

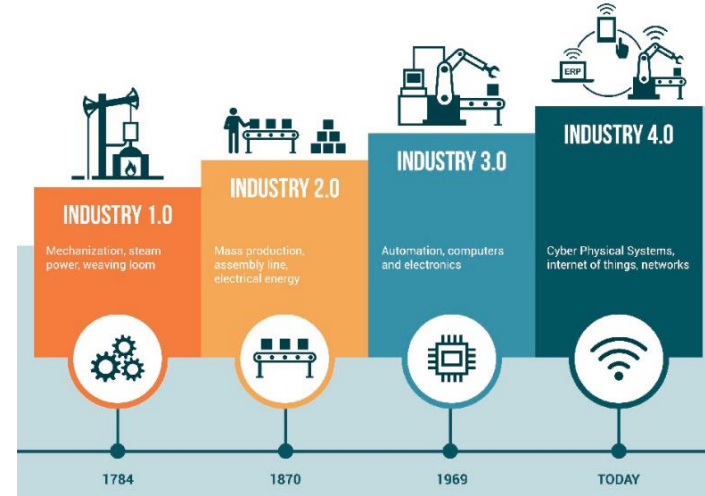


Industry 4.0: Embracing Digital Manufacturing

By Calvin Chen, Embedded Product Manager

Industrial Revolutions

- There's been three industry revolutions so far:
 - 1.0 (Mechanization) – 1784 ~ 1870
 - 2.0 (Mass Production) – 1870 ~ 1914
 - 3.0 (Computerization) – 1969 ~ 20xx
- Industry 1.0
 - The transition from skilled artisans to unskilled workers using machine powered by water or steam
- Industry 2.0
 - The dawn of mass production and assembly; electricity replaced water/steam as the primary source of power in factories
- Industry 3.0
 - The start of the computer age and automation, driven by advancements made in the electronics/computer field

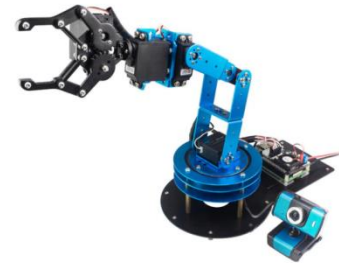


Industrial Revolutions Patterns

- Industry 1.0
 - The development of the steam powered engine
- Industry 2.0
 - Mass production
- Industry 3.0
 - The development of the modern computer
- Industry 4.0
 - The evolution of the computer/networking
- The odd numbered revolutions (1.0 and 3.0) are driven by disruptive technologies
- The even numbered revolutions (2.0 and 4.0) are characterized by the synergy of existing technologies, rather than new ones

Industry 4.0 – Cyber Physical Systems

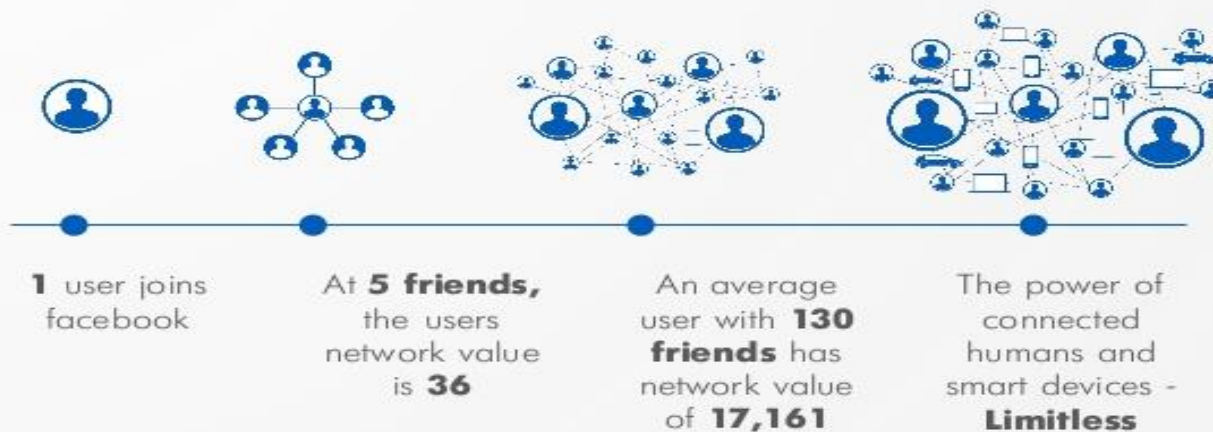
- The synergy of computers and networking
- Computers in isolation will be transformed into computers with networking capability, so they can communicate with other computers
- The advent of Cyber Physical Systems (CPS)
- CPS are an integration of computation, networking, and physical process/device
- For example, a robotic arm is a CPS
 - Computation = compute unit
 - Physical device = arm + camera
 - Networking = network port/wireless



