device with 16 devices using cyclic polling]
Special features	Analog available with 2.1 version masters with multi-scan 3.0 version offers diagnostic and data transfer capabilities.	EDS file used for device parameters and rapid start-up	Function blocks used for process control may be distributed into field devices. Time stamping of data optimizes control.	GSD file used for device parameters
Strengths	• Low cost • Easy to install • Easy to support • Fast • Supports high power • Flexible topology	• Interfaces to A-B • Flexible implementation • Flexible data capabilities • Supports high power • ODVA marketing	• Long length • Well supported • Convenient user objects • Extensive diagnostics • Capable of being IS	• Long length • Very fast • Well supported in Europe and North America
Weaknesses	• Short bus length • Limited data/node	• 4-20 mA instrumentation not widely available	• Moderate speed • Expensive field devices • Limited bus power	• Must have auxiliary power
Optimal applications	Use for discrete I/O where low cost and simplicity are important. May readily interface with most PLC, DCS systems. Gateways conveniently to high level protocols.	Use for discrete I/O into Allen Bradley PLCs. Also may be desirable for motor control applications.	Use for analog I/O in process or discrete I/O over long distance. Use for IS analog & discrete I/O. Supported by many process instrument manufacturers throughout the world.	Use for high speed analog and discrete I/O and for variable speed drives. Supported by European manufacturers. Ideal for high speed AS-i gateway applications.

	Profibus-PA	Modbus	IO-Link	Ethernet
	PROFIBUS	MODBUS	IO-Link	Ethernet-APL Profinet Ethernet/IP
Topology	Trunk with branching or chicken foot	Trunk/drop	Star (point-to-point from master to device)	Star (point-to-point switch/ router to device) Ring (DLR)
Max distance (Voltage drop may further limit distance)	1900 m (6200 ft) 120 m spur Using FISCO 1000 m	1200 m (4000 ft)	20 m max per drop	100 m max per drop APL: 200 m max per spur APL: 1000 m max per trunk
Max # devices	32	32	1 per connection port : typically 8 ports per gateway	100 m max between switches/ routers 1000 m max APL trunk between field switches
Cabling	Shielded twisted pair	Shielded twisted pair	3 or 5 conductor unshielded cable	Shielded twisted multiconductor
Max power delivery	Current: up to 500 mA Voltage range: 9 to 32 VDC	Current: up to 87 amps Voltage range: 11 to 25 VDC	Current: 3.5 A (combined all 8 ports) Voltage range: 18 to 30 VDC	Separate power source is normally used POE: can supply 90 W per device APL: 2 conductor Ethernet with power
Hazardous area wiring	Intrinsically Safe (IS), explosionproof and nonincendive devices; conduit, IS, tray cabling and nonincendive wiring	Explosionproof and nonincendive devices; conduit and tray cabling	Explosionproof and nonincendive devices; conduit and tray cabling	Explosionproof and nonincendive devices; conduit and tray cabling APL: 2 conductor Ethernet with power capable of I.S.
Data transfer size	1 byte variable, up to 244 bytes	1 byte variable (RTU mode)	Up to 32 bytes	64-1518 bytes or more
Bus access method	Transparent to Profibus-DP w/ coupler. Cyclic polling for data & acyclic for diagnostics & calibration with link master.	Synchronous and asynchronous poll and response	Master slave	Protocol dependent. Typically producer - consumers for cyclic data
Transmission rate	31.25 Kbit/s (IEC 61158-2)	9 Kbit/s to 56 Kbit/s	4.8 Kbit/s to 230 Kbit/s	10 Mbs / 100 Mbs / 1000 Mbs
Approximate cycle time	100 ms [3 I/O per device with 16 devices using cyclic polling]	75 ms @ 38.4 Kbit/s [3 I/O per device with 16 devices using synchronous polling]	18 ms (4.8 kB) 2.3 ms (38.4 Kb), 0.4 ms (230 kB)	<1 ms possible
Special features	Couples directly to DP in transparent manner (DP limited to 45 Kbit/sec) or links to DP as a slave/master to PA	—	IODD file used for device parameters, events, and special features	Prototcol options include: EtherCAT, EtherNet/IP, PROFINET, POWERLINK, SERCOS III, CC-Link IE, and Modbus TCP, OPC UA, Webserver
Strengths	• Long length • Well supported in Europe • Capable of being IS	• Easy to install • Easy to support • Long length • Widely used on existing DCS systems	• Easy to install • Easy to support • Easy device replace / parameterization • Widely supported on PLC/DCS systems	• Very fast • Large data volume • Moderate lengths • Widely supported on PLC/ DCS systems • Capable of being I.S.
Weaknesses	• Moderate speed • Limited bus power • Connected to control system via Profibus-DP	• Moderate speed • Must have auxiliary power	• Higher installed cost than conventional • Not a bus network, point-to-point • Connectors generally required • Limited Haz Loc gateways and devices	• Not really a bus network, point-to-point • Connectors generally used • Must have auxiliary power, POE injector, or APL
Optimal applications	Use for analog I/O in process or discrete I/O over long distance. Use for IS analog and discrete I/O. Supported by many European instrument manufacturers.	Use for field devices with discrete and analog I/O over long distances. Common legacy bus used with AS-i gateways.	Use for complex discrete field devices. Strong support in Factory Automation	Use for complex field devices with discrete and analog I/O over long distances.

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Valmet Flow Control Oy

Vanha Porvoontie 229
01380 Vantaa, Finland
flowcontrol@valmet.com
+358 10 417 5000
valmet.com/flowcontrol

Valmet Flow Control Inc.

26271 US Hwy 59
Fergus Falls, MN 56537, USA
sales.stonel@valmet.com
+1 218 739 5774

For more information,
valmet.com/flowcontrol/stonel

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