Advanced Process Manager Implementation Guidelines

AP12-500

Honeywell

Implementation
Advanced Process Manager - 1

Advanced Process Manager Implementation Guidelines

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About This Publication

This publication summarizes the Advanced Process Manager (APM) implementation process, guides you to procedures and references you need to implement APMs, describes APM operations considerations in implementing and using redundant NIMs, APMMs, and IOPs, and defines the UCN Node points and Node Specific points you must build for each APM.

This publication supports TDC 3000X software Release 500.

Change bars are used to indicate paragraphs, tables, or illustrations containing changes that have been made to this manual effective with Release 500. Pages revised only to correct minor typographical errors contain no change bars.

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INTRODUCTION
Section 1

This introduction summarizes the Advanced Process Manager implementation tasks, lists reference publications, and describes implementation dependencies.

1.1 SUMMARY OF ADVANCED PROCESS MANAGER IMPLEMENTATION TASKS

While most of the information in this publication relates to Advanced Process Manager (APM) functions, APM data points, and APM operating considerations, other implementation activities must also be completed to make the APM functional. The Engineering Personality activities listed below may be affected by the implementation of an APM or must be used to implement an APM. Note that most of these activities are necessary to configure an LCN system even when an APM is not present.

See subsection 1.2 for references to instructions for each of these activities.

Activities named in `THIS TYPEFACE` are activated by targets on the Engineering Personality Main Menu.

- `UNIT NAMES`—The process units defined for each APM data point are established in this activity.

- `AREA NAMES`—The area name and descriptor for any units with APM points that will be assigned to that area are established in this activity.

- `LCN NODES`—Identifies and defines the nodes on the Local Control Network. In the case of Network Interface Modules, this activity defines the node numbers for the NIMs and the process network number for the Universal Control Network.

- `VOLUME CONFIGURATION`—The NIM checkpoint volume, &8np, the CL/PM sequences and LM ladder logic volume, &9np, and the journal volume, !2np are established in this activity. Volume &8np must have adequate storage space to accommodate the APM checkpoint data, plus space to accommodate all other devices on all of the Universal Control Networks (UCNs) in this system. Volume &9np must have adequate space to accommodate all LM ladder logic programs and all CL/PM and CL/APM sequences. Volume !2np must have adequate space to accommodate system journals, including Sequence of Events, when implemented.

- `APPLICATION MODULE`—Any AM points that are members of a control strategy that includes APM points are built in this activity. Connections to the APM points are defined in `tagname.parameter` form.

- `NETWORK INTERFACE MODULE`—Identifies and defines:
  (1) all nodes on the UCN,
  (2) the network-specific and node-specific configuration,
  (3) all APM data points, and
  (4) NIM library text for APM sequence names.

- PICTURE EDITOR, FREE FORMAT LOGS, BUTTON CONFIGURATION—Any of pictures, logs, and buttons built by these activities can access APM points, once the points are built and loaded.

- HM HISTORY GROUPS—APM data point values for which continuous history is to be collected are defined in this activity by assigning them to specific HM history groups.

- AREA DATA BASE—This activity defines how and where data for data points, including APM data points, are used and displayed in a given process area. The area database is the database loaded into a Universal Station, so that the database defines the process area monitored and controlled through the US. In addition, the area database defines where units are assigned.

- Control Language (CL)—User-written CL/APM programs are entered and compiled in this activity.

1.2 REFERENCES

1.2.1 References for Engineering Activities

- UNIT NAMES and AREA NAMES

  Network Form Instructions in the *Implementation/Startup and Reconfiguration - 1* binder

  Network Data Entry in the *Implementation/Startup and Reconfiguration - 1* binder

- VOLUME CONFIGURATION—Section 7 of the *Engineer's Reference Manual* in the *Implementation/Startup and Reconfiguration - 2* binder

- APPLICATION MODULE

  Application Module Control Functions in the *Implementation/Application Module - 1* binder

  Application Module Algorithm Engineering Data in the *Implementation/Application Module - 1* binder

  Application Module Parameter Reference Dictionary in the *Implementation/Application Module - 1* binder

  Data Entity Builder Manual in the *Implementation/Engineering Operations - 1* binder

- NETWORK INTERFACE MODULE

  Advanced Process Manager Control Functions and Algorithms in the *Implementation/Advanced Process Manager - 2* binder

  Advanced Process Manager Parameter Reference Dictionary in the *Implementation/Advanced Process Manager - 2* binder

  Data Entity Builder Manual in the *Implementation/Engineering Operations - 1* binder

- PICTURE EDITOR, FREE FORMAT LOGS, BUTTON CONFIGURATION

  Instructions for these activities are in the *Implementation/Engineering Operations - 2* binder.

- HM HISTORY GROUPS

  HM History Group Form Instructions in the *Implementation/Engineering Operations - 1* binder

  Data Entity Builder Manual in the *Implementation/Engineering Operations - 1* binder

- AREA DATA BASE

  Area Form Instructions in the *Implementation/Engineering Operations - 1* binder

  Data Entity Builder Manual in the *Implementation/Engineering Operations - 1* binder

- Control Language (CL)

  CL/AM publications in the *Implementation/Application Module - 2* binder

  CL/APM publications in the *Implementation/Advanced Process Manager* - 2 binder

  Data Entity Builder Manual in the *Implementation/Engineering Operations - 1* binder

1.2.2 References for Hardware Implementation

1.2.2.1 Site Planning

LCN Site Planning in the *System Site Planning* binder

Universal Control Network Installation in the *Installation/Universal Control Network* binder

Advanced Process Manager Site Planning in the *System Site Planning* binder

1.2.2.2 Installation and Checkout

LCN System Installation in the *LCN Installation* binder

LCN System Checkout in the *LCN Installation* binder

Advanced Process Manager Installation in the *Implementation/Advanced Process Manager - 1* binder

Advanced Process Manager Checkout in the *Implementation/Advanced Process Manager - 1* binder

1.2.2.3 Service

Five/Ten-Slot Module Service in the *LCN Service/Local Control Network - 1* binder (Network Interface Module)

Advanced Process Manager Service in the *PM/APM Service* binder

1.3 APM IMPLEMENTATION DEPENDENCIES

Figure 1-1 shows which Advanced Process Manager implementation tasks depend on information entered in other tasks. This figure does not necessarily dictate the order in which the tasks must be completed, but it does show all of dependencies that must be satisfied before the APM can be fully operational.

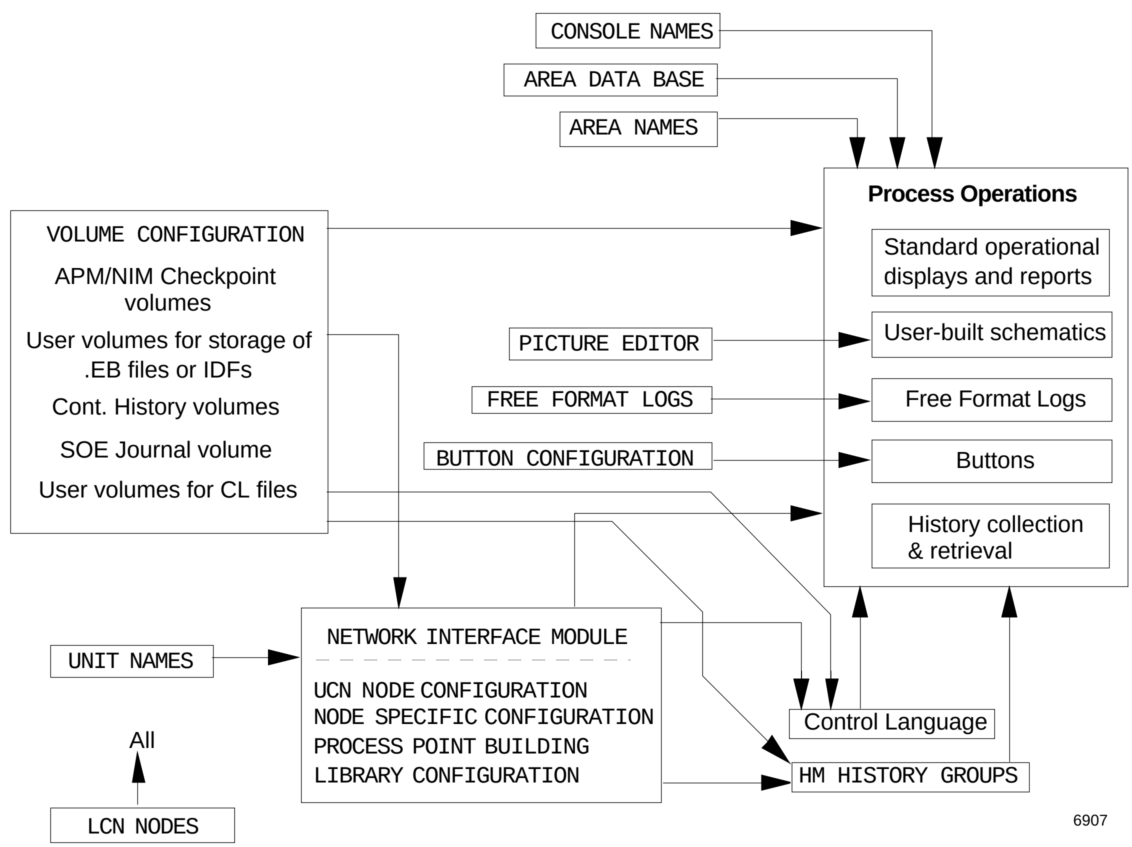


Figure 1-1 — Advanced Process Manager Implementation Dependencies

APM OPERATIONAL CONSIDERATIONS
Section 2

This section describes operational characteristics of the Advanced Process Manager that you should consider as you implement your APM(s).

2.1 THE ADVANCED PROCESS MANAGER SUBSYSTEM

The Advanced Process Manager performs data acquisition and control functions, including regulatory, logic, and sequential control. The APM offers a powerful complement of prebuilt data acquisition and control algorithms, and it executes user-prepared sequence programs written in the APM version of Control Language, CL/APM.

Figure 2-1 is a conceptual diagram of an Advanced Process Manager subsystem.

The transition from the LCN to the Universal Control Network (UCN) is made by a Network Interface Module (NIM). Usually, there is a pair of redundant NIMs.

The Advanced Process Manager consists of an Advanced Process Manager Module (APMM), I/O Processors (IOPs), and Field Termination Assemblies (FTAs) to which the process field wiring is connected. For additional reliability, APMMs can be configured as redundant pairs, as can High Level Analog Input and Output IOPs, Smart Transmitter Interface IOPs, and Digital Input/Output IOPs.

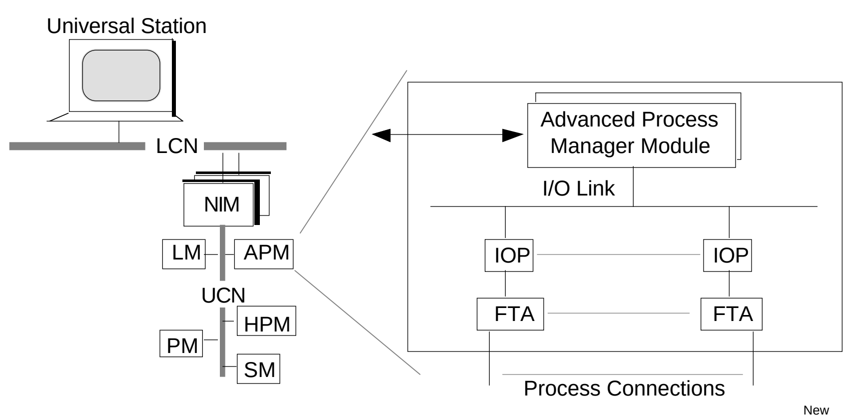


Figure 2-1 — Conceptual Diagram of an Advanced Process Manager Subsystem

2.2 NIM AND APM SUBSYSTEM REDUNDANCY

2.2.1 Redundant NIMs

NIMs can operate as redundant pairs, where one NIM is the primary and on-line, while its partner backs up the primary and maintains a copy of the primary's database. Should the primary NIM fail or be taken out-of-service, its partner takes over, becoming the new primary.

2.2.1.1 LCN and UCN Addresses for NIMs

LCN addresses for NIMs are established through the `LCN NODES` activity on the Engineering Personality Main Menu and through address pinning on the LCN interface in the node electronics. To facilitate operation and the handling of unusual situations, such as unexpected fail-overs or the separation of LCN segments, we recommend that you assign sequential addresses (odd/even) to each NIM pair.

UCN addresses for NIMs are established through the `UCN NODE CONFIGURATION` activity on the NIM Build Type Select Menu, and through address pinning on the UCN interface in the node electronics. NIMs should be assigned to the lowest UCN addresses, starting with address one. Each NIM pair uses one odd and one even address. We recommend that for possible expansion, UCN addresses one through six be reserved for NIMs, even if though fewer than three NIM pairs are actually in use.

2.2.1.2 Sequence of Events Support

Sequence of Events reporting is available with the Advanced Process Manager. For Sequence of Events to be supported on the UCN, both NIMs must be equipped with EPNI circuit boards.

2.2.2 Redundant APMMs

APMMs can be configured as redundant pairs. One of the APMMs operates as the primary and its partner operates as its backup. Should the primary APMM fail, lose communications on either network, or be taken out-of-service, its partner takes over becoming the new primary.

2.2.2.1 UCN Addresses for APMMs

Each of the partner APMMs uses one UCN address (odd) and its partner uses the next address (even). We recommend that for possible expansion, UCN addresses one through six be reserved for NIMs, even though fewer than three NIM pairs are actually in use; therefore, the first APMM could start at UCN address seven and its partner APMM would use address eight.

If the UCN has a mix of APMs and other UCN products, the first APMM in each APM uses an odd UCN address and its partner APMM (if there is one) uses the next even address. Each of the other redundant UCN products also use consecutive (odd/even) UCN addresses and each non-redundant UCN product uses one UCN address.

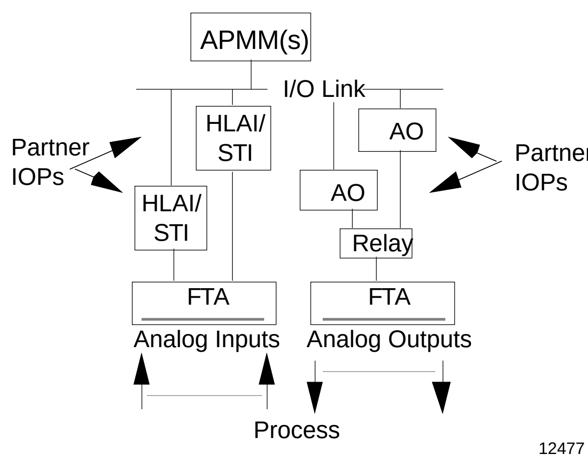
2.2.3 Redundant IOPs

The following IOPs are available as redundant partners.

- Analog Output (AO)
- High Level Analog Input (HLAI)
- Smart Transmitter Interface (STI)
- Digital Input (DI)
- Digital Output (DO)

Either one of the partner IOPs operates as the primary and the other backs up the primary. Each of the partners connects to the process through a single Field Termination Assembly (FTA).

Both the primary and backup IOPs receive all data from the UCN or from the process simultaneously, and should the primary IOP fail, the backup IOP takes over automatically, becoming the new primary IOP. Such a failover is transparent to the remainder of the system, except for Universal Station displays that show IOP status information. An IOP failover is completed in 100 milliseconds or less.



