

Epic Biomedical Device Integration with Capsule

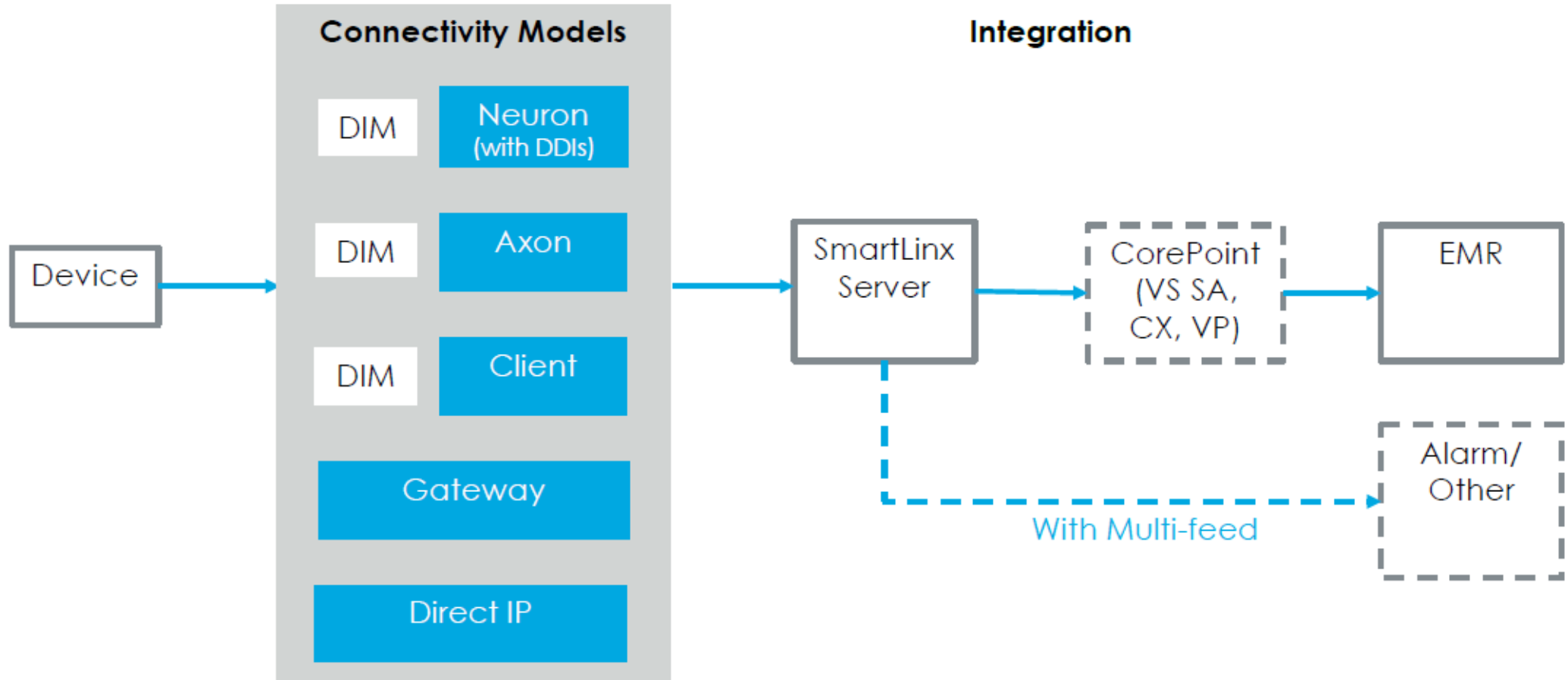
Agenda

1. Data flow to Epic from Capsule
 1. Connectivity overview
 2. Neurons / DIM's
 3. Axons:
 - Serial cables
 - Settings
 - Axon configuration
 4. SmartLinx

