DirectNet for MPF

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DirectNet Protocol

- Used by Direct Logic PLCs from Automation Direct
  - 205 series: DL250 and DL240 CPUs have built-in support
  - Some 305 and 405 series CPUs also support directNet
    - Some changes may be needed to support these
- Master/slave serial protocol for PLC data
- Asynchronous RS232C or RS422, 300 to 38,400 baud
- Can drive up to 90 PLCs on one serial line
  - Point-to-point or multi-drop configurations possible
  - Up to 3300 feet/1000 meters
- Provides remote access to PLC data
  - I/O points, V-memory, timers, counters, relays and stages
  - Ladder logic and internal scratchpad data also accessible
    - Remote ladder logic programming is not implemented yet
DirectNet for Bitbus at APS

- DirectNet used in APS vacuum controls since 1999
- Connected to an RS232 Bitbus Universal Gateway with custom BUG firmware
  - Implemented directNet protocol in BUG
  - Reduce Bitbus link traffic and protocol handshake delays
- Disadvantages:
  - Needs Bitbus — extra VME board, limited message size
  - BUG firmware is hard to modify and debug
  - Doesn’t support remote ladder logic programming
  - Not usable outside of APS
Why use MPF?

- Supports multi-port serial IP module (SBS Octal Serial)
  - Other ports can be used if MPF serial support is written
- Works with any drvIpac IP carrier board
- Optional secondary CPU can reduce IOC workload
- The IOC can be distant from the secondary CPU & PLC
- DirectNet for MPF was developed with
  - MPF 1-7
  - MPF Serial 1-3
  - Earlier versions might also work
Driver Structure

<table>
<thead>
<tr>
<th>ai, bi, mbbi etc.</th>
<th>ao, bo, mbbo etc.</th>
<th>dnMpfInteract.c</th>
</tr>
</thead>
<tbody>
<tr>
<td>devXiDnMpf.c</td>
<td>devXoDnMpf.c</td>
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<tr>
<td>devDnMpf.c</td>
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<td>directNetClient.cc</td>
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</tbody>
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IOC

IOC or 2nd CPU

MPF

directNetServer.cc

MPF Serial Driver
PLC Addressing

- PLCs are named in the vxWorks startup script
  
  ```
  createDnMpfPLC("VAC01", 1, "DNServ01", 0)
  ```

- Records use addresses familiar to PLC programmers
  
  `@VAC01 X24`  X-input bit 024  
  `@PLC5 V2005`  V-memory word 02005  
  `@Mu19 CTA6`  Counter 6 value  
  `@RM101 T42`  Timer 042 status bit

- Addresses are expressed in octal

- Input records can address any PLC location

- Output records can only write to locations V2000-V2777
  
  - Prevents IOC from changing PLC outputs directly
  - To control hardware, a PLC program must copy the value
  - Ensures PLC programs can avoid all interference from an IOC
Record Types Supported

Input Records:
- Binary input (bi)
- Multi-bit binary input (mbbi)
  - Reads up to 16 bits from any single PLC data word
- Multi-bit binary input direct (mbbiDirect)
  - As for mbbi
- Analog input (ai)
  - Reads a whole PLC data word
  - PLC must convert internal BCD values to Binary first
  - Input conversions (LINR field) are not supported

Output Records:
- Binary output (bo)
- Multi-bit binary output (mbbo)
  - Writes up to 16 bits to any single PLC data word
- Multi-bit binary output direct (mbboDirect)
  - As for mbbo
- Analog output (ao)
  - Writes a whole data word
  - PLC must convert from Binary to BCD if needed
Read and Write Caches

◆ Read data from a PLC is cached
  ◆ “Nearby” data values are grouped into a single request
    ◆ Locations up to 16 words (32 bytes) apart are considered “nearby”
  ◆ Periodic scanned records get cached data unless it is older than half their scan period
    ◆ Many records addressing the same location or group will not cause unnecessary repeat reads
  ◆ SCAN = I/O Interrupt can be used to process a record whenever its cache group gets new data
    ◆ At least one record in the group must initiate a read

◆ Write data uses a separate write-through cache
  ◆ Multiple bo records can safely set different bits in the same word
  ◆ IOC and PLC cannot both safely update bits in the same word
**Status Information**

- **dbior** displays per-PLC status information
  - Communications statistics (#reads, #writes, #failures)
  - Cache line ranges and timestamps
  - Cache buffer contents
- **DirectNet Interactive program for command line use**
  - Displays data from any PLC location
  - Can modify the value at any V-memory location
    - A hidden command is needed to write outside the usual limits
  - May eventually be able to update PLC ladder logic programs