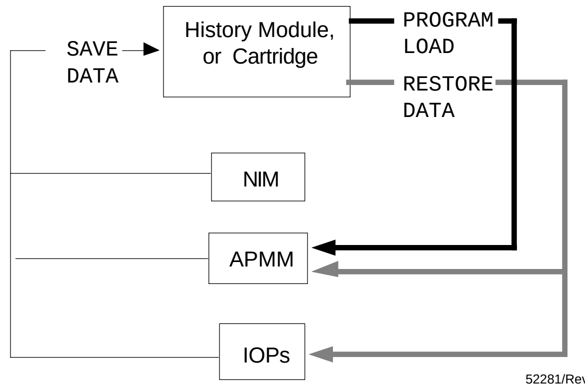
At the APM Detail Status display, you can request that the primary and backup roles for the partner IOPs be exchanged. To do this, select the appropriate IOP pair, then select `RUN STATES`, `SWAP PRIMARY`, and press `ENTER`.

Synchronization of the database in the partner IOPs is verified as the backup IOP checks that the primary IOP received and responded to each data item, and by periodic comparisons of the databases in both IOPs.

In the sketch above, both HLAI IOPs and both STI IOPs monitor the inputs from the FTA. For AO IOPs, a relay is used to direct the analog output from the primary IOP to the FTA. A diagnostic routine verifies that the interconnections between the partner IOPs are functional and that the analog-output relay makes any changeover within a predetermined time interval.

2.3 SAVING AND RESTORING OF APM INFORMATION

Three of the five load, save, and restore targets, that appear at the bottom of the UCN Status display and PM Status display when the LOAD/SAVE RESTORE target is selected, save and restore NIM and Advanced Process Manager information as indicated in this diagram.



The functions of each of the three commands is as follows:

- PROGRAM LOAD—Loads the APMM software personality image from the &1np volume on an HM, or from a cartridge or floppy, to the selected APMM in the selected Advanced Process Manager.

- RESTORE DATA—Restores point data stored in the &8np checkpoint volume on an HM, or from a cartridge or floppy, to the APMM(s) in the selected Advanced Process Manager, or to the selected IOP on an APM Status display. For more information on checkpointing, refer to Section 21 of the *Engineer's Reference Manual* in the *Implementation/Startup & Reconfiguration - 2* binder.

- SAVE DATA—Saves all point data in the NIM and the APMM(s) in the selected Advanced Process Manager into the &8np checkpoint volume on an HM, or onto a cartridge or floppy. This target requests a "demand" checkpoint. Automatic checkpointing can also save this data at the established automatic checkpoint interval for this system. For more information on checkpointing, refer to Section 21 of the *Engineer's Reference Manual* in the *Implementation/Startup & Reconfiguration - 2* binder.

2.3.1 Maintenance of Consistent NIM and APM Databases

It is possible to create inconsistent NIM and APM databases through misuse of the point loading, checkpointing, and deleting functions. These inconsistencies can cause valid control connections between points to appear to operators as invalid.

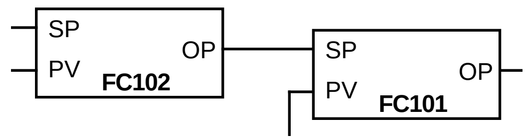
Here are three scenarios that can cause inconsistent, mismatched data in the NIM and APM:

- (1) Save NIM and APM checkpoint data. (2) Use the Data Entity Builder to build and load points in the APM. (3) Before the new APM database is saved in the checkpoint files, shut down and reload the NIM, using the unmodified checkpoint as the data source (the APM data is not restored, so it still has data for the new points, but the NIM does not).

- (1) Use the Data Entity Builder to build and load points in the APM. (2) Save NIM and APM checkpoint data. (3) Use the DEB to delete a point (this removes it from the APM and NIM databases). (4) Restore the APM database, using the checkpoint data which still has the point that was deleted (the NIM database was not restored, so the APM has data for the point that was deleted but the NIM does not).

- (1) With the NIM's LOADSCOP parameter containing NIMAndPM, use the DEB to build and load APM points. (2) Change the NIM's UCN Node Configuration entity so that LOADSCOP contains NIMOnly, then delete a point (the delete affects the NIM only; the APM still has data for the point).

As an example of the confusion that can be caused by NIM/APM database mismatches, consider the APM points in this sketch. FC102 has a control-output connection to FC101. Any of the three scenarios described above could cause the NIM to loose the tag name for FC102. An operator at a Group or Detail display is not able to see any information about FC102. Even more confusing, FC101's setpoint (SP) may be changing and its output (OP) following, even though there is no apparent input. This is because the cascade is operating properly in the APM, but due to the mismatch in NIM and APM databases, the operator can't see FC102.



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To avoid database mismatches, follow these recommendations:

- When you use the Data Entity Builder to load and to delete points, do so while UCN Node Configuration parameter LOADSCOP in the NIM contains NIMAndPM. If you need to change it to NIMOnly, be sure to change it back as soon as possible.

- Keep only one version of each of the checkpoints for each NIM/APM combination. If you have to have differing version, be aware that the NIM and APM checkpoints in different versions may not match.

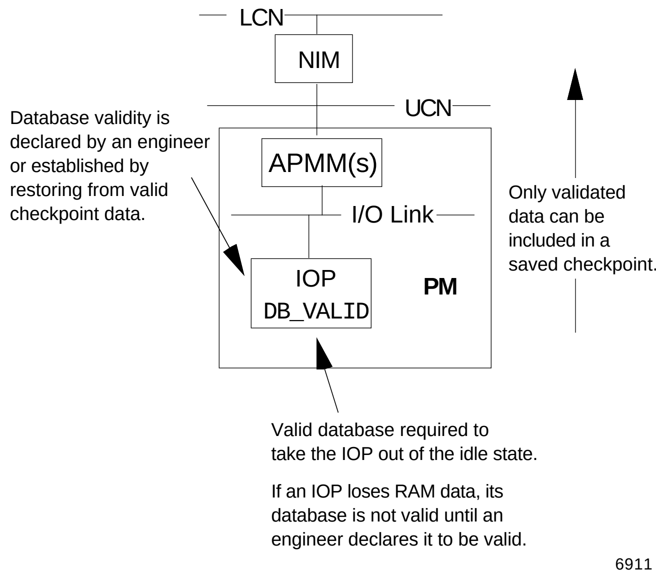
- Immediately after you load or delete points in an APM, use the SAVE DATA target on the UCN Status display or APM Status display to update the checkpoint.

- Also remember that when an APM database is saved, the entire NIM database is also saved. If points were built for another UCN node, and the database for that node was not saved, the NIM database will not match that other node.

2.3.2 IOP Database Security

An IOP cannot be changed from its idle (IDL) state to an operating state unless it has a valid database (normally, a non-idle IOP has OK status). Until the IOP is switched out of the idle state, it does not process data, and if it has an output value, that value does not change. An IOP accepts parameter value changes from Universal Stations and user-written programs only when it is not idle. Therefore, the process is protected from incorrect output changes that might occur if the IOP were started without a validated database.

In an IOP that has lost its random-access memory (RAM) data, and no point data has yet been loaded into it, all parameter values in the IOP are the default values.



These are two ways to validate an IOP's database:

- By using the RESTORE MODULE or RESTORE ALL Target on the APM Status display to restore a valid checkpoint in the IOP.
- By placing the keyswitch in the ENG position, selecting an IOP, and on the APM Status display, select RUN STATES, VALIDATE IOP DB, and ENTER.

After either of these two conditions is met, when the STARTUP target or the VALIDATE IOP DB target is selected on the APM Status display, IOPs with valid databases are shown as DB_VALID.

Therefore, an engineer can declare any IOP database as valid, but would do so only if he or she is sure that required point data has been loaded into the IOP from the DEB or by restoring the database from a valid checkpoint.

Data from an IOP with an invalid database cannot be saved; therefore, only valid data is included in the checkpoint data for an APM.

If a checkpoint restore of an IOP fails, the database is marked invalid because only a portion of the database may have been restored.

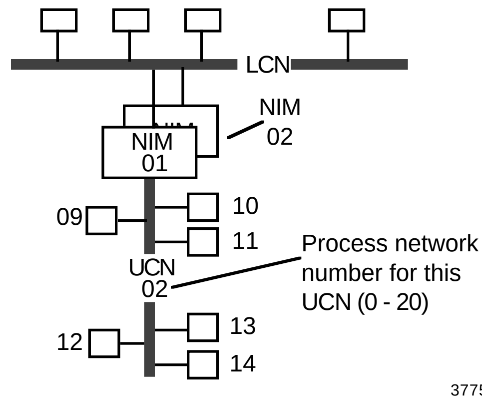
If power is removed from an IOP and restored shortly thereafter, the IOP may retain the database in its RAM, and in such a case, the database remains valid and restoration of data from a checkpoint or validating by an engineer is not necessary.

BUILDING POINTS
Section 3

This section defines the UCN node entities (points), node-specific entities (points), and process data points that must be built and loaded into the APMs.

3.1 BUILDING UCN AND NODE-SPECIFIC POINTS

A UCN point must be built for each node on a UCN, including each NIM, each APMM, and any redundant partners. Also, you must build a node-specific point for each APMM and each other node on the UCN. The UCN and LCN points are reserved entities. These entities must be built and loaded before data points can be loaded into the nodes on the UCN.



These entities are built with the Data Entity Builder. After you select `NETWORK INTERFACE MODULE` on the Engineering Main Menu, select the `UCN NODE CONFIGURATION` and `NODE SPECIFIC CONFIGURATION` picks to access the Parameter Entry Displays (PEDs) used to build them. For information about the values to be entered, refer to the *Advanced Process Manager Parameter Reference Dictionary* in the *Implementation/Process Manager - 2* binder.

For the UCN example in sketch above, the following reserved entities would be built:

UCN Node	UCN Point	Node-Specific Point
NIM, UCN node no. 1	$NM02N01	N/A
NIM, UCN node no. 2	$NM02N02	N/A
APMM (or other) node no. 9	$NM02N09	$NM02B09
.	. .	
.	. .	
.	. .	
node no. 14	$NM02N14	$NM02B14

In the example above, NIM 01 and NIM 02 are partners in a redundant node pair. The APMMs can also be paired as redundant partners (for more information, see Section 2). A UCN point and a node-specific point must be built for each APMM and all redundant partners.

3.2 DATA POINT BUILDING

Data points are also built with the Data Entity Builder. After selecting `NETWORK INTERFACE MODULE` on the Engineering Main Menu, select `PROCESS POINT BUILDING`.

The resulting menu allows you to choose one of several types of points, for example Analog, Digital, Process Module, etc. Pulse Input points, and Smart Transmitter Interface points are subsets of Analog Input points.

If you choose Regulatory PV or Regulatory Control points, an additional menu on the second page of these displays allows you to choose further sub-types of those points such as Summer, Totalizer, PID, or Rampsoak points.

Process data point building consists of selecting options and entering parameters into the parameter entry screen displays and then loading the set of point specifications. Refer to the *APM Control Functions and Algorithms* manual for information about each point type. Refer to the *APM Parameter Reference Dictionary* for parameter details. The *System Startup Guide* contains brief examples of data point building.

Points can only be loaded when the designated slot is in the inactive state, or the IOP containing the designated slot is in the Idle state. Points are loaded by selecting appropriate targets on the Data Entity Builder’s Command Menu or from the Parameter Entry Display by pressing a function key. The *Process Operations Manual* explains how to make points active or inactive. Deleting a point leaves that slot active with default parameters as a database. Individual slots can be set to inactive status through the Slot Summary display.

You can either store a copy of the parameter entry data to an Intermediate Data File (IDF) or to an Exception Build file. The IDF store is easier, but the Exception Build file is more adaptable for use in another system, or in later release software and the parameters can be edited using the Text File Editor. Refer to the *Data Entity Builder Manual* for the procedures. Once the points are loaded and the database is set valid, the entire database can be checkpointed (saved) in a format that is easily reloaded in mass.

While building points, you may need to specify I/O connections to other points. The other points can be built as described above or they can be denoted as untagged (hardware reference) points. An untagged point is built by specifying a syntax that refers to the IOP type, IOP card number, slot number and parameter, all preceded by an exclamation point; for example, !AO12S03.OP. The complete format is explained in the *APM Control Functions and Algorithms* manual for applicable points. Untagged points are easy to specify and do not deduct from the maximum NIM point count. The disadvantage is that they are relatively invisible in the system and operators or maintenance technicians may not be aware of their presence. Therefore, you should keep careful records of the IOPs and slots where untagged points are implemented or use the Find Names utility to list them. Like tagged points, the slot must be inactive or the IOP idled to load them. You can check the slot status on the Slot Summary display.

3.3 RECONFIGURATION

There are several occasions when you may wish to reconfigure the APM data base:

- To add an IOP
- To delete an IOP
- To change from one IOP type to another
- To add control points
- To delete control points
- To change the scan rate

If you wish to replace an existing IOP with the same type (for example, a later revision), no reconfiguration is necessary. The IOP may be replaced with power on and the process running.

Note that changing from one IOP type to another amounts to deleting one IOP and adding another. The various procedures are discussed in the following paragraphs.

Before starting you should —

- call up the UCN Status Display and fix any Soft Fail or Part Fail errors
- chekpoint the APM (save the data) to a cartridge and to the HM so that you can return to the original configuration if necessary.

You will find it helpful to have the *Command Processor Operation* manual (for Find Names functions) and the *Data Entity Builder* manual (to reconstitute/load points/delete points) available. Section 7 in the *Advanced Process Manager Service* manual provides information on inserting and removing the physical IOP board.

3.3.1 To Add An IOP

The IOP card can be inserted with power on and the process running.

Then, reconstitute the Node Specific configuration file, NMnnBxx (where nn = the Network number and xx = the node number on the UCN). The procedure follows.

To reconstitute the Node Specific configuration file—

- Select NETWORK INTERFACE MODULE from the Engineering Menu
- Select NODE SPECIFIC CONFIGURATION from the NIM BUILD TYPE Menu
- Enter the desired Network Number and Node Number into the NODE SPECIFIC CONFIGURATION display. If the word UNENTERED appears at the top, press ENTER until it disappears (repeat if necessary).
- Hold the CTRL key down and press 7.

The Parameter Entry Display should now contain a copy of the values that were loaded into the system. The following steps change the values and reload the APM.

- Page forward to the IO MODULE CONFIGURATION section and make the necessary changes (select IOP types and enter file/card numbers).
- To load the new configuration hold the CTRL key down and press ~ (F12)
- Hold the CTRL key down and press 9 (F9) to return to the NIM BUILD menu.

> **NOTE**
>
> If you added an SOE card, you must also reconstitute the NIM entity under UCN NODE CONFIGURATION and set the TIMESYNC parameter to ENABLED. Then, reload the NIM entity as above.

- Select the Process Point Building target for the Point Build Menu. Choose a point type for the new IOP and configure points as needed.
- You can load each point by holding the CTRL key down and pressing ~ (F12) or you can write each point to an IDF and then execute a LOAD MULTIPLE.
- Manually checkpoint to the HM (twice) and to the backup media (twice).

3.3.2 To Delete An IOP

For the IOP being removed—

- Make sure that no points exist for those slots. If you do not have adequate records, you can reconstitute each slot for that IOP and make a list. Note that this will not locate hardware reference points (such as !DO03S05.SO). If you think hardware reference points were built for for this IOP, try to find them using the Find Names function (refer to the Command Processor manual).

- Use Find Names to determine where each point is used. Delete those point references in CL programs and schematics. They will have to be recompiled. Point references in the Area Data Bases must be deleted. You must reinstall the Area Data Base, but if new points will be added to either the area or schematics or CL programs, wait until that is done.

- Set each point in the IOP module to INACTIVE or
- Set the IOP module to IDLE.