Metcalfe's Law of Networking

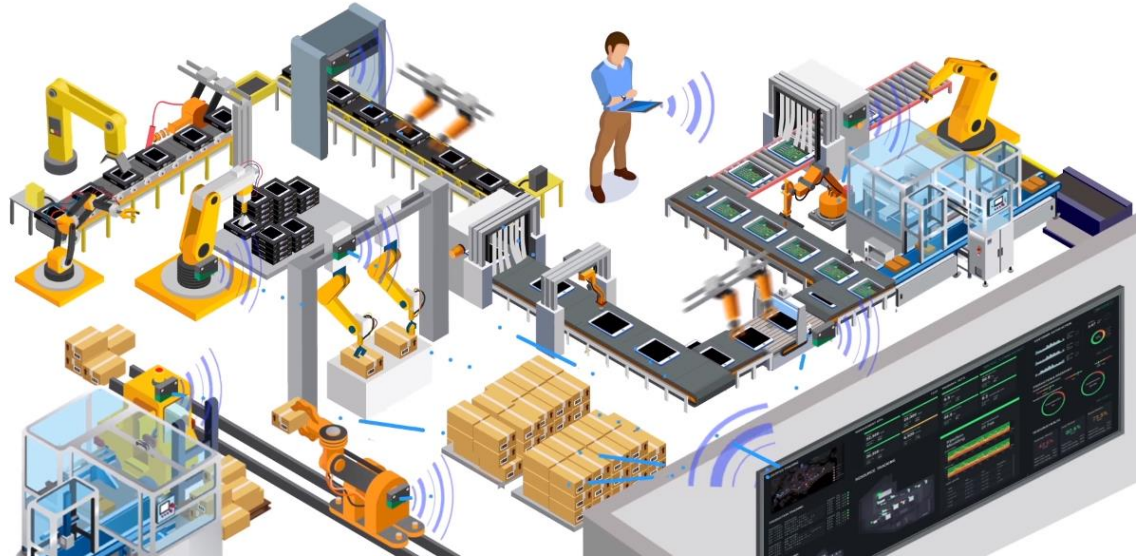
- Attributed to Robert Metcalfe, the co-founder of ethernet in 1973
- The value of a network grows almost exponentially as the number of connected devices scale up

THE NETWORK EFFECT OF CONNECTIONS – METCALFE'S LAW



Industry / Smart Factory 4.0

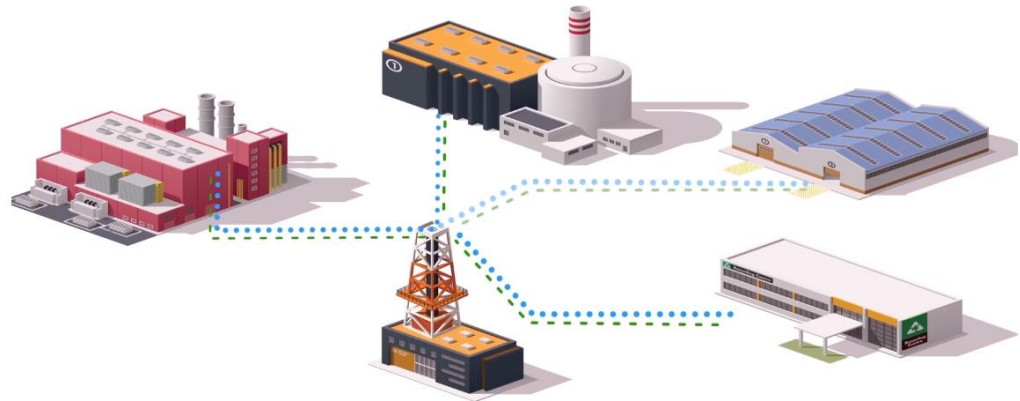
- Smart Factory 4.0 will be using CPS to perform the assembly process and to manage the dataflow
- Humans will oversee and monitor the entire operation
- CPS with enough intelligence may be able to self-monitor and self-repair itself, if needed