2. Troubleshooting
 1. Axon troubleshooting
 2. Ensemble
 3. Epic

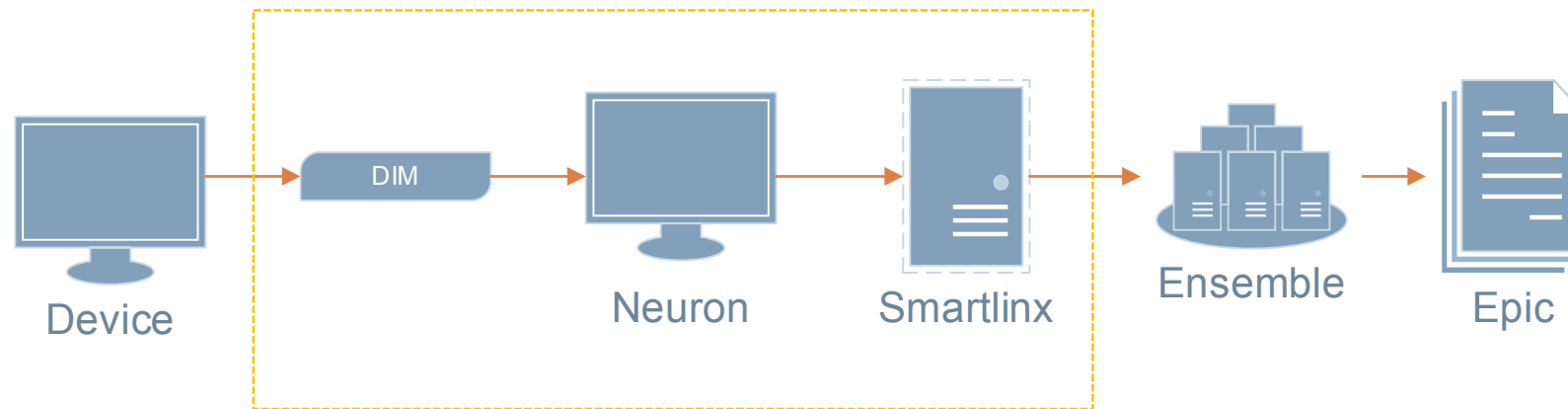
3. Advanced Troubleshooting
 1. MPI ID conventions
 2. Neuron data view
 3. SmartLinx
 - DMM Stacks
 - Output connectors
 - Loopback

Data path from device to EMR



DIM = Device Identification Module (DIM)

Data flow to Epic from Capsule



* New components *

Device to Neuron Connectivity



Device

Serial Cable

Connects to
medical
device

DIM

Identifies
device
connected

Patch Cable

Connects
DIM to
Neuron

Neuron

Manages
device
connectivity
at the bedside,
sends data to
server

Neurons

- Connects to Smartlinx server via PHS IS wired and wireless networks
- Collects parameters, alarms, and waveforms
- Neuron configuration contains drivers needed for device data
- Typically configured for a specific location (i.e. OR, ICU)
- Displays connected devices and current data transmission
- Can buffer data collected during loss of network (Axons cannot)
- Inputs:
 - Medical device data from DIMs
 - ADT info for current patient, if applicable
- Outputs
 - Medical device data to Smartlinx



Device Identification Module (DIM)