- Delete all points in the IOP.

- Reconstitute the Node Specific configuration file, NMnnBxx (see 3.3.1 for a procedure) and change the IOP module to NONE. Or, if it is being replaced by another IOP, this is the time to configure the new IOP type.

- To load the new configuration hold the CTRL key down and press **~** (F12).

- Hold the CTRL key down and press 9 (F9) to return to the NIM BUILD menu.

> **NOTE**
>
> If you deleted an SOE card, you must also reconstitute the NIM entity under UCN NODE CONFIGURATION and set the TIMESYNC parameter to DISABLED. Then, reload the NIM entity as above.

- Manually checkpoint to the HM (twice) and backup media (twice).

The IOP card can be now be removed with power on and the process running.

3.3.3 Changing The Control Point Mix or Scan Rate

The point mix and the scan rate are configured as a part of the APM Box Data Point. This is viewed at the Universal Station, on the Node Specific Configuration display. These are the choices for Regulatory PV and Regulatory Control points, and the flag, logic, numeric, digital composite points, etc. preceding the SCANRATE parameter on the configuration display. SCANRATE refers to the Regulatory/Logic point scan cycle (REG1LOG1, etc.).

To change the point mix and/or the scan rate—

- Set the APM to IDLE. If you can access the UCN Status display from another US, this step can wait until you are ready to load the new configuration.

- If you are deleting control points, use the Find Names function to determine where those points are used (refer to the *Command Processor* manual). Delete the point references in CL programs and schematics.

- Create a Selection List of all APM control points (but not IOP resident points).A selection list is just a list of points in a file. For the procedure, refer to Section 7 in the *Data Entity Builder Manual*. The UCN Status Display's Point Summary List, your IDF files, and good records can help you to build the Selection List.

- Using the Selection List created above, either Reconstitute Multiple to an IDF file, or Print System Entities to an exception build file. Section 7 in the *Data Entity Builder Manual* describes these procedures. In brief, select the Command Menu. Then*—

  To Reconstitute to an IDF file—

  Select Reconstitute Multiple
  Enter a Reference Path Name (for example NET>nnnn>)
  Enter a pathname for the IDF file (for example CTLPNTS.DB)
  Enter the pathname name for your Selection List (for example SLIST.EL)
  Press Enter. Wait for the operation to complete.

  To Print System Entities to an Exception Build file—

  Select Print Entities
  Select Print System Entities
  Enter a Reference Path Name (for example NET>nnnn>)
  Enter the pathname name for your Selection List (for example SLIST.EL)
  Enter a Destination pathname for the exception build file (for example EXFILE.EB)
  Press Enter. Wait for the operation to complete.

  The IDF file (.DB) or the Exception Build file (.EB) will be used later to reload the control points.

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*For the examples shown, when you only specify a file name, the Reference Path Name is prefixed to form a complete path name. If any files are on removable media, specify the full path name.

- Reconstitute the Node Specific Configuration file (see 3.3.1 for a procedure) and enter the necessary changes.

- To load the new configuration hold the CTRL key down and press F12 (the APM must be in IDLE).

NOTE

If you increase the Scan Rate, more Processing Units are required (Refer to section 3 in the *APM Control Functions and Algorithms manual*). If you exceed the Processing Units limit, the configuration changes are not loaded.

To reload the control points from your IDF or Exception Build file, go to the Command Menu. Then—

- To reload from an IDF file—

  Select Load Multiple
  Enter a Reference Path name
  Select With Overwrite
  Enter a pathname name for the IDF file (for example CTLPNTS.DB)
  Press Enter. Wait for the operation to complete.

- To reload from an Exception Build file—

  Select Exception Build
  Enter a reference pathname
  Select With Overwrite
  Select Load Entities
  Enter a pathname for the exception build Source file (for example EXFILE.EB)
  Enter a pathname for the IDF file for example BADPNTS.DB). This is for points that don't load (if any), but a file name is required.
  Press Enter. Wait for the operation to complete.

- Restart the APM.

- Manually checkpoint to the HM (twice) and to the backup media (twice).

At this point, you will probably want to go build control points as allowed by the new configuration.

NIM LOADING AND PERFORMANCE
Section 4

This section describes methods for estimating Network Interface Module loading and assessing the results of your estimates. Also described is the implementation of a second NIM (or NIM pair) on a UCN, to share the processing load.

4.1 ESTIMATING NIM LOADING

Tables 4-1 and 4-2 provide an example of NIM loading estimates for the NIM in a performance cluster with one APM on the UCN, three Universal Stations, one History Module, and one Application Module, (for more information about a performance cluster, refer to the *Engineer's Reference Manual*). The HM contains APM checkpoints and continuous history.

The Universal Stations are used to view standard displays and two custom schematics. Each custom schematic contains 250 parameters, 50 of which are on fast update. Refer to Table 4-3 for added schematic Load Factors. Refer to the Set Collection command in the *Picture Editor Reference Manual* for more information on fast update.

Use Table 4-1 for systems with a 68020 NIM and Table 4-2 for systems with a 68040 NIM. 68020 and 68040 refer to the NIMs microprocessor type. If the NIM contains a K4LCN board, it is a 68040 NIM. If not, it is a 68020 NIM.

A NIM load estimate is calculated by multiplying the value you entered in the Number column by the factor in the Load Factor column, entering the results in the Induced Load column, and adding the values in the Induced Load column. Comments following the tables explain more about the considerations. In the first example, the total induced load is 625, which is 62.5% of the maximum load allowed for a NIM.

You should make a loading estimate for each NIM in your system. If you have several NIMs, consider using a spread sheet on a personal computer to do your calculations. The following comments along with Tables 4-1 and 4-2 help to further explain the process:

General —

- Indicate the number of active LCN nodes, that is, those that are principally accessing information from the UCN resident devices. For the History Module, this means continuous history. Then apply the load factors as explained below.

- **Redundant Nodes**—Count redundant node pairs (NIMs, AMs, APMMs, HPMMs, PMMs, LMs and SMs) as one node.

Table 4-1 — 68020 NIM Loading Estimator

Load Sources	Units to be entered in Number column	Number	Load Factor	Induced Load
US Induced Load				
Universal and U^{X}S Stations	Number principally accessing this NIM	3	15	45
Fast Schematic Displays	Number principally accessing this NIM	2	85	170
UCN Induced Loads				
PMs, APMs, HPMs, LMs and/or SMs on the UCN	Number of PMs, APMs, HPMs, LMs and SMs on the UCN	10	10	100
History Module Induced Load				
Continuous History:				
68020 HM (2400 Points per minute)	Number of HMs principally accessing this NIM	1	30	30
68040 HM (3000 Points per minute)	Number of HMs principally accessing this NIM	0	40	
Checkpoints	Number of HMs checkpointing this NIM	1	70	70
AM and A^{X}Ms Induced Loads (90 Points/second)				
AMs with 68020 microprocessor	Number principally accessing this NIM	1	150	150
AMs with 68040 microprocessor	Number principally accessing this NIM	0	200	
CG Induced Loads				
Computer Gateways (100 parameters/second)	Number principally accessing this NIM	1	60	60
			Total Induced Load:	**625**
			Maximum Allowable Load:	**1000**
			% of maximum allowable load:	**62.5**

Table 4-2 — 68040 NIM Loading Estimator

Load Sources	Units to be entered in Number column	Number	Load Factor	Induced Load
US Induced Load				
Universal and U^{X}S Stations	Number principally accessing this NIM	3	6	18
Fast Schematic Displays	Number principally accessing this NIM	2	35	70
UCN Induced Loads				
PMs, APMs, HPMs, LMs and/or SMs on the UCN	Number of PMs, APMs, HPMs, LMs and SMs on the UCN	10	4	40
History Module Induced Load				
Continuous History:				
68020 HM (2400 Points per minute)	Number of HMs principally accessing this NIM	0	12	0
68040 HM (3000 Points per minute)	Number of HMs principally accessing this NIM	1	16	16
Checkpoints	Number of HMs checkpointing this NIM	1	28	28
AM and A^{X}Ms Induced Loads (90 points/second)				
AMs with 68020 microprocessor	Number principally accessing this NIM	0	60	0
AMs with 68040 microprocessor	Number principally accessing this NIM	1	80	80
CG Induced Loads				
Computer Gateways (100 parameters/second)	Number principally accessing this NIM	1	24	24
			Total Induced Load:	**276**
			Maximum Allowable Load:	**1000**
			% of maximum allowable load:	**27.6**

Schematics—

- Assume that the schematics are principally accessing this NIM.
- For every Universal Station there is a base load factor as shown in Table 4-1 or 4-2. Add to this the load factor from Table 4-3 —

Table 4-3— Schematic Load Factor

Total Parameters in Schematic	Number of Parameters on Fast Update	Added Load Factor 68020	Added Load Factor 68040
100	0	0	0
100	50	65	26
150	0	5	2
150	50	70	28
200	0	15	6
200	50	75	30
250	0	20	12
250	50	85	34

HMs—

- The checkpoint load factor is in addition to the History Module factor. The 68020 HM Continuous History load factor is based on a HM with a 68020 processor collecting history for 2400 points per minute. The 68040 HM Continuous History load is based on a HM with a 68040 processor collecting history for 3000 points per minute.

AMs and A^{X}Ms—

- The AM load factor is based on a fully-loaded AM accessing data from this NIM. A fully loaded 68020 AM processes 90 points per second. A fully loaded 68040 AM processes 120 points per second.

CGs—

- The CG load assumes that it is requesting 100 parameters per second from the NIM.

4.2 ASSESSMENT OF NIM LOADING

The following are the NIM loading categories:

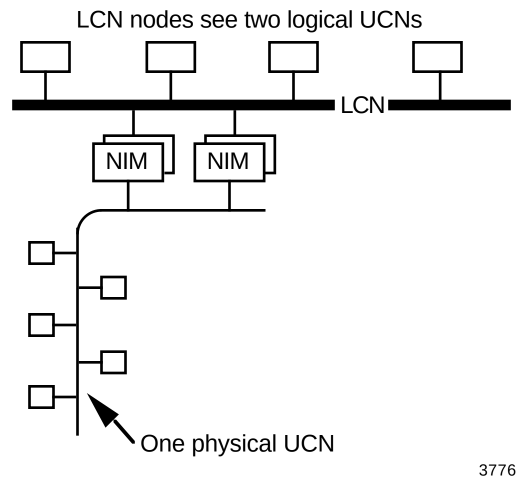
- A NIM whose total induced load is 750 (75%) or less can be expected to perform as specified under all actual system-use conditions.
- If the total induced load is between 750 and 1000 (75% to 100%), the NIM load is marginally acceptable, and display of information from this NIM and its reporting of events may occasionally be sluggish, especially during a process upset or a peak load such as multiple point loading.
- If the total induced load is above 1000 (100%), the NIM should be considered overloaded, and should a failover to the backup NIM or some other system upset occur, the view to the process may be temporarily lost.

4.3 USE OF A “REMOTE” NIM TO SHARE PROCESSING LOAD

An additional NIM (redundant NIM pair) can be added to the UCN and the LCN to share the processing load with another NIM. To use such a NIM, you must adhere to certain rules for point assignments and operational practices.

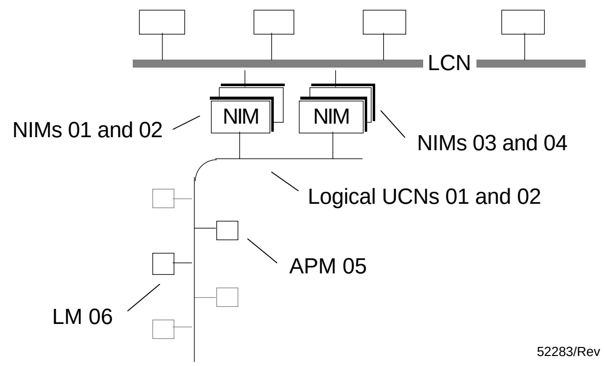
4.3.1 Implementation of Two Logical Process Networks

From the LCN viewpoint, the two NIMs (redundant NIM pairs) are on separate process networks, even though they are connected to the same physical UCN. The first NIM (configured as ThisNIM) is assigned to process network n (n is in a range from 1 to 20; each UCN and each Data Hiway is one process network) and the second NIM (configured as RemotNIM) is assigned to process network n+1. The assignment of the network numbers is arbitrary, but consistent, logical assignment simplifies operating practices.



The NIMs to be configured as ThisNIM and RemotNIM and their process networks must first be defined in the NCF through the Engineering Personality’s `LCN NODES` activity. Then, all of the UCN nodes, including the NIMs, are defined on both process networks by building UCN entities (NIM points) and Node Specific entities (box points). In the UCN Node entities, about half of the nodes on each process network are configured with NODEASSN = ThisNIM and the remainder with NODEASSN = RemotNIM. Each node assigned as ThisNIM on process network n is assigned as RemotNIM on n+1, and each node assigned as ThisNIM on process network n+1 is assigned as RemotNIM on network n.

For example, for the UCN node numbers in this sketch, you would build the following UCN node and node-specific entities:



Node	UCN	UCN Entity Name	NODEASSN	Node Specific Ent. Name
NIM 01	01	$NM01N01	ThisNIM	N/A
NIM 02	01	$NM01N02	ThisNIM	N/A
NIM 03	01	$NM01N03	RemotNIM	N/A
NIM 04	01	$NM01N04	RemotNIM	N/A
APM 05	01	$NM01N05	ThisNIM	$NM01B05
LM 06	01	$NM01N06	RemotNIM	$NM01B06
NIM 01	02	$NM02N01	RemotNIM	N/A
NIM 02	02	$NM02N02	RemotNIM	N/A
NIM 03	02	$NM02N03	ThisNIM	N/A
NIM 04	02	$NM02N04	ThisNIM	N/A
APM 05	02	$NM02N05	RemotNIM	$NM02B05
LM 06	02	$NM02N06	ThisNIM	$NM02B06

As you build process points to reside on the two logical UCNs, assign approximately equal numbers of points to each UCN (parameter NTWKNUM), but take care to assign points that use peer-to-peer communication to the same UCN (peer-to-peer communication is through connections from points in one logical UCN node to points in other nodes on the same logical UCN).

NOTE

All nodes must be assigned to both UCNs (some local, some remote). This is necessary to assure proper UCN cable handling.

4.3.2 Operational Considerations for Two Logical Process Networks

Use of the SAVE DATA target to checkpoint data from the UCN nodes and the restoration of checkpoint data to the nodes can be accomplished only from the UCN Status display for the process network the nodes are assigned to (NODEASSN = ThisNIM). If you try from the wrong display, a “node assignment” error message appears. If some of the points in a UCN node are assigned to process network n and others are assigned to process network n+1, you will have to use SAVE DATA twice, once from each UCN Status display.

For automatic checkpointing to save all data, it must be enabled through the UCN Status displays for both process networks and for each UCN node to be auto-checkpointed.

Alarming, message transfers, and event-initiated processing are handled by the NIMs and no special operational considerations are required.

4.3.3 Functional Relationships of Two Logical Process Networks

Successful implementation and use of two NIMs and logical process networks that share processing loads is more likely if you understand the relationships described here.

The UCN node configuration establishes the relationships of the two NIMs (or two pairs of redundant NIMs) and the two logical process networks. For example, NIMs are assigned to the appropriate UCN through configuration.

The relationships of APMs to the NIMs is defined in the UCN node point parameter NODEASSN, which contains either ThisNIM or RemotNIM. Two UCN node entities are configured for each UCN node, one on each process network. The APM’s points are processed by the NIM on the process network for which the APM's NODEASSN value is ThisNIM.