Connected Smart Factories

- Each smart factory will be connected to each other
- As inventory is consumed at one factory, the system can automatically send the replenishment requirement to another factory
- As units are completed, the factory can send the shipping requirement to a logistic company

Connected Factories



Embedded System Family

Basic

Fanless
Embedded
System



BCO-1000 Series
[Bay Trail]

Rugged

Fanless
Embedded
System



RCO-1000 Series
[Bay Trail]



RCO-3000 Series
[Broadwell-U]



RCO-6000 Series
(Skylake / Kaby Lake)

Machine Vision

System

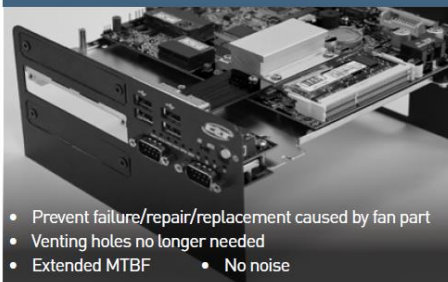


VCO-6000 Series (Skylake / Kaby Lake)

Embedded Systems Key Features

- Fanless and cableless design for better reliability and acoustics
- Industrial grade components for improved quality and longer lifecycle
- Thermal performance for fanless design
- Shock & Vibration up to 5 Grms to MIL-STD-810G compliance

Fanless Design



- Prevent failure/repair/replacement caused by fan part
- Venting holes no longer needed
- Extended MTBF
- No noise

Industrial Grade Component

- Strict component selection adopting industrial grade parts like capacitor, power choke, etc.
- Better electrical performance and more stable system performance
- Product longevity supported
- Less RMA + Longer product lifecycle= Lower TCO (total cost of ownership)

Thermal Performance



- Utilize metal material (copper and aluminum) to accomplish fanless
- Fast heat dissipation by integrated heat pipe on heat block and heat sink
- Unique thermal design that allows desktop CPU (up to 35W) to operate without fan in extended temperature range

Shock & Vibration

RCO & ACO Series comply with MIL-STD 810G on shock & vibration in order to sustain in environment like industrial automation, transportation, military, etc.



SHOCK



VIBRATION

Embedded Systems Key Features

- Single piece design for robust structure and ease of installation/assembly
- Power protection for harsh factory environment: OVP, OCP, and RP
- Extended operating temperature for durability
- Expandability for future I/O via Universal I/O+mini PCIe or PCI/PCIe slots

One-Piece Design



- Robust structure
- Less joint parts and screws for higher shock & vibration tolerance
- Easy assembly, disassembly, maintenance
- Sealed housing to prevent dust

Power Protection

- Over voltage protection
- Over current protection
- Reverse protection



Extended Operating Temperature

C&T fanless embedded systems support extended temperature to allow application in difficult and harsh environment.



Expandable & Modularization

The modular design approach helps with the ease of installation to achieve rapid deployment, and provide wide variety of configurable options to achieve scalability.

DisplayPort Port+DIO



COM Port




BCO-1000 Key Features

- Price valued embedded system
- Single LAN only
- 9~30VDC operating voltage range
- -20C to 50C operating temperature range
- Single universal I/O slot

