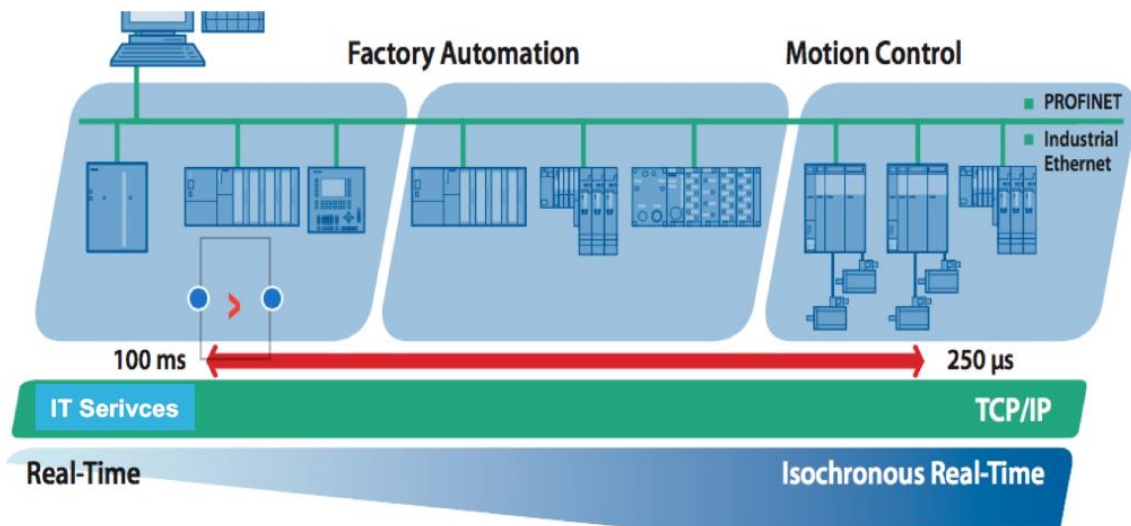


Jitter w % w komunikacji profinet jest zależny od czasu pojedynczego cyklu w sieci profinet.

Rozróżniamy 3 typy sieci profinet:

- Class A (CC-A) Cykl 100 – 512ms
- Class B (CC-B) Cykl 1 – 10ms
- Class C (CC-C) Cykl 250 micros – 1ms

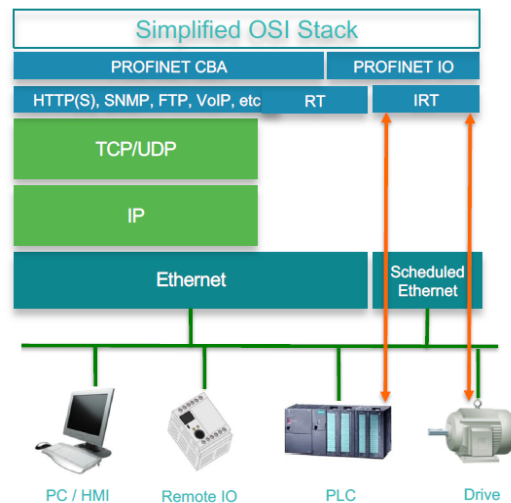
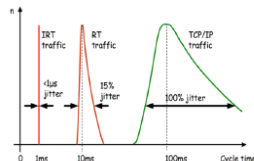
Definicja do której klasy należy ramka profinetowa jest zawarta w samej ramce przy użyciu Frame ID. Tak więc Jitter 100% dla ramki profinetowej klasy B oznacza jitter 10 ms.