UCN nodes configured with NODEASSN = RemotNIM appear on the UCN Status display for the process network associated with the NIM that is not processing their points, even though they don’t logically belong to that network. The boxes for UCN nodes that logically belong to a process network are green and the boxes for nodes that logically belong to the other process network are yellow.

Because process points are assigned to a process network as the points are built, an APM, can contain points that belong to one network and other points that belong to the other network. A point’s database resides partly in the APM and partly in the NIM that has the same process network assignment as the point.

Consider this checkpointing example for process networks 1 and 2: when the data for an APM is checkpointed, all point data for the APM is saved in the checkpoint directory for process network 1, but the NIM-resident data for the points assigned to network 2 is not saved until another checkpoint operation saves the data for network 2 in the directory for that network.

SERIAL DEVICE INTERFACE IMPLEMENTATION
Section 5

This section describes methods to connect various devices to the Advanced Process Manager through a Serial Device Interface.

5.1 GENERAL IMPLEMENTATION INFORMATION

The Serial Device Interface (SDI) allows various devices to be easily connected to the APM. Field Termination Assemblies (FTA) connected between the device(s) and the SDI I/O Processor (IOP) contain firmware to map the device data so that it mimics data from a Smart Transmitter. Each type of device uses a corresponding type of FTA designed to process the I/O and return any status or control signals required by that type of device.

The SDI IOP itself must be configured as a Smart Transmitter Interface module (STIM). Note that up to two SDI FTAs can be connected to each SDI IOP. The first FTA uses the first 8 STI points; the second uses STI points 9 – 16. Each FTA can support one specific device type.

The following standard interfaces are currently supported:

- Manual Auto Station
- Toledo Weigh Scale, Models 8142-2089
- Toledo Weigh Scale, Models 8142-2189
- UDC 6000 Process Controller

Other SDI Interfaces are being developed. Contact Honeywell for more information.

Section two of the *Advanced Process Manager Control Functions and Algorithms* manual describes the characteristics, constraints, and operating considerations for SDI options. It also provides charts showing how the critical parameters relate between the APM and the serial device.

The remainder of this section discusses the unique implementation of each Serial Device Interface option.

5.2 MANUAL/AUTO STATION IMPLEMENTATION

Physical installation of the Manual/Auto Station is described in the *Advanced Process Manager Installation Manual* and in the *Manual/Auto Station Installation/Operation* manual (see References).

Only the following configurations are supported per FTA to avoid a soft failure diagnostic timeout.

Table 5-1 — Supported M/A Configurations

Full Configuration	Plus Basic Configuration	Number of Active M/A Stations Per FTA
4	0	4
3	1	4
2	2	4
1	3	4

APM implementation typically requires that you build a PID Regulatory Control point, configure the SDI IOP as an STI module (during Node Specific Configuration), and build supporting logic gates.

Some of the logic gates described in this section are optional and are used to write the following information back to the Manual/Auto Station:

- valve position
- the alarm state
- the override flag

Figure 5-1 illustrates the signal flow necessary to fully implement each M/A Station. In this drawing and those that follow, RegCtl refers to the Regulatory control point; SDI refers to the SDI IOP configured as an STI point, and Logic refers to a logic point.

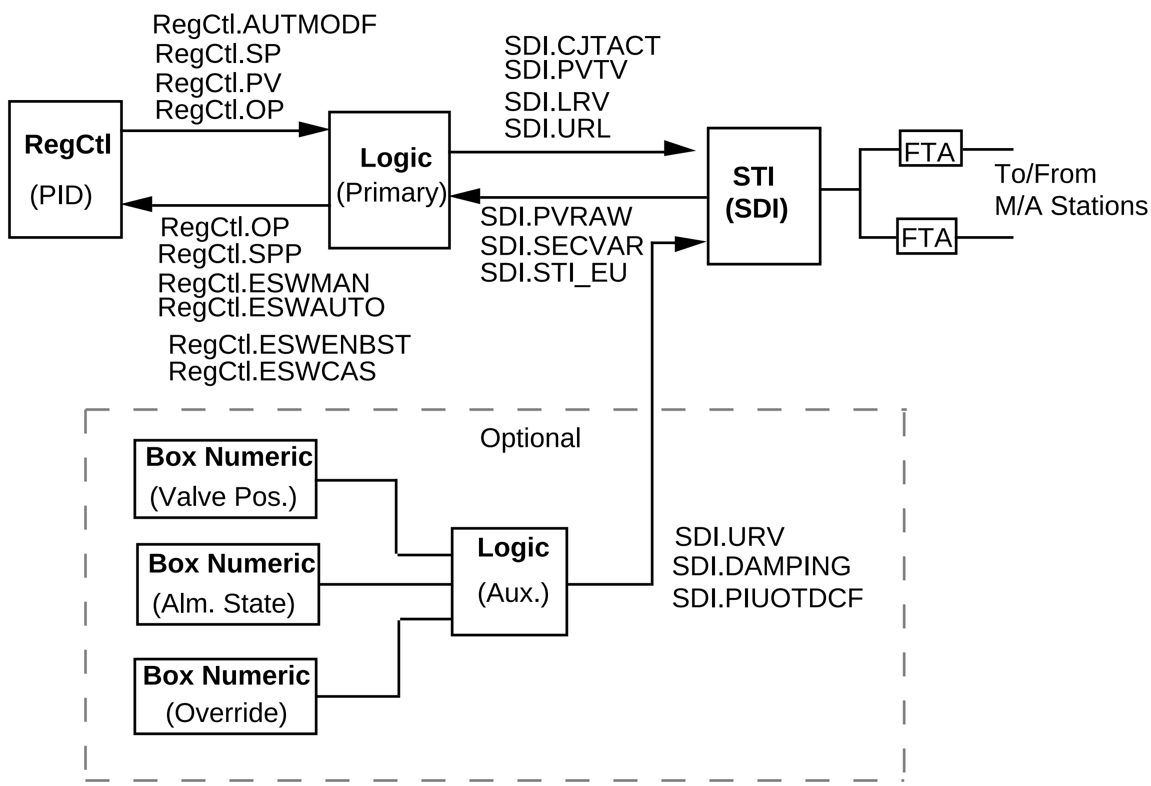


Figure 5-1 — Manual/Auto Station Implementation Strategy

5.2.1 Input Functions from the Manual/Auto Station

Signals sent from the Manual/Auto Station include mode change requests, also Setpoint and OP change requests along with the Setpoint and OP values. The configuration needed to handle these signals is discussed in the following paragraphs.

5.2.1.1 Setpoint and Mode Change Requests

The Manual/Auto Station request for an SP, OP, or mode change is determined by a change in the value of parameter STI_EU. Figure 5-2 shows how the primary logic point in the APM is configured with a series of “Equals” blocks to detect values of 1, 3, or 4. The value of STI_EU is normally 0, but temporarily changes to 1 through 4 depending on the request (refer to the *Advanced Process Manager Control Functions and Algorithms* manual).

A Setpoint change request causes SO1 to enable the PVRAW value through logic block Output 1. PVRAW is the desired setpoint from the Manual/Auto Station.

When there is a manual or auto mode change request from the Manual/Auto Station, STI_EU enables SO3 or SO4, respectively, to turn on the appropriate external switching flag to the regulatory control point.

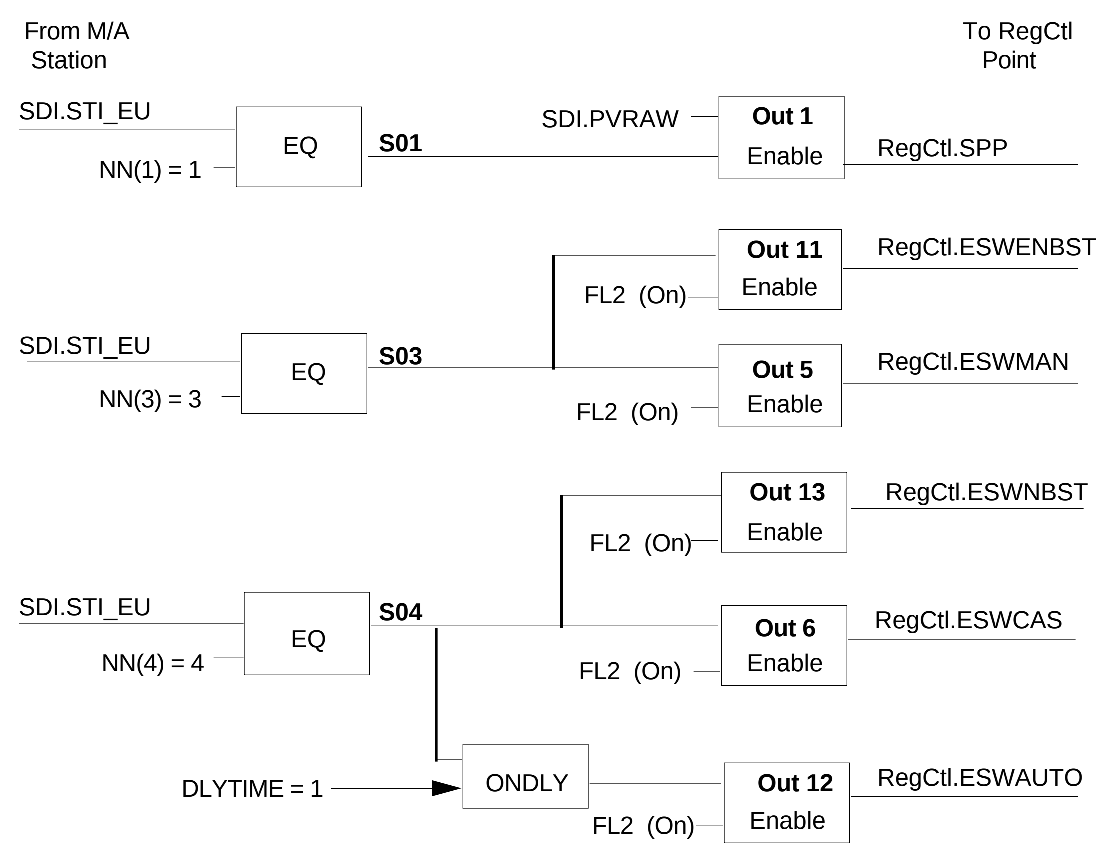


Figure 5-2 — Setpoint and Mode Change Request Strategy, APM New

5.2.1.2 OP Change Requests

In an APM, the mode attribute parameter (MODATTR) for the regulatory control point must be set to PROG before the OP parameter can be changed by a logic point. Figure 5-3 shows the strategy. When the STI_EU parameter's value equals two indicating an OP change request, logic gate SO2 triggers logic gate Out 4 setting the mode attribute to PROG. The ONDLY gate then enables the requested OP value in the SECVAR parameter through gate Out 2. Finally, as ONDLY turns off, gate Out 3 switches the mode attribute back to OPER. Figure 5-4 illustrates the timing.

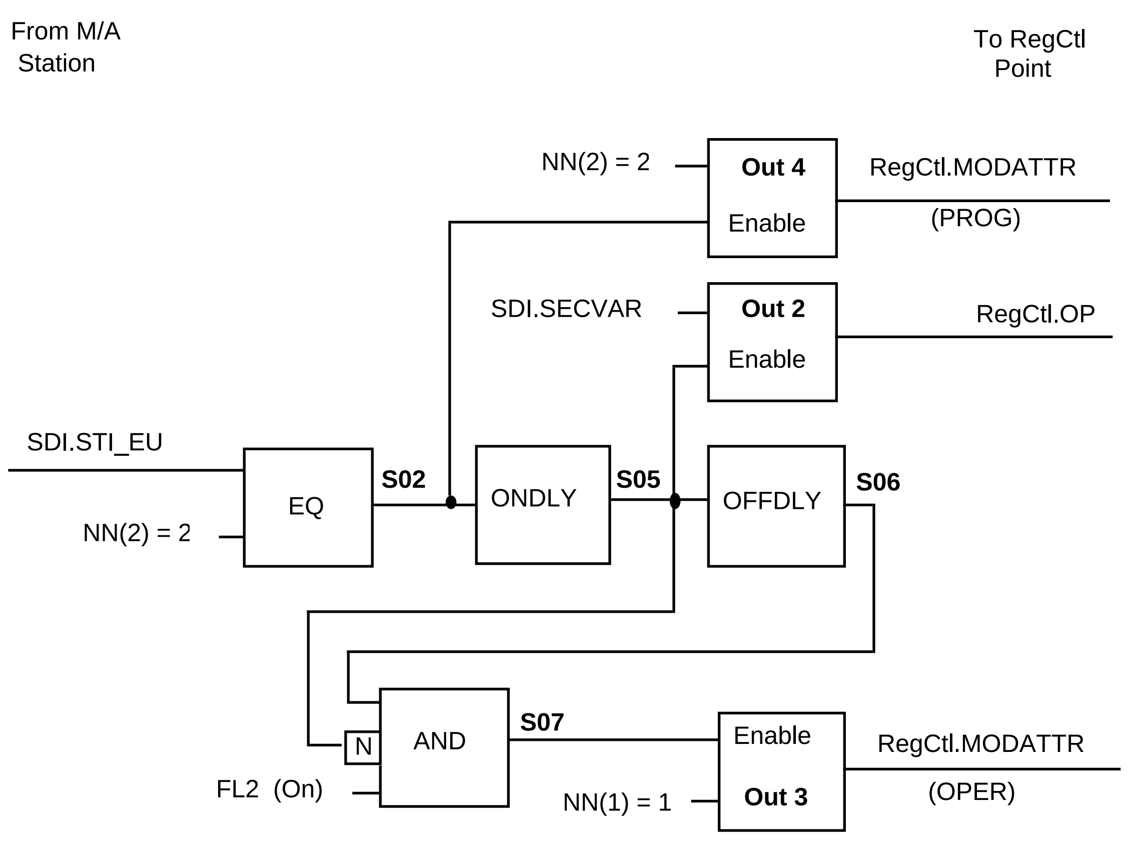


Figure 5-3 — OP Change Request Strategy, APM

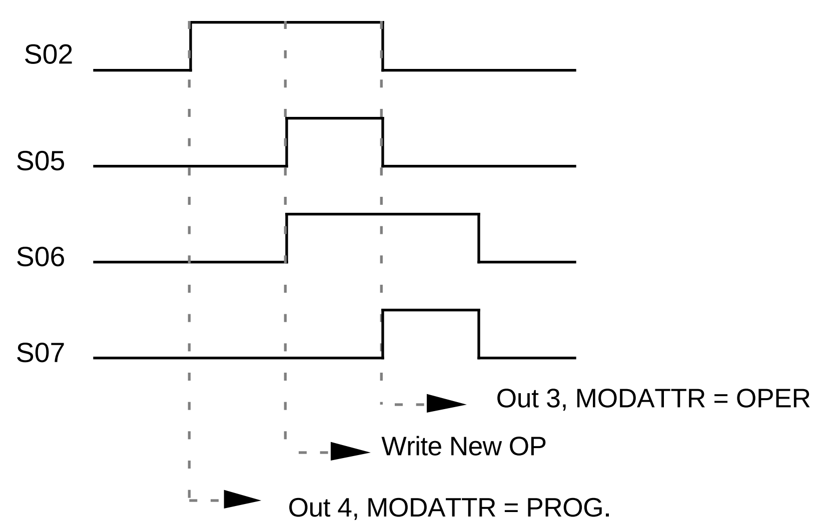


Figure 5-4 — APM OP Request Strategy Timing

5.2.2 Output Values and Control Functions Sent to the Manual/Auto Station

Signals sent back to the Manual/Auto Station for display purposes include the mode, the Setpoint, and OP. An auxiliary logic point can be used to send the Override Flag, alarms, and the valve position.