	BCO-1000	BCO-1010	BCO-1020	BCO-1030
	Basic Fanless System ideal for space-constrained applications	Basic Fanless System with one Universal Expansion Slot	Basic Fanless System with two Universal Expansion Slots	Basic Fanless System with 8-bit Digital I/O, DVI-I/DP dual display output, and 6x COM ports
CPU Onboard	Intel® Celeron® J1900			
Memory	1x 204-pin DDR3L-1066/1333 SO-DIMM, up to 8GB			
Graphic Output	1x DVI-I (optional Display Port: BCO-1010A, BCO-1020C & BCO-1030)			
LAN	1x GbE RJ45, Intel® I210-AT (Support Wake-on-LAN and PXE)			
Storage	1x mSATA	1x mSATA & 1x Internal 2.5" SATA HDD Bay		
Internal Expansion Slot	1x SIM, 2x Full-size mini-PCIe (1x shared with mSATA)			
Power	9-30 VDC, AT/ATX Select, 3-pin Terminal Block			
Audio	Line out/Mic In Phone Jack			
Operating Temperature	-20°C to 50°C			
Dimensions (WxDxH)mm	142 x 101 x 30	142 x 101 x 41.5	142 x 101 x 58	142 x 101 x 75
Weight	TBC	TBC	TBC	TBC
Universal Expansion Slot (front)	0 (BCO-1000)	0	0	1
Universal Expansion Slot (rear)	0	1 (BCO-1010)	0	0
DP, 8-bit Isolated DIO (rear)		BCO-1010A		
2x COM (rear)		BCO-1010B		
DP, 8-bit Isolated DIO, & 2x COM (rear)			BCO-1020C	
4x COM (rear)			BCO-1020D	
DP, 8-bit Isolated DIO, & 4x COM (rear)				BCO-1030

RCO-1000 Key Features

- Dual LAN support
- Higher 9~48VDC operating voltage range
- -25C to 70C extended operating temperature range
- Up to 2 x universal I/O slot



	RCO-1000	RCO-1010	RCO-1020	RCO-1030
	Ultra compact Fanless System ideal for space-constrained applications	Compact Fanless System with one Universal Expansion Slot	Compact Fanless System with three Universal Expansion Slots	Compact Fanless System with 8-bit Digital I/O, DVI-/DP dual display output, and 6x COM ports
CPU Onboard	Intel® Atom® E3827 / E3845, or Celeron® J1900			
Memory	1x 204-pin DDR3L-1066/1333 SO-DIMM, up to 4GB			
Graphic Output	1x DVI-I (optional Display Port: RCO-1010A, RCO-1020C & RCO-1030)			
LAN	2x GbE RJ45, Intel® I210-AT (Support Wake-on-LAN and PXE)			
Storage	1x mSATA	1x mSATA & 1x Internal 2.5" SATA HDD Bay		
Internal Expansion Slot	2x SIM, 2x Full-size mini-PCIe (1x shared with mSATA)			
Power	9-48 VDC, AT/ATX Select, 3-pin Terminal Block			
Audio	Line out/Mic In Phone Jack			
Operating Temperature	-25 °C to 70 °C			
Dimensions (WxDxH)mm	150 x 105 x 37	150 x 105 x 49	150 x 105 x 65	150 x 105 x 85
Weight	0.69 kg	0.88 kg	0.98 kg	1.11 kg
Universal Expansion Slot (front)	0 (RCO-1000)	0	1	2
Universal Expansion Slot (rear)	0	1 (RCO-1010)	0	0
DP, 8-bit Isolated DIO (rear)		RCO-1010A		
2x COM (rear)		RCO-1010B		
DP, 8-bit Isolated DIO, & 2x COM (rear)			RCO-1020C	
4x COM (rear)			RCO-1020D	
DP, 8-bit Isolated DIO, & 4x COM (rear)				RCO-1030

RCO-3000 Key Features

- Higher CPU performance
- -40C to 70C extended operating temperature range
- More expandability including PCI/PCIe slots and network module; up to 6 x LAN ports or 2 x LAN + 4 x PoE LAN