| Conformance Class A (CC-A)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Conformance Class B (CC-B)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Conformance Class C (CC-C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Standard Ethernet Components</li> <li>Certified Devices and Controllers</li> <li>Infrastructure Manufacturer Certified <ul style="list-style-type: none"> <li>Copper, Fibre, Wireless (all)</li> </ul> </li> </ul> <p>Communication</p> <ul style="list-style-type: none"> <li>TCP/IP, RT</li> <li><b>Cyclic I/O (100-512ms)</b></li> <li>Alarms</li> <li>LLDP for Topology Information</li> <li>Redundancy Class 1 (Optional)</li> </ul> <p>Typical Applications</p> <ul style="list-style-type: none"> <li>Building Automation</li> </ul> | <ul style="list-style-type: none"> <li>Standard Ethernet Components</li> <li>Certified Infrastructure <ul style="list-style-type: none"> <li>Copper, Fibre</li> </ul> </li> </ul> <p>Communication</p> <ul style="list-style-type: none"> <li>LLDP-MIB for Information</li> <li>LLDP PROFINET TLVs</li> <li><b>Cyclic I/O (1-10ms)</b></li> <li>SNMP Diagnostics</li> <li>Support PDEV Profile</li> <li>Redundancy Class 1 (Required)</li> <li>Redundancy Class 2 (Optional)</li> </ul> <p>Typical Applications</p> <ul style="list-style-type: none"> <li>Factory Automation</li> <li>Process Automation</li> </ul> | <ul style="list-style-type: none"> <li>Proprietary Ethernet Components <ul style="list-style-type: none"> <li>Deterministic Ethernet - IRT</li> </ul> </li> </ul> <p>Communication</p> <ul style="list-style-type: none"> <li>IRT</li> <li>Cyclic I/O (250μs-1m)</li> <li>Time Synchronisation (PTP)</li> <li>Hardware Bandwidth Reservation</li> <li>Redundancy Class 1 (Required)</li> <li>Redundancy Class 2 (Required)</li> <li>Redundancy Class 3 (Required)</li> </ul> <p>Typical Applications</p> <ul style="list-style-type: none"> <li>Multi-axis Motion Control</li> </ul> |

# PROFINET IO – Communication Channels

- PROFINET IRT (Isochronous Real-Time)
  - Cycle times of up to 1ms with less than 1µs jitter
  - All device clock/bus cycles synchronised
  - Standard L2 Frame
  - Uses IEEE 1588 PTP – with extensions
  - Requires **proprietary** ASIC and an FPGA! CC-C
  - PROFINET IO for complex motion control traffic
    - Niche applications** - <5% typically in a factory/plant
    - Not supported by Cisco switches



## PROFINET L2 RT Frame Construction

|           | Destination MAC |                  |    |    |    |    |    | Source MAC |               |    |             | 802.1Q Tag |                 |    |    |    |    |
|-----------|-----------------|------------------|----|----|----|----|----|------------|---------------|----|-------------|------------|-----------------|----|----|----|----|
|           | 0000            | 00               | 1b | 2b | 25 | b7 | 1d | 00         | 0e            | 8c | fe          | 75         | e2              | 81 | 00 | a0 | 00 |
| Ethertype | 0010            | 88               | 92 | c0 | 01 | 80 | 80 | 80         | 55            | 80 | 23          | 00         | 00              | 00 | 00 | 00 | 00 |
| Frame ID  | 0020            | 00               | 00 | 00 | 00 | 00 | 00 | 00         | 00            | 00 | 00          | 00         | 00              | 00 | 00 | 00 | 00 |
|           | 0030            | 00               | 00 | 00 | 00 | 00 | 00 | 00         | 00            | ba | 80          | 35         | 00              |    |    |    |    |
|           |                 | PROFINET IO Data |    |    |    |    |    |            | Cycle Counter |    | Data Status |            | Transfer Status |    |    |    |    |

| Frame ID        | Data Type                   |
|-----------------|-----------------------------|
| 0x0000 – 0x00FF | Time Synchronisation        |
| 0x0100 – 0x7FFF | Real-Time Class 3 (IRT)     |
| 0x8000 – 0xBEFF | Real-Time Class 2           |
| 0xC000 – 0xFBFF | Real-Time Class 1 (RT)      |
| 0xFC00 – 0xFCFF | Acyclic Tx (Alarm or Event) |
| 0xFE00 – 0xFEFC | Cyclic Tx (Priority Event)  |
| 0xFEFD – 0xFEFF | DCP                         |

Ethertype: 0x8100 – VLAN Tagged (0x8892 inside tag)  
 Cycle Counter: Increments in 32.5µs ticks  
 Data Status: Primary, Backup, Valid, Invalid  
 Transfer Status: Reserved