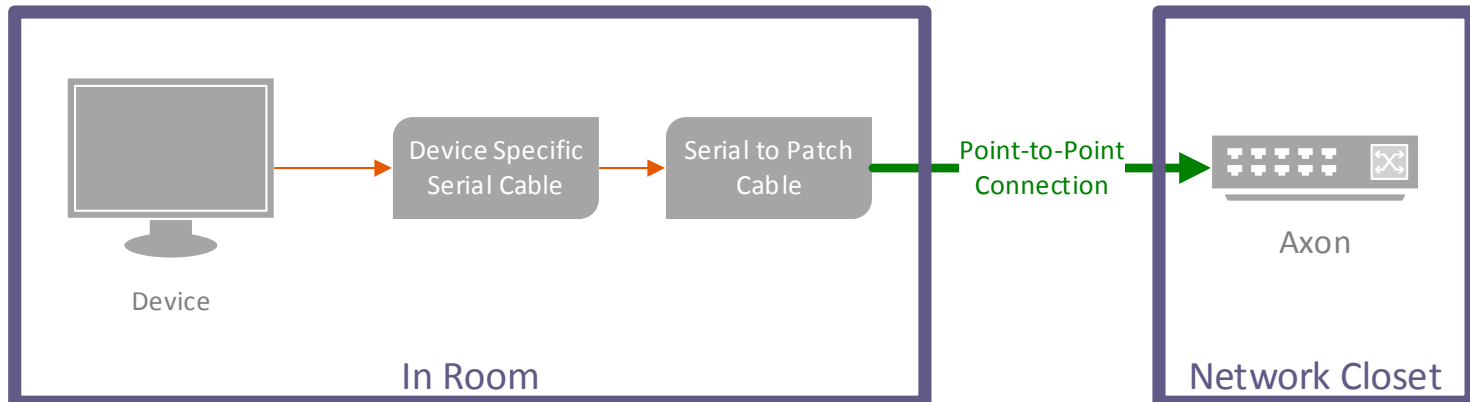
- DIM connects the medical device to Capsule's communication device on the network (Neuron or Axon)
 - We will not use DIMs for Axons
- You can program a DIM by connecting it to a Neuron and configuring on the Neuron interface- Label it
- DIM is programmed with:
 - Medical Device Type
 - Free Text label for identifying the device called "ID Tag" (i.e. MON1 , VENT1)
 - Baud Rate
 - Parity / Data / Stop



DIM usage allows you to connect the device into any port on the neuron.

Axons

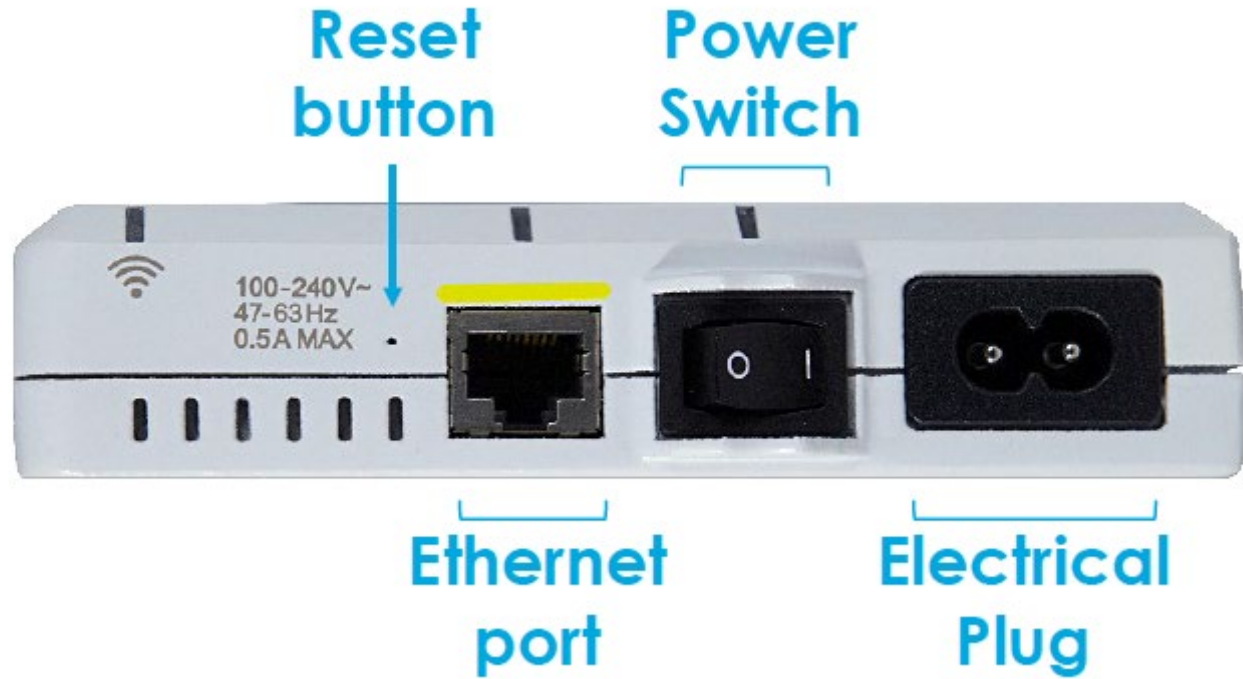
- 8-Port, 4-Port, & 1-Port Configurations
- Used in most Main Biomed areas (replaced Lantronix devices)
- Dialysis, Endoscopy, MRI areas, etc.
- Wired connection
- Each port is programmed to a specific room & device type
 - DIM's are not needed since we have same device type
- Only collects parameters from devices (no waveforms)
- Powered over ethernet
- No data caching