5.2.2.1 Fundamental Signals Sent to the Manual/Auto Station

Figure 5-5 illustrates how the Setpoint, PV, OP, and mode flag from the regulatory control point are written back to the Manual/Auto Station using logic gates.

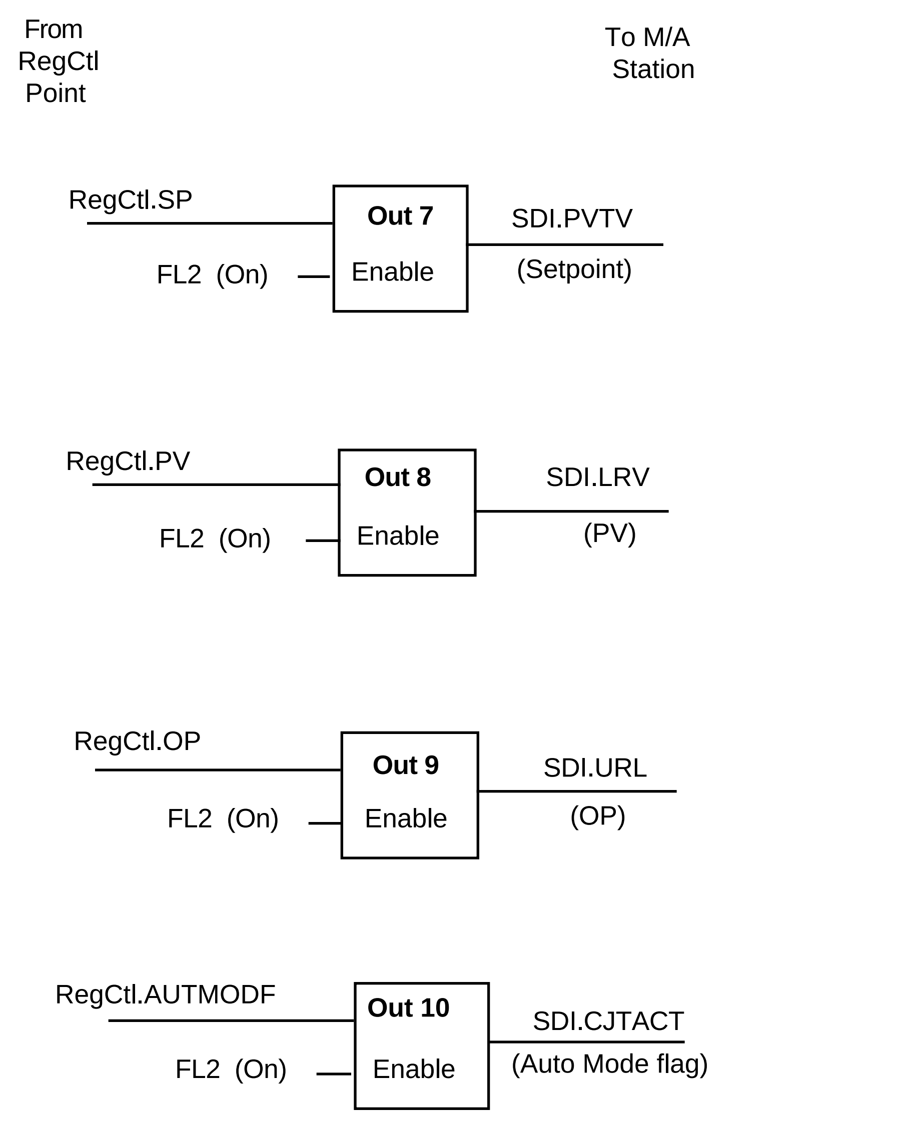


Figure 5-5 — Values written to M/A Station

5.2.3 Additional Logic Implementation

The logic functions described in this section are optional but provide useful functions.

5.2.3.1 Optional Logic Implementation

Some additional logic can be used to feed back the override flag, alarm status, and valve position to the Manual/Auto Station. Figure 5-6 illustrates how these signals can be returned to the Manual/Auto Station.

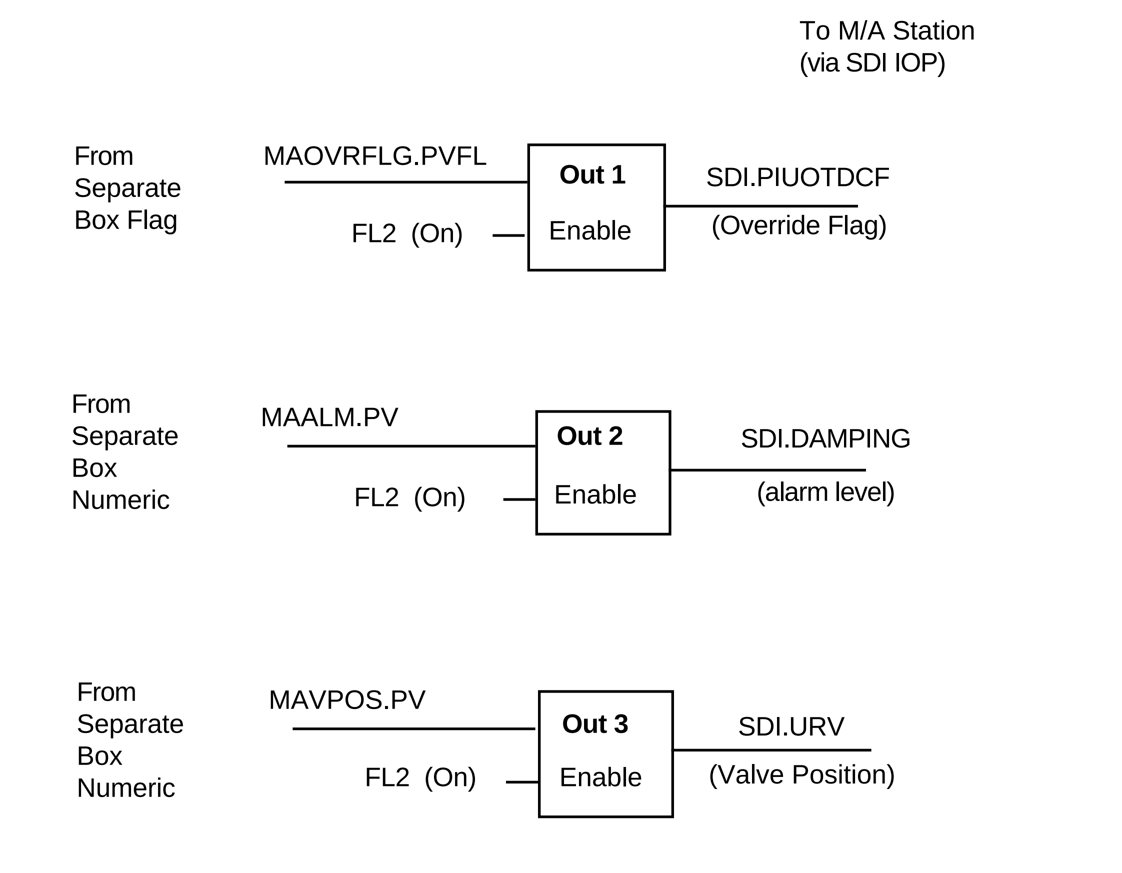


Figure 5-6 — Auxiliary Logic Point Implementation

5.2.3.2 Alternative Alarming Strategy

Figure 5-7 illustrates an alarming scheme whereby the PV High and Low Alarm Flags can be used to feed back PV out-of-range alarms to the Manual/Auto Station. PVHIFL on alone sets alarm 1, PVLOFL on alone sets alarm 2, and alarm 3 is set when both are on (this is an alternative to using logic gate Out 2 as shown in Figure 5-6).

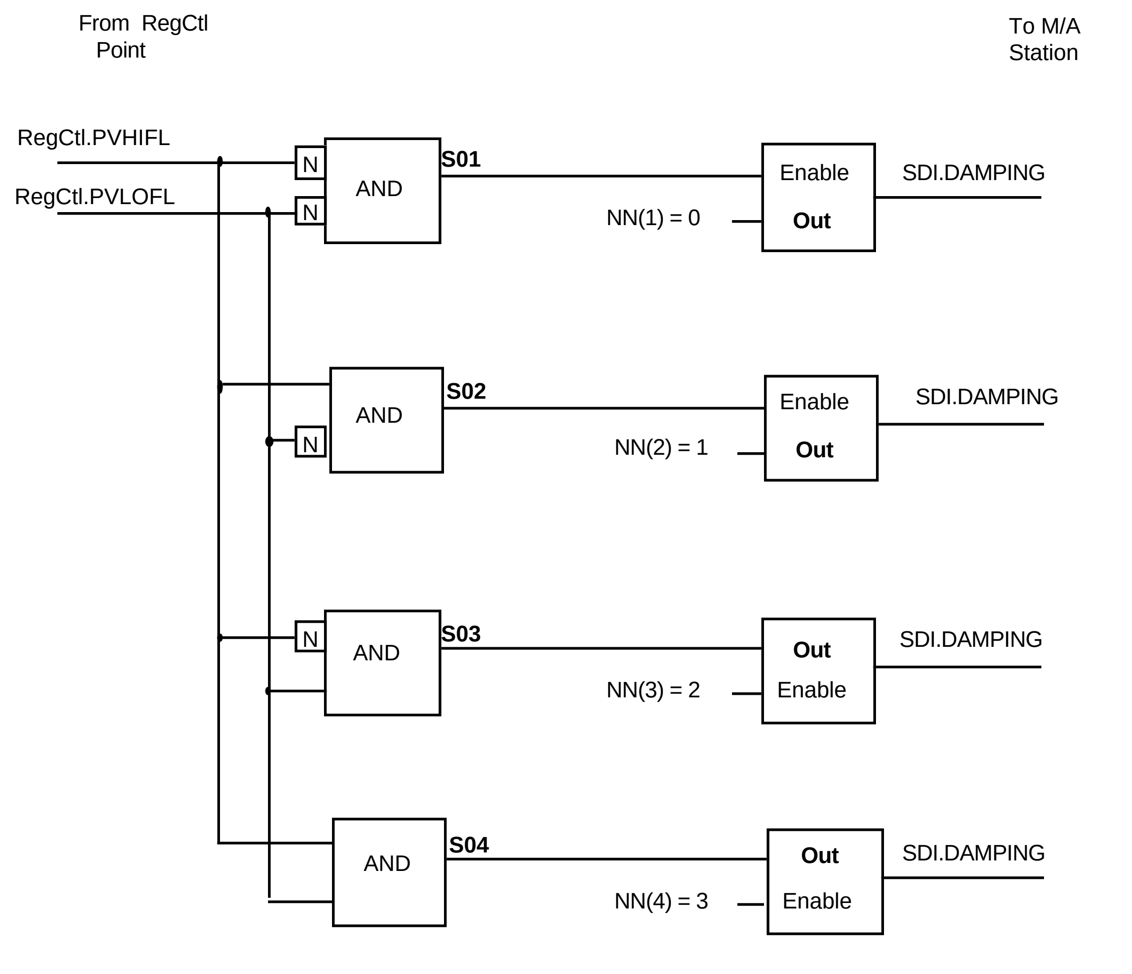


Figure 5-7 — PV Out-Of-Range Strategy

5.3 WEIGH SCALE IMPLEMENTATION

5.3.1 Methods of Control

The model 8142-2089 or 8142-2189 Toledo Weigh Scale can be controlled through a CL program or schematic (or both). In this section, a simple example is provided to show how a schematic could be used.

5.3.2 Control Schematic Example

Figure 5-8 shows a simple schematic for Toledo Weigh Scale control using the Serial Device Interface. This schematic is a simple example to show the approach and may not be suitable for actual control. Figure 5-8 shows how the schematic appears in the Picture Editor and provides some formatting information.

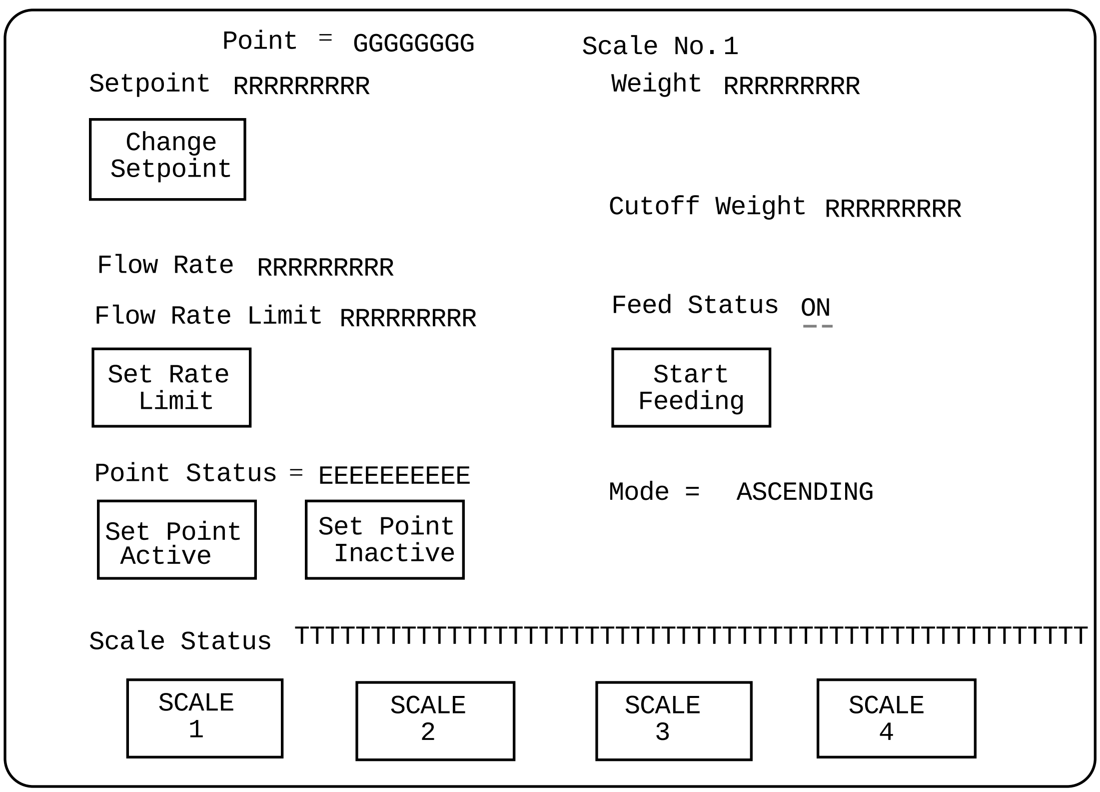


Figure 5-8 — Weigh Scale Schematic Example 11330

The following comments explain how the schematic is used—

- One of the four scales is selected.
- A weight setpoint value is sent to the scale.
- When Start Feeding is selected, feed control is turned on. When the weight has reached the setpoint value, the feed is turned off automatically at the scale. Feed status, weight, flow rate, etc., are reported through value objects on the screen.

Figure 5-9 shows the targets. Action sequences are shown in italics.