### L3 Subnet-to-subnet

- 802.1Q tag is optional, EtherType 0x0800
- UDP header modified
  - Source Port is Frame ID RT\_CLASS\_1

error\_14.48.pcapng

Plik Edytuj Widok Idź Przechwytyj Analizuj Statystyki Telefonia Bezprzewodowe Narzędzia Pomoc

Zastosuj filtr wyświetlania ... <Ctrl-/>

| No. | Info                                                        | Time     | Source        | Destination   | Protocol | Length |
|-----|-------------------------------------------------------------|----------|---------------|---------------|----------|--------|
| 1   | RT1, ID:0x8000, Len: 40, Cycle:61440 (Valid,Primary,Ok,Run) | 0.000000 | Siemens_8f... | SiemensI_7... | PNIO     | 64     |
| 2   | 443 → 49190 [ACK] Seq=1 Ack=1 Win=8192 Len=0                | 0.034890 | 172.24.5.2... | 172.24.5.2... | TCP      | 64     |
| 3   | RT1, ID:0x8001, Len: 40, Cycle:61472 (Valid,Primary,Ok,Run) | 0.035814 | Siemens_8f... | SiemensI_7... | PNIO     | 64     |
| 4   | RT1, ID:0x8000, Len: 40, Cycle:40960 (Valid,Primary,Ok,Run) | 0.074899 | SiemensI_7... | Siemens_8f... | PNIO     | 64     |
| 5   | RT1, ID:0x8000, Len: 40, Cycle:40992 (Valid,Primary,Ok,Run) | 0.075894 | SiemensI_7... | Siemens_8f... | PNIO     | 68     |
| 6   | RT1, ID:0x8000, Len: 40, Cycle: 0 (Valid,Primary,Ok,Run)    | 0.135978 | Siemens_8f... | SiemensI_7... | PNIO     | 64     |
| 7   | RT1, ID:0x8001, Len: 40, Cycle: 32 (Valid,Primary,Ok,Run)   | 0.160123 | Siemens_8f... | SiemensI_7... | PNIO     | 64     |
| 8   | RT1, ID:0x8000, Len: 40, Cycle:45056 (Valid,Primary,Ok,Run) | 0.202901 | SiemensI_7... | Siemens_8f... | PNIO     | 68     |
| 9   | RT1, ID:0x8000, Len: 40, Cycle:45088 (Valid,Primary,Ok,Run) | 0.203926 | SiemensI_7... | Siemens_8f... | PNIO     | 68     |
| 10  | RT1, ID:0x8000, Len: 40, Cycle: 4096 (Valid,Primary,Ok,Run) | 0.255907 | Siemens_8f... | SiemensI_7... | PNIO     | 64     |
| 11  | RT1, ID:0x8001, Len: 40, Cycle: 4128 (Valid,Primary,Ok,Run) | 0.286001 | Siemens_8f... | SiemensI_7... | PNIO     | 64     |
| 12  | RT1, ID:0x8000, Len: 40, Cycle:49152 (Valid,Primary,Ok,Run) | 0.330909 | SiemensI_7... | Siemens_8f... | PNIO     | 68     |
| 13  | RT1, ID:0x8000, Len: 40, Cycle:49184 (Valid,Primary,Ok,Run) | 0.331932 | SiemensI_7... | Siemens_8f... | PNIO     | 68     |

Frame Number: 6  
 Frame Length: 64 bytes (512 bits)  
 Capture Length: 64 bytes (512 bits)  
 [Frame is marked: False]  
 [Frame is ignored: False]  
 [Protocols in frame: eth:ethertype:pn\_rt:pn\_io]

> Ethernet II, Src: Siemens\_8f:1f:5a (ec:1c:5d:8f:1f:5a), Dst: SiemensI\_74:e9:df (8c:f3:19:74:e9:df)

> PROFINET cyclic Real-Time, RT1, ID:0x8000, Len: 40, Cycle: 0 (Valid,Primary,Ok,Run)

FrameID: 0x8000 (0x8000-0xBBFF: Real-Time(class=1 unicast): non redundant, normal)  
 CycleCounter: 0  
 > DataStatus: 0x35 (Frame: Valid and Primary, Provider: Ok and Run)  
 TransferStatus: 0x00 (OK)  
 PROFINET IO Cyclic Service Data Unit: 40 bytes