	RCO-3000	RCO-3011x	RCO-3022xx
	Advanced Fanless System based on Intel® Broadwell-U processors		
	Advanced Fanless System based on Intel® Broadwell-U processors and with one PCI or PCIe x4 expansion slot		
	Advanced Fanless System based on Intel® Broadwell-U processors and with two PCI or PCIe x4 expansion slot		
CPU Onboard	Intel® Core™ i5-5350U, i3-5010U, Celeron® 3765U		
Memory	1x 204-pin DDR3L-1333/1600 SO-DIMM, up to 8GB		
Graphic Output	1x DVI-I, 1x Display Port		
LAN	2x GbE RJ45 (Support Wake-on-LAN and PXE)		
USB, Serial, & Digital I/O	2x USB 3.0, 6x USB 2.0, 4x RS-232/422/485, 8x isolated digital I/O		
Storage	2x 2.5" SATA HDD Bay (1x internal, 1x removable) and 2x mSATA (RAID 0/1/5/10)		
Internal Expansion Slot	2x Full-size mini-PCIe (shared with mSATA)		
Power	9-48 VDC, AT/ATX Select, 3-pin Terminal Block		
Audio	Speaker-out / Mic-in Phone Jack		
Operating Temperature	-40 °C to 70 °C		
Dimensions (WxDxH)	185 x 197 x 57.4 mm	185 x 197 x 85 mm	185 x 197 x 105 mm
Weight	2.16 ~ 2.54 kg	2.64 ~ 3.09 kg	2.95 ~ 3.33 kg
Universal Expansion Slot (front)	1 (RCO-3000)	2	2
Universal Expansion Slot (rear)	0	0	0
1x PCIe x4		RCO-3011E	
1x PCI		RCO-3011P	
2x PCIe x4			RCO-3022EE
2x PCI			RCO-3022PP
4-Port GbE Expansion Option in Front Universal Expansion Slot (RJ-45 or M12 with PoE option)	1	1	1

RCO-6000 Key Features

- Kaby Lake i7 quad core CPU performance
- -25C to 70C extended operating temperature range
- More expandability including PCI/PCIe slots and network module; up to 10 x LAN ports or 2 x LAN + 8 x PoE LAN



	RCO-6000	RCO-6011x	RCO-6022xx
	Superior Fanless System with LGA-1151 socket for Intel® Skylake-S processors	Superior Fanless System with LGA-1151 socket for Intel® Skylake-S processors and with one PCI or PCIe x16 expansion slot	Superior Fanless System with LGA-1151 socket for Intel® Skylake-S processors and with two PCI or PCIe x8/x16 expansion slot
CPU Support	LGA-1151 Socket for Intel® Skylake Processors (Core™ i7-6700TE, i5-6500TE, i3-6100TE, Pentium® G4400TE, Celeron® G3900TE)		
Memory	2x 260-pin DDR4-1866/2133 SO-DIMM, up to 32GB		
Graphic Output	1x DVI-I, 2x Display Port		
LAN	2x GbE RJ45 (Support Wake-on-LAN and PXE)		
USB, Serial, & Digital I/O	6x USB 3.0, 2x USB 2.0, 4x RS-232/422/485, 16x isolated digital I/O		
Storage	4x 2.5" SATA HDD Bays with RAID 0/1/5/10 support (2x internal, 2x removable)		
Internal Expansion Slot	2x SIM, 4x Full-size mini-PCIe (shared with mSATA)		
Power	9-48 VDC, AT/ATX Select, 3-pin Terminal Block		
Audio	Speaker out/Mic In Phone Jack		
Operating Temperature	-25 °C to 70 °C		
Dimensions (WxDxH)	240 x 261 x 79 mm	240 x 261 x 107 mm	240 x 261 x 127 mm
Weight	4.37 ~ 5.41 kg	TBC	5.54 ~ 6.64 kg
Universal Expansion Slot (front)	2 (RCO-6000)	2	2
Universal Expansion Slot (rear)	0	1	2
1x PCIe x16		RCO-6011E	
1x PCI		RCO-6011P	
2x PCIe x8			RCO-6022EE
2x PCI			RCO-6022PP
1x PCIe x16 & 1x PCI			RCO-6022PE
4-Port GbE Expansion Option in Front Universal Expansion Slot (RJ-45 or M12 with PoE option)	2	2	2

VCO-6000 Key Features

- Maximum expandability via multiple PCI/PCIe slots configuration
- Single side, front facing ports for ease of maintenance and installation
- Kaby Lake i7 quad core CPU performance
- -25C to 70 wide operating temperature



GPU Computing Series Key Features

- GPU is NVIDIA GTX 1050TI w/ 1.98 TFLOPS performance
- Inclusion of a system fan to control the GPU thermal profile
- Kaby Lake i7 quad core CPU performance
- 2 x universal I/O slot on RCO for expandability



VCO-6020-1050TI



RCO-6020-1050TI



Embedded Systems Designed for Industry 4.0

- Wide range of products from valued line to high-end system with maximum expandability and i7 quad core processor
- Ideal computation unit for a CPS
- Wide range temperature and voltage support for reliability in a Smart Factory 4.0 environment
- Multiple LAN support for a connected network environment