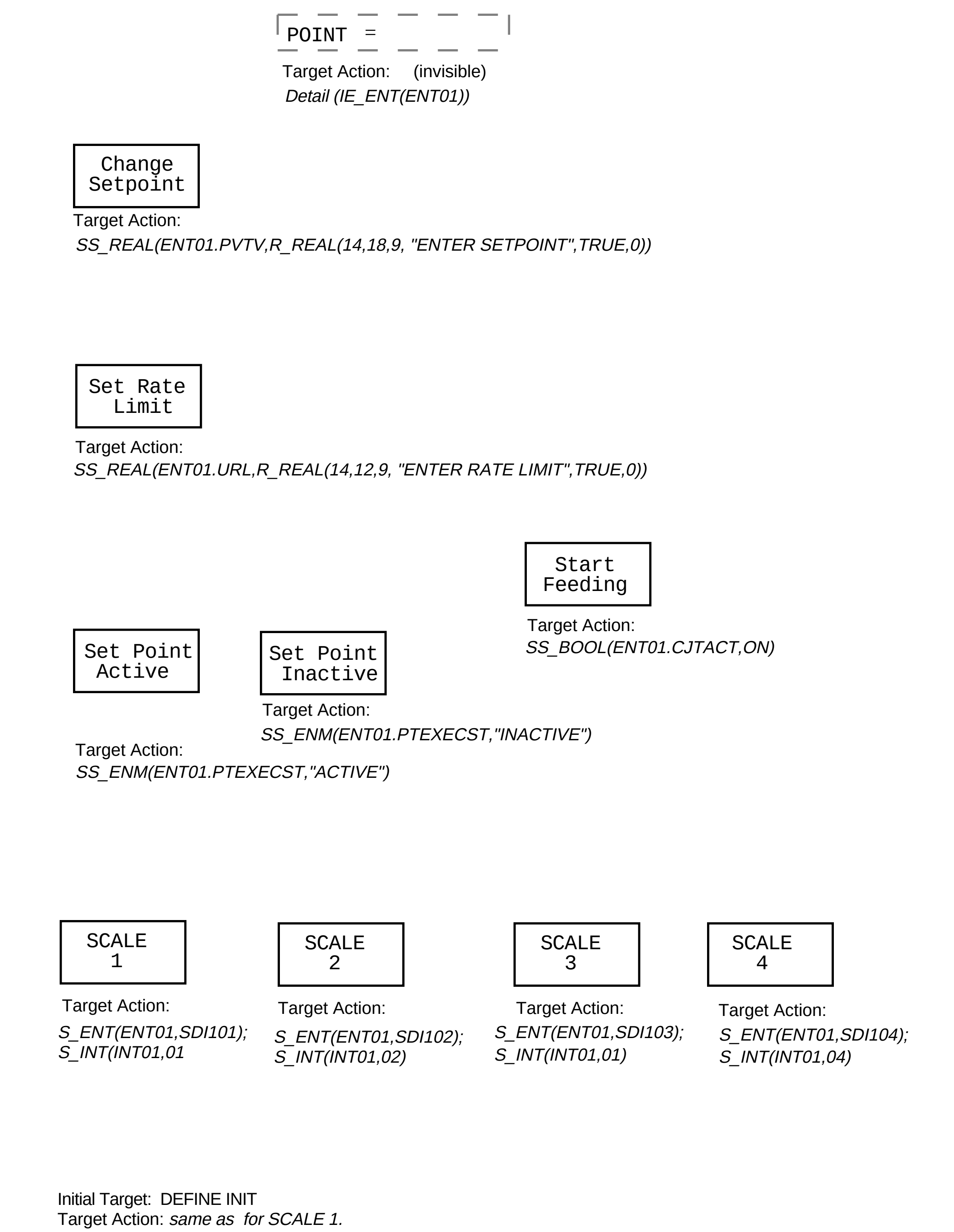


Figure 5-9 — Weigh Scale Schematic Targets

11329

Figure 5-10 shows the values, variants, and conditional behavior.

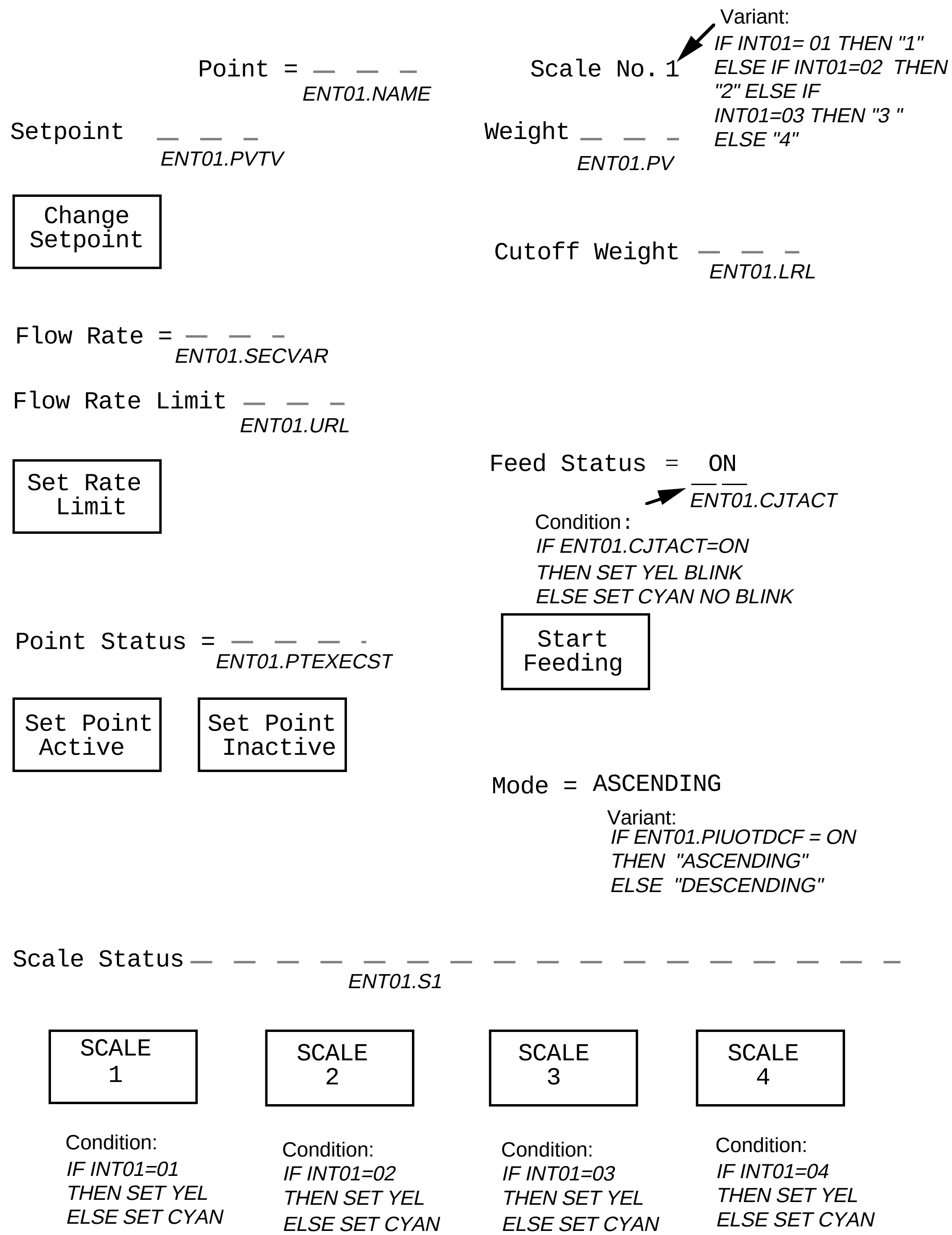


Figure 5-10 — Weigh Scale Schematic Values and Variants

11331

5.3.2.1 Control Schematic Description

To understand the control, you should refer to the table of Weigh Scale/STI parameters in the *Advanced Process Manager Control Functions and Algorithms* manual. For help in understanding Picture Editor functions, refer to the *Picture Editor Reference Manual.*

The following comments help to explain the example schematic—

- Upon invoking the schematic, an initial target selects Scale 1 as described below. This guarantees that the DDB variables contain acceptable starting values.

- Selecting one of the four scale targets loads the DDB Entity ENT01 with the proper point reference. It also loads the DDB Integer INT01 with the scale number 1, 2, 3, or 4. Conditional behavior changes the selected target from white to yellow.

- At the top of the schematic, a value displays the contents of ENT01 to show the point name. A variant tests INT01 and displays the selected scale number. An invisible target over the word: Point = is provided call up the detail display if needed.

- The Change Setpoint and Set Rate Limit targets open ports for an operator to type in desired values.

- The Start Feeding target stores ON for parameter CJTACT to turn the feed on. A value displays the text: ON after the words Feed Status. Below the word ON, a text line turns yellow and blinks when a conditional behavior test finds CJTACT = ON. When the setpoint is reached and feed is stopped at the scale, CJTACT returns to Off. OFF is displayed for the Feed Status and the line returns to steady state cyan.

- A variant tests parameter PIUOTDCF and displays ascending or descending mode. If you need to change the mode, you can do so at the Detail Display.

5.3.2.2 Point Configuration

A typical STI point configured for use with the schematic is shown in Table 5-5. Default values are acceptable in most cases. Some output values are set to 0 and some control parameters are initially configured to OFF for safety. Ascending weight is assumed; if descending is desired, set PIUOTDCF to OFF.

Use your own point name, unit number, network, node, and slot numbers. Use default values for parameters not included. The last four entries contain required values.

Four points, (SDI101 through SDI104) were built for use in this example to show how four scales could be controlled. Configuration of the points was the same except for the name and slot number. Because each scale is connected to a separate FTA, scales 3 and 4 require a second SDI IOP and its two associated FTAs.

Table 5-5 — APM STIM (SDI) Point

Parameter	Entry
NODETYP	APM
PNTFORM	FULL
PNTMODTY	STIM
SENSRTYP	STT
PVCHAR	LINEAR
STI_EU	MV
DECONF	
LRV	1
URL	0
DAMPING	0
PIUOTDCF	ON (Ascending)
CJTACT	OFF
INPDIR	DIRECT
PVEUHI	100.0 (Required)
PVEULO	0.0 (Required)
PVEXEUHI	100.0 (Required)
PVEXEULO	0.0 (Required)

5.3.2.3 Schematic Enhancements

You could add a drawing of a scale and insert parameters in appropriate places.

Some functions can be eliminated and others could be added. For example, if you only have one scale, eliminate the Point and Scale identifiers and the scale targets. Substitute the point ID in all expressions for ENT01. You may want to add a target to call the Detail Display for that point.

If you need to change from ascending to descending mode frequently, that functionality could be built into the schematic.

You can build the scale targets into another schematic to call a subpicture with scale control functions.

5.4 UDC 6000 Process Controller

5.4.1 Overview

The UDC 6000 Controller is a stand-alone single loop controller. Up to four UDC Controllers can be connected through each of the two FTAs to an SDI IOP. Communication uses the EIA-485 protocol.

Refer to PM12-520, the *PM/UDC 6000 Integration Manual* for configuration information and references to other UDC 6000 publications.

PEER-TO-PEER COMMUNICATION AND PERFORMANCE
Section 6

This section discusses Peer-to-Peer Transaction Throughput constraint in terms that allow general estimates on system capability to be made before implementation of the overall control strategy has been carried out. A description of the performance statistics and methods that can be used to troubleshoot performance problems are included.

6.1 SYSTEM CONSTRAINTS ON PEER-TO-PEER COMMUNICATION

System constraints limit the quantity of data that can be transported between peer APMs. These constraints include limits on

- the number of parameters that can be passed using specific transport mechanisms (configuration limits).
- the total number of parameters that can be serviced in each second (Parameter Throughput).
- the number of transactions that can be processed each second (Transaction Throughput).

6.1.1 Configuration Limits

Peer to peer configuration limits are discussed in Section 3 of the *Control Functions and Algorithms Manual.*

6.1.2 Parameter Throughput Limit

The limit on Parameter Throughput in the APM has been estimated at 400 parameters per second. The sum of all parameter requests to any individual APM should not exceed this value.

While it is important that system configuration not exceed this limit, previous experience indicates that the Transaction Throughput limit discussed below is usually reached first.

6.1.3 Transaction Throughput Limit

When parameters are transported over the UCN, they are sent in groups called messages. Two kinds of messages are involved: request messages and response messages.

- Request messages are those sent by the node that wants the data to the node that owns the data. They list all the parameters to be transported.

- Response messages are sent by the node that owns the data to the node that requested the data. They contain the actual parameter values.

All parameter transport requires a complete cycle of message request and message response. Such a cycle is called a transaction. Note that transactions occur when peer nodes communicate and also when NIMs and PMs/APMs communicate in response to LCN initiated requests.

The rate at which transactions occur is called the Transaction Throughput. Like Parameter Throughput, it is one component of the overall load on the APM. In most applications, Transaction Throughput is a more important component of load than Parameter Throughput.

Lab measurements have shown that in most configurations, the APM can handle 50 transactions per second.

In general, when a peer-to-peer configuration is designed, it should target a Transaction Throughput at or below 50 for steady-state and peak-load conditions alike. However, if this limit is exceeded by small amounts at infrequent intervals, the effect is small. UCN overruns result and some of the peer transactions will slow down.

Large and frequent overrun counts or UCN overrun soft failures are signs that Transaction Throughput is too heavy.

Cases where 50 transactions per second is too much—Certain configurations can have communications overruns at Transaction Throughput loads below 50.

CAUTION

Application engineers should be particularly cautious if a significant number of peer-to-peer connections make reference to IOP resident data.

The APM peer-to-peer communication capability is primarily intended to support transport of Control Processor resident data. If large amounts of IOP owned data must be transported, they should first be fetched into the Control Processor by a local connection. The peer-to-peer connections can then reference the data from its Control Processor location.

6.2 LOCAL AND REMOTE DATA

In the following discussion, Transaction Throughput values are always quoted in units of transactions per second.

Imagine a UCN with P + 1 APM nodes operating as peers and one NIM node connected to the LCN (see Figure 6-1).

For an APM called ME, data transactions can be divided into two classes:

- those that transport remote data not owned by ME into ME
- those that transport local data owned by ME into other nodes.

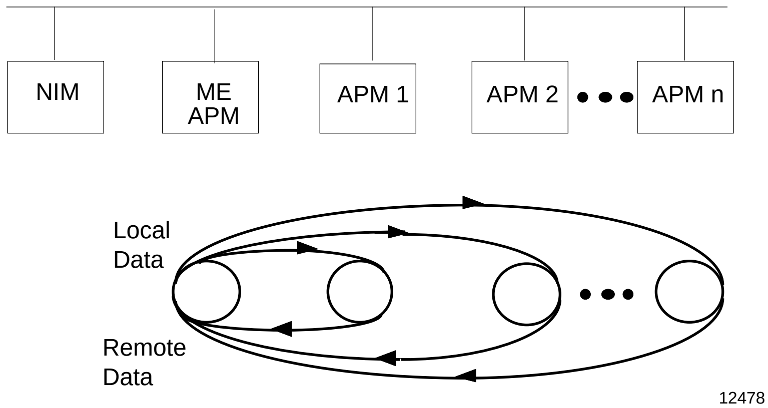


Figure 6-1 — Local and Remote Data

Remote data can be transported by pulls (reads) from ME or by pushes (writes) from the P other nodes. Similarly, Local data can be transported by pushes from ME or by pulls from the P other nodes. The distinction between remote and local has to do with who owns that data that is to be transported, not with whether pushes or pulls are used to effect the transport.

For nodes that are exclusively data sinks, the peer-to-peer load is caused only by remote data. For nodes that are exclusively data sources, the situation is reversed.

6.2.1 Transaction Load from Peer Traffic

Transaction load on ME, generated by the P peer APM nodes, depends strongly on two factors:

- the number of other nodes communicating (P), and
- the specific mechanisms used to transport data between ME and the peer nodes.

Node Count Effects—The dependence on P is linear.

Configuration Effects—The dependence on configuration is harder to characterize. Relevant factors include the following:

- **ME is a data source, data sink, or both**. If peer transactions transport only local data, ME is a pure source. If peer transactions transport only remote data, ME is a pure sink. Using ME as both a source and a sink, typically doubles the transaction load.
- **Data is transported by pulls, pushes, or both**. Data transport to and from ME is accomplished primarily by pull or push mechanisms, or by a combination of the two. It is advantageous to use exclusively one or the other.
- **Data is transported by continuous points, sequence points, or both**. Data transport to and from ME is accomplished primarily by continuous point mechanisms (connections configured in Regulatory PV, Regulatory Control, or Logic points), by sequence point mechanisms (Read and Write statements in Process Module Data points), or by a combination of the two. It is advantageous to use exclusively one or the other.

6.2.2 Push/Pull Examples

The following examples illustrate the range of variation possible due to configuration options:

Example 1: Very Inefficient Transaction Usage

Both pushes and pulls are used to accomplish data transport. Both continuous and sequence point mechanisms are used.

Remote Transaction Load = 10 x P
Local Transaction Load = 10 x P

Example 2: Moderately Efficient Transaction Usage

Transport mechanisms are restricted to pushes. Both continuous and sequence mechanisms are used.

Remote Transaction Load = 6 x P
Local Transaction Load = 6 x P

Example 3: Moderately Efficient Transaction Usage

Transport mechanisms are restricted to pulls. Both continuous and sequence mechanisms are used.

Remote Transaction Load = 6 x P
Local Transaction Load = 6 x P

Example 4: Moderately Efficient Transaction Usage

Transport mechanisms are restricted to continuous mechanisms. Both pushes and pulls are used.

Remote Transaction Load = 6 x P
Local Transaction Load = 6 x P

Example 5: Moderately Efficient Transaction Usage

Transport mechanisms are restricted to sequence mechanisms. Both pushes and pulls are used.

Remote Transaction Load = 8 x P
Local Transaction Load = 8 x P

Example 6: Efficient Transaction Usage

Only pulling is used for data transport. Only continuous mechanisms are used.

Remote Transaction Load = 2 x P
Local Transaction Load = 2 x P

Figure 6-2 shows the dependence of transaction load on node count for each of the examples listed above. Each plot applies to transport of either remote or local data.

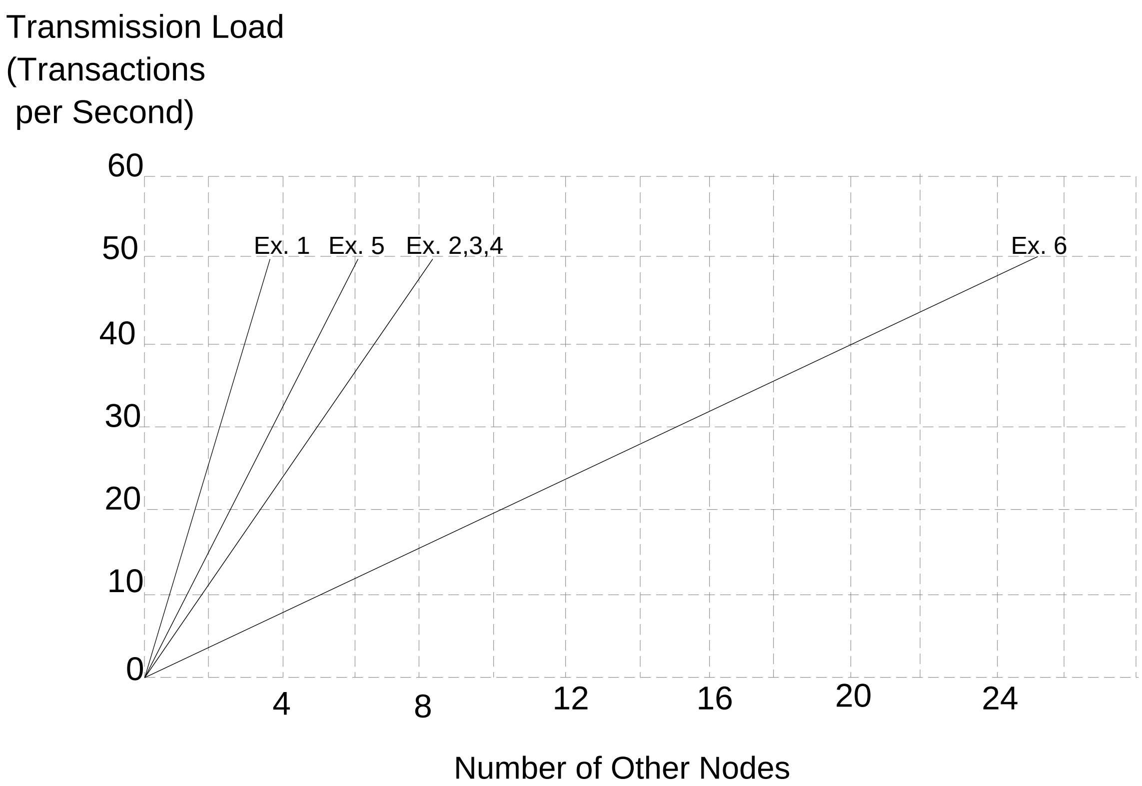


Figure 6-2 — Transmission Throughput 12117

Note that for certain types of applications, even the approach used in example 6 may impose too much load. This is further described in subsection 6.5

6.3 TRANSACTION LOAD FROM NIM TRAFFIC

Transaction load imposed by the NIM upon ME can vary greatly depending on static factors such as LCN configuration. It also depends on dynamic factors such as:

- how many active displays draw data from ME
- how many AM or CM strategies pull and push to ME
- whether history data is being collected
- how many events are being generated by ME.

To roughly characterize these variations, two categories of loads can be considered:

- typical
- large

6.3.1 Typical NIM, Transaction Load = 8

This might be generated by an LCN with the following nodes and activities:

- one 68020 AM
- one CM50 generating requests at its maximum rate
- one HM generating requests at its typical rate
- one group displays on fast update
- one group displays on normal update
- one schematic display of about 100 parameters
- one detail display

6.3.2 Large NIM, Transaction Load = 21

This might be generated by an LCN with the following nodes and activities:

- two 68020 AMs
- one CM50 generating requests at its maximum rate
- one HM generating requests at its maximum rate
- two group displays on fast update
- two group displays on normal update
- three schematic displays of about 100 parameters each
- two detail displays

6.4 ESTIMATING TRANSACTION THROUGHPUT

Use the following procedure to estimate Transaction Throughput:

1. Identify how many APMs will be connected to the UCN.
2. Consider each APM one at a time thinking of it as the ME node.
3. Identify how many peer nodes will be communicating with ME (P).
4. Estimate whether ME is primarily a data source, primarily a data sink, or both.
5. Consider the kind of data to be transported and whether all or just a few transport mechanisms must be used.
6. Use the graph in Figure 6-2 to gauge the Transaction Throughput used to transport remote data.
7. Use the graphs in Figure 6-2 to gauge the Transaction Throughput used to transport local data.
8. Gauge the transaction load that will be posed by the NIM. Estimate it as either large or typical.
9. Compute an estimate of total transaction load by summing the load from peer local data, peer remote data, and the NIM. This number will serve as an upper limit on the actual transaction load that the configuration will generate.
10. Check how close the estimated total transaction load comes to the limit of 50 transactions per second. Note that configurations exceeding this limit may still run symptom free, particularly if the number of parameters transported in each transaction is low.
11. Repeat this procedure for each APM that uses peer to peer communication.

6.5 DESIGNING TO HANDLE HEAVY LOADS

Although the PM/APM supports a variety of peer-to-peer transport mechanisms, applications that are expected to impose a heavy UCN communication load are best served by focusing on one of the two sequence mechanisms (Sequence Reads or Sequence Writes) and excluding others.

The reason for this is that the ability to program how and when peer-to-peer requests are made gives the application engineer the highest level of control over communications loading.

There are three load minimization strategies that can be used only with Sequence Reads and Sequence Writes.

- **Continuous Data That Can Tolerate a Low Rate of Update—**Some data may need to be transported over the UCN for regulatory or other kinds of continuous control activities. However, the update rate may not need to be as high as one or two Hz. If this is the case, Sequence Reads and Sequence Writes allow the control engineer to set the update rate as low as control requirements allow.

- **Status Data That Changes by Exception—**Various kinds of status data tend to change at infrequent intervals. To fetch or send this kind of data at a regular rate, however slow, could be wasteful. With Sequence Writes, this data can be sent to receivers only when it changes.

- **Data Associated with Common Equipment—**Batch applications frequently involve common equipment such as pipe headers which are used by multiple PM/APMs. Status and process variable data associated with this equipment needs to be made available to each PM/APM as needed. For many such applications, the common equipment may be used by only one PM/APM at a time.

  In applications like these, using a continuous push or pull mechanism to transport the data could be extremely wasteful as these mechanisms are active constantly, even when the recipient node has no need of the data. A more efficient approach is to use Sequence Writes.

  With Sequence Writes, the PM/APM that owns the equipment wiring can send the necessary data to the one node currently using the equipment.

In general, applications that need the most efficient peer-to-peer transport mechanism should use Sequence Reads or Sequence Writes.

6.6 HELPFUL HINTS

6.6.1 Adding Connections to an Existing Configuration

Adding more peer to peer connections may or may not have an effect on transaction load, depending on the particulars of the configuration. What matters is whether the new connection causes a new transport mechanism to be used or causes an operative transport mechanism to access an additional node.

For example, suppose that points RP0901, RC0901, and LG0901 each fetch three parameters from APM 11. If several more pulls from APM 11 were added into any Regulatory PV, Regulatory Control, or Logic points in APM 9, then no additional transaction load would result on either APM 9 or APM 11. However, if the pulls were directed to node 13 or if they were performed by a sequence running in APMDP0901, then the transaction load would increase at both the requesting and responding nodes.

6.6.2 Adding Another APM to an Existing UCN Configuration

When adding
to an existing configuration, do a careful analysis on the amount of peer data the node will source, the amount it will sink, and the node(s) which will be partner(s) in transactions.

Estimate transaction loads using the method described above for the new node and any nodes to which it may communicate. If estimated transaction loads severely exceed the limit of 50 transactions per second, then consider alternative system implementations.

6.6.3 Where Overruns Can Occur

In some heavily loaded peer-to-peer configurations, UCN overruns occur on the nodes(s) that have the highest transaction load. However, in other cases, overruns occur on nodes with transaction loads of less than 50. This is caused by peer access to a node that is overloaded and, therefore, cannot respond quickly to the request.

6.6.4 Effect of Alarm Inhibit

Since event reporting is one of the APM activities that causes transaction load, an intermittent or steady event load that is heavy can contribute to peer-to-peer communication problems. It is often thought that inhibiting alarms at the NIM should ameliorate this effect; this is incorrect. Event inhibit affects the transport of events on the LCN. Event traffic on the UCN remains unaffected.

6.6.5 Using Mostly One Transport Mechanism and a Little Bit of Another

If the purpose is to minimize transaction load, there is no advantage to making small or partial use of a particular transport mechanism. The reason for this is that if a new transport mechanism is used, even if for only a single parameter to a single other node, additional transactions are required.

Consider Example 2, described previously, that uses only the continuous pull mechanism to transport peer to peer data. If such a configuration were changed by adding a single Regulatory Control point running once per second, doing peer-to-peer pushes, then the local transaction load would go from 2 x P to 2 x P + 1. Conversely, adding more Regulatory Control or Logic point pulls, as long as the points were running on the same cycle and directed to the same node, would not affect the transaction load at all.

6.6.6 Nonredundant Versus Redundant APMs

A nonredundant APM in a peer-to-peer strategy generates somewhat less transaction load than a redundant APM. This is true even when the secondary is not in the backup state. However, the specification of 50 transactions per second does apply to the redundant case.

Nonredundant nodes have a slightly higher capability. The difference arises from the fact that redundancy imposes additional communication burden in the form of database backup operations in the Control Processor and status scans between the primary and secondary communications processors.

6.7 PEER-TO-PEER PERFORMANCE MONITORING

6.7.1 Peer-to-Peer Statistical Parameters

The statistics described in the following paragraphs are used to analyze peer to peer communications efficiency and to determine if a problem exists or is imminent. They are particularly useful for isolating problems to a node or a few nodes. Most of these statistics are presented on the Toolkit displays (refer to section 10 in the *Engineer's Reference Manual*).

In Release 410 and later software, the following types of statistics are provided:

- Percentage of free time available to the Central Processing Unit (CPU Free)
- Transaction Trip Times,
- Request/Response Transaction Throughput,
- Requests/Response Parameter Throughput,
- Node Access Rate,
- Event Throughput Rates, and
- Miscellaneous.

In general, three dimensions of statistics are reported: maximum, minimum, and average.

- Maximum values are collected for all statistics,
- Minimum values are only collected for the CPU Free statistics, and
- Average values are computed as a running average over the previous minute of samples.

Each parameter is briefly described in terms of the type of statistic it supplies. Additional information can be found in the *APM Parameter Reference Dictionary*.

6.7.1.1 CPU Free Statistics

These statistics indicate the percentage of time in each second that the specified CPU is idle. Statistics are available for two CPUs: the Communication (COM) Processor and the Control (CTL) Processor.

The parameters are:

Parameter	Statistic Measured
COMCFAVG	Average CPU Free Time for the Communications Processor
COMCFMAX	Maximum CPU Free Time for the Communications Processor
COMCFMIN	Minimum CPU Free Time for the Communications Processor
CTLCFAVG	Average CPU Free Time for the Control Processor
CTLCFMAX	Maximum CPU Free Time for the Control Processor
CTLCFMIN	Minimum CPU Free Time for the Control Processor

6.7.1.2 Transaction Trip Time Statistics

UCN trip time statistics measure how many milliseconds it takes for a transaction to traverse part or all of its circuit.

Peer-to-peer request messages typically contain requests directed toward more than one responding node. Figure 6-3 shows the simplest case of a single responding node. When multiple responders are involved, request time values are based on the slowest response path.

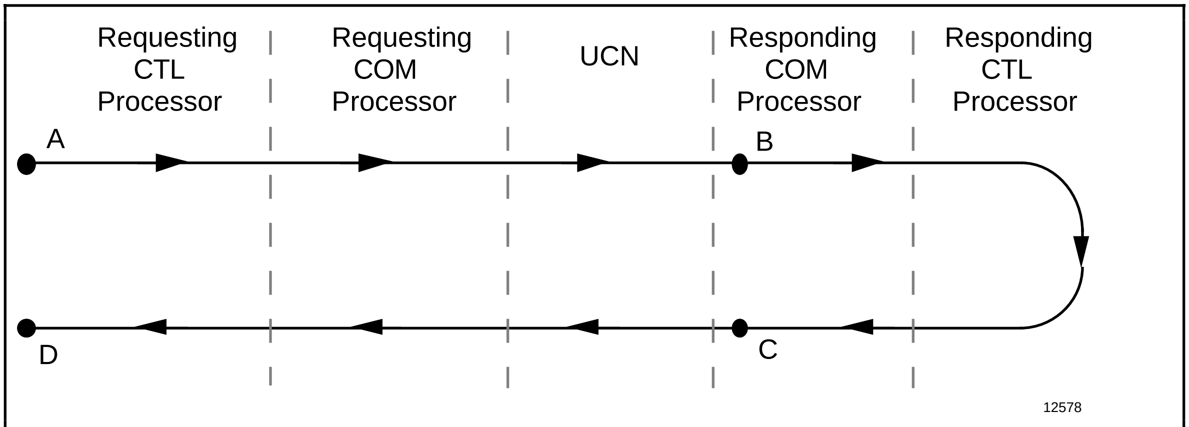


Figure 6-3 Request/Response Path

Request trip time–Request trip time statistics provide the time required to go from A to D. They are measured in the requesting Control (CTL) Processor.

Response trip times–Response trip times statistics provide the time required to go from B to C. They are measured in the responding Communication (COM) Processor.

Trip time statistics are made available for fetch and store transactions. Store trip times would typically be a little larger than fetch trip times because more processing is generally required for parameter store operations.

Statistics are also provided that give a weighted sum of response fetch and store trip times.

The Transaction Trip Time parameters are shown in the following table:

Parameter	Statistic Measured
FRQUTAVG	Average Fetch Request Trip Time
FRQUTMAX	Maximum Fetch Request Trip Time
FRSPTAVG	Average Fetch Response Trip Time
FRSPTMAX	Maximum Fetch Response Trip Time
SRQUTAVG	Average Store Request Trip Time
SRQUTMAX	Maximum Store Request Trip Time
SRSPTAVG	Average Store Response Trip Time
SRSPTMAX	Maximum Store Response Trip Time
TRATAVG	Average UCN Response Trip Time (includes both fetches and Stores)
TRATMAX	Maximum UCN Response Trip Time (includes both fetches and stores)

6.7.1.3 Parameter and Transaction Throughput Statistics

These parameters specify the number of transaction and parameter accesses serviced by the node under examination. They include both fetches and stores. Transactions to the secondary APM are not included in the accumulated counts.

The parameters are:

Parameter	Statistic Measured
NPARAVG	The average number of parameters serviced per second (both requests and responses) to all other nodes.
NPARMAX	The maximum number of parameters serviced per second (both requests and responses) to all other nodes.
NPRQUAVG(n)	The average number of parameter requests serviced per second (issued to node n) when n = 1, 3, 5, ... 63 (n = 0 returns the average total number of parameter requests to all other nodes).
NPRQUMAX(n)	The maximum number of parameter requests serviced per second (issued to node n) when n = 1, 3, 5, ... 63 (n = 0 returns the maximum total number of parameter requests to all other nodes).
NPRSPAVG(n)	The average number of parameter responses serviced per second (issued to node n) when n = 1, 3, 5, ... 63 (n = 0 returns the average total number of parameter responses to all other nodes).
NPRSPMAX(n)	The maximum number of parameter responses serviced per second (issued to node n) when n = 1, 3, 5, ... 63 (n = 0 returns the maximum total number of parameter responses to all other nodes).
NTRAAVG	The average number of transactions per second (both requests and responses) to all other nodes.
NTRAMAX	The maximum number of transactions per second (both requests and responses) to all other nodes.
NTRQUAVG(n)	The average number of transaction requests per second (issued to node n) when n = 1, 3, 5, ... 63 (n = 0 returns the average total number of transaction requests to all other nodes).
NTRQUMAX(n)	The maximum number of transaction requests per second (issued to node n) when n = 1, 3, 5, ... 63 (n = 0 measures requests issued to all other nodes).
NTRSPAVG(n)	The average number of transaction responses per second (issued to node n) when n = 1, 3, 5, ... 63 (n =0 returns the average total number of transaction responses to all other nodes).
NTRSPMAX(n)	The maximum number of transaction responses per second (issued to node n) when n = 1, 3, 5, ... 63 (n = 0 returns the maximum total number of transaction responses to all other nodes).

6.7.1.4 Node Access Rate Statistics

These parameters specify the number of UCN nodes that the node under examination communicates with within a one second period of time. They include both fetches and stores.

Parameter	Statistic Measured
NORQUAVG	The average number of nodes to which requests are made each second.
NORQUMAX	The maximum number of nodes to which requests are made each second.
NORSPAVG	The average number of nodes to which responses are made each second.
NORSPMAX	The maximum number of nodes to which responses are made each second.
NOTRAAVG	The average number of nodes accessed each second (includes both requests and responses).
NOTRAMAX	The maximum number of nodes accessed each second (includes both requests and responses).

6.7.1.5 Event Throughput Statistics

These parameters specify the number of events generated by the APM per second. The parameters are:

Parameter	Statistic Measured
NEVTAVG	The average number of events per second (this statistic uses a two second average rather than the one minute average used on all other statistics.
NEVTMAX	The maximum number of events per second.

6.7.1.6 Miscellaneous Parameters

Parameter	Meaning
BNDRESET	The maximum/minimum (bounds) Statistic Reset flag.
BNDRSTIM	The time of the last BNDRESET reset (APM only).
NSCANTIM*	Specifies the number of scan items in the UCN Scan Table
SUMSLTSZ*	Specifies the total amount of memory allocated for CL programs.

Resetting Statistic Values—Maximum, minimum, and average statistics can be reset at any time. This allows the user to establish a known start time at which statistics gathering begins. Resetting the statistics has the following effects:

- Maximum values are set to zero and then grow to larger values as new instantaneous values are computed.
- Minimum values are set to the maximum range limit and then shrink to smaller values as new instantaneous values are computed.
- Average values are set to the current instantaneous value.

*These are viewed on the APM/PM Diagnostic Display-Control Configuration page.

When a Statistic Reset occurs, the time of reset is recorded in parameter BNDRSTIM which can be referenced later to see how long data has accumulated.

Statistic Reset typically occurs as the result of a target selection at the UCNSUMM, NODESTA1 or NODESTA2 displays. The effect of selecting the reset target at these three displays differs as indicated below.

- When reset is commanded from UCNSUMM all statistics in all UCN nodes are initialized as described previously.
- When reset is commanded from NODESTA1 all statistics in the selected node are initialized.
- When reset is commanded from NODESTA2, all statistics in the selected node are initialized.

The value of parameter BNDRSTIM is displayed on both the NODESTAl and NODESTA2 displays.

If desired, Statistics Reset can also be controlled from CL programs. To do so, the parameter BNDRESET is written to ON at each node where statistics are being monitored. On a read, BNDRESET always returns OFF.

6.8 TROUBLESHOOTING PM OR APM COMMUNICATIONS OVERLOAD

6.8.1 Troubleshooting Guidelines

While it is best for TDC 3000^X applications to be designed so that communication overload does not occur this is not always done. When overload problems occur, refer to the tips on the following pages and answer the questions below.

- What are the signs of PM OR APM overload?
- How do I know that the physical components of UCN communications are operating correctly?
- How can I tell that the overload is in the PM or APM and not the NIM?
- How do I know which PMs or APMs are reporting symptoms?
- How do I know which PMs or APMs are the ones in overload?
- What are the possible causes of overload?
- What if the symptoms occur under peak load but not steady state conditions?

6.8.1.1 Cases where PM OR APM Overload Is Indicated

Several different symptoms can indicate overload of PM or APM communications capabilities:

- Intermittent black-outs or question marks appearing where UCN data is shown on US screens.
- Diagnostic time-out soft failures reported by a PM or APM COM processor.
- UCN overrun soft failures reported by a PM or APM.
- Moderate to high levels of UCN overrun counts.

Note that for the first symptom there are a variety of causes including the following:

- Poor physical communication integrity on the UCN. This might result from poor cable connections, poor cable layout, marginal modems or other communication equipment.
- NIM communications overload.

6.8.1.2 Distinguishing Physical Network Problems from APM Communications Overload

Poor network integrity can be identified through the use of the UCN communication statistics displays which include the following:

- **UCN COMM display**—This display is invoked by selecting the UCN COMM target on the UCN Status display. It shows UCN communication statistics for 16 nodes at a time. Refer to the *Universal Control Network Guidelines* document for explanation of how to interpret statistics.
- **UCN Statistics display—**This display is invoked by selecting the UCN STATS target on the PMM or APMM Diagnostic Display. It shows communications statistics for one UCN node at a time. Refer to the *Universal Control Network Guidelines* document for explanation of how to interpret statistics.
- **UCNEVENT and UCNCOMM Schematics**—These schematics show communication statistics for 16 UCN nodes at a time. Refer to the *Universal Control Network Guidelines* document for an explanation of how to interpret statistics.

If these displays indicate physical communication problems those problems should be corrected before doing further troubleshooting or making any other system changes.

6.8.1.3 Distinguishing NIM Communication Overload from PM or APM Communications Overload

Symptoms at the Universal Stations can be caused by NIM overload as well as PM or APM overload. To distinguish these two cases do the following:

- Use the on-line loading statistics available for the NIM to develop a thorough understanding of the NIM load. Crucial to this understanding will be the steady state value of the NIM CPU Free statistic (viewed on the Toolkit displays). If it is below 20% the NIM is a possible cause of US symptoms. NIM performance statistics can be observed from several different schematics. Schematic PERFMENU provides an overview of available LCN and UCN performance schematics. Schematics useful for studying NIM loading are CPUCHKR, PARCHKR, NODEPRF and NIMTRND.
- Make a similar study for all PMs or APMs referenced by the US displays showing symptoms. As with the NIM, Communications Processor CPU Free values below 20% warrant further investigation. PM/APM performance schematics (UCNSUMM, NODESTA1 and NODSTA2) can be invoked from schematic PERFMENU as can NIM performance schematics. Further information about how to use UCNSUMM, NODESTA1 and NODESTA2 is presented below.
- Although not always present, when event journals show one or more occurrences of the message "job queue full”, this is a definite indication of NIM overload.

6.8.1.4 Identifying APMs or AM That Are Reporting Symptoms

lt is entirely straightforward to identify the node showing symptoms. As a result this is typically known by the time troubleshooting begins:

- If the symptom is a soft failure then the journal event includes the number of the reporting node.

One case that is slightly more subtle concerns UCN Overruns:

- If the overrun rate is too low to cause a soft failure, the symptom may be observed by selecting the CONTROL CONFIG target on the PMM or APMM Diagnostic Display. UCN Overrun statistics are shown along with Point Processing and IO Link Overrun statistics at the bottom of the screen. Either the CURRENT HOUR UCN ACCESS OVERRUNS or PREVlOUS HOUR UCN ACCESS OVERRUNS, or both will be non-zero if overruns are occurring. Overruns of about 50 per hour or less are not cause for great concern, but you should investigate counts greater than this.
- Information can also be obtained by looking at the MAXIMUM REQUEST TRIP TIME parameters on the NODESTA1 schematic. If either value is over 500 ms, then overruns are probably occurring from time-to-time. If either is over 750 ms, then overruns are definitely occurring at some rate.

Note that the node or nodes showing symptoms are not necessarily the same as the nodes causing the symptoms. For example if APM 5 is making requests to APM 9, and APM 9 is overloaded, APM 5 could show overruns even though its own Communications processor was lightly loaded.

6.8.1.5 Identifying Heavily Loaded APMs

Because overload at one node can cause symptoms at another node, a method is needed to track down the overloaded nodes:

- Call up the UCNSUMM schematic. This display was designed to give summary information for all nodes configured on the UCN. Four types of information are presented on this display:

Node Access Rate,	Parameter Throughput, and
Transaction Throughput,	Transaction Response Trip Times.

- For locating overloaded nodes, Response Trip times are the most useful. For this statistic, average values over 300 ms or maximum values over 500 ms may indicate problems. However, regardless of the absolute value shown, locate the node with the highest average Response Trip Time.
- For the node identified call up the NODESTA1 schematic and look at average and minimum COM CPU Free statistic. If average values are less than 20%, or minimum values are less than 10% then this node is probably causing symptoms.
- After a node with low COM CPU Free has been located, continue to use UCNSUMM and NODESTA1 schematics until all nodes with average COM CPU Free below 20% have been located.
- Transaction Throughput values shown on the UCNSUMM schematic are harder to interpret than Response Time values. There are configurations that run well with average Transaction Throughput greater than 50. Conversely, there are configurations which run poorly with Transaction Throughput under 30. Variations are caused by factors such as the magnitude of Parameter Throughput, the types of parameters being transferred, and the location of the data being transferred.

  Note that requesting IO Link data from the UCN can be particularly costly to COM Processor performance. As a rule of thumb, an average Transaction Throughput value of 40 or greater can be considered high.
- The Parameter Throughput values shown on the UCNSUMM schematic are also hard to interpret. While 400 Is generally a fairly high value, systems can run flawlessly with values considerably higher.

6.8.1.6 Identifying the cause of Node overload:

Event Traffic—APM or PM communications overload can sometimes be caused by high steady state event throughput.

- Call up the NODESTA1 schematic. Look at the average Event Throughput. Values greater than 10.0 indicate heavy activity that could be overloading the Communications Processor.
- If heavy event load is present, enable the event journals and examine them for chattering events.

Parameter Transfers on the UCN—After overloaded nodes have been identified the next step is to analyze system configuration to see why. This process may involve examination of schematic source code, point build IDF files, CL source code or other system configuration data generated by application engineers. It can be very labor intensive. Node performance statistics can assist somewhat in this process.

- Call up the UCNSUMM schematic. Look at the average Node Access Rate. Values greater than 7 may indicate that too many nodes are making requests to the node in question.
- Call up the NODESTA2 schematic. This display may be used to show which UCN nodes are placing a communication burden on the node in overload. Any node that is not communicating with the node selected at schematic invocation shows zeroes for all statistics. Nodes that are communicating show non-zero values.
- Look at the Transaction Throughput data on the NODESTA2 schematic. Investigate nodes that are placing a high Transaction Throughput burden on the overloaded node (for either request or response transactions).
- Look at the Parameter Throughput data on the NODESTA2 schematic. Investigate nodes that are placing a high Parameter Throughput burden on the overloaded node (for either request or response transactions).

Two other tools may be helpful to analyze the configuration of peer connections on a UCN. These are the Find Names and Documentation Tool utilities. Refer to the *Command Processor Manu*al in the *Implementation/Engineering Operations - 1 binder* for information on these functions. Together they can be used to construct tables of all peer-to-peer connections that put a load on each node.

Constructing such tables involves two general steps:

- Use Find Names to generate lists of all entity-parameter references in all checkpoints and all PM/CL or APM/CL programs used in the UCN configuration.
- Use the Documentation Tool's filtering capabilities to isolate those entity-parameter references that indicate peer connections.

6.8.1.8 When Symptoms Seem to Occur Only under Peak Conditions

When a node experiences overload during peak conditions, it will generally be marginal under steady-state conditions. Thus, an examination of steady-state data will almost always identify nodes that are overloaded, and are therefore causing symptoms.

- In rare cases where analysis of data taken under normal operating conditions is not sufficient, trends can be used. Parameter values displayed in the UCNSUMM, NODESTAl and NODESTA2 schematics have corresponding names indicated as well.
- For example on UCNSUMM the characters "TRAT..." appear under the Transaction Response Trip Time column. The three dots indicate that "MAX” may be appended to get the name of the parameter displayed in the MAX column while "AVG" may be appended to get the name of the parameter displayed in the AVG column. Knowing this, take trends of $NMuuBnn.TRATMAX and $NMuuBnn.TRATAVG to see if any node shows strong deviations over a long period of time. The symbol "uu" here denotes the UCN number while "nn" denotes the node number of the APM in question.
- NODESTA1 follows the same convention for displaying parameter names as UCNSUMM. For example in the CPU Free Percentage area of the screen, COMCF..." indicates that three statistical values for COM Processor CPU Free may be trended by referring to $NMuuBnn.COMCFMlN, $NMuuBnn.COMCFMAX or $NMuuBnn.COMCFAVG.
- NODESTA2 follows the same convention with one additional detail. Note that under the Transaction Throughput Response column “NTRSP...(i)" appears. This indicates that $NMuuBnn.NTRSPAVG(i) gives the average number of responses per second that the node under study is sending to node i, while $NMuuBnn.NTRSPAVG(0) Gives the total number of responses per second that the node under study is servicing for all other nodes.

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