Device
Specific
Serial Cable

Serial to
Patch Cable

Axons



EPIC AND ENSEMBLE INFORMATION	
LOCATION	ENSEMBLE NAMING CONVENTION
BLAKE 4 ENDO HOLD (HOLD,PEDI, PROC)	MGHENDO_HOLD## (HOLD, PEDI, PROC)
BLAKE 4 ENDO REC (where @ is letter)	MGHENDO_REC@
CRP 9 ENDO	MGHENDO_CRPHOLD## (HOLD,REC,PROC)
YAW 8 PEDI HEME-ONC	MGHYAWPEDI_01
ELLISON 2 MRI	MGHMRI_ELL2##
WHITE 1 MRI	MGHED_MRI01
EP HOLDING ROOM	MGHEP_HOLD##
HEMODIALYSIS	MGHHD_BAY##
LUNDER 6 MRI/Proc Room	MGHMRI_LUNPROC01
MGW IR SUITE 1 (where @ is a letter)	MGHWALIR_1@
MGW ULTRASOUND IMAGING AREA (where @ is a letter)	MGHWALUS_4@

Device Specific Serial Cables and Settings

Device	Baud Rate	Parity/Data Bits/Stop Bits	Protocol
Solar	9600	N81	NA
Invivo Expression	9600	N81	Invivo
Carescape B series	19200	N81	NA
Dash Series	9600	N81	NA
Fresenius 2008T	9600	N81	NA

Device	Serial Cable	Additional Adapters
Solar	B1-CFB	
Invivo Expression	B1-CFA	
Carescape B Series	B1-CFT	USB to serial converter
Dash Series	B1-CAQ	
Fresenius 2008T	B1-CFH	

Capsule Patch Cables

Ordering Information

DataCaptor Device Cables: B1 - CFX

DataCaptor DIM Patch Cable 2 foot: B1-CPAT-DIM-2

DataCaptor DIM Patch Cable 5 foot: B1-CPAT-DIM-5

DataCaptor DIM Patch Cable 14 foot: B1-CPAT-DIM-14

DataCaptor Direct Patch Cable 5 foot: B1-CPAT-DIR-5

DataCaptor Direct Patch Cable 14 foot: B1-CPAT-DIR-14

DataCaptor DIM-to-PC Patch Cable 5 foot: B1-CPAT-DIMPC-5

DataCaptor DIM-to-PC Patch Cable 14 foot: B1-CPAT-DIMPC-14

DataCaptor Direct-to-PC Patch Cable 5 foot: B1-CPAT-DIRPC-5

DataCaptor Direct-to-PC Patch Cable 14 foot: B1-CPAT-DIRPC-14

Direct Patch Cable

Static connections to Terminal Server

- Connectors
 - to Device Cable: D-sub 9 pin (DE-9) male
 - to Terminal Server: RJ45
- Cable length not including connectors:
5 feet (1.5 m) or 14 feet (4.2 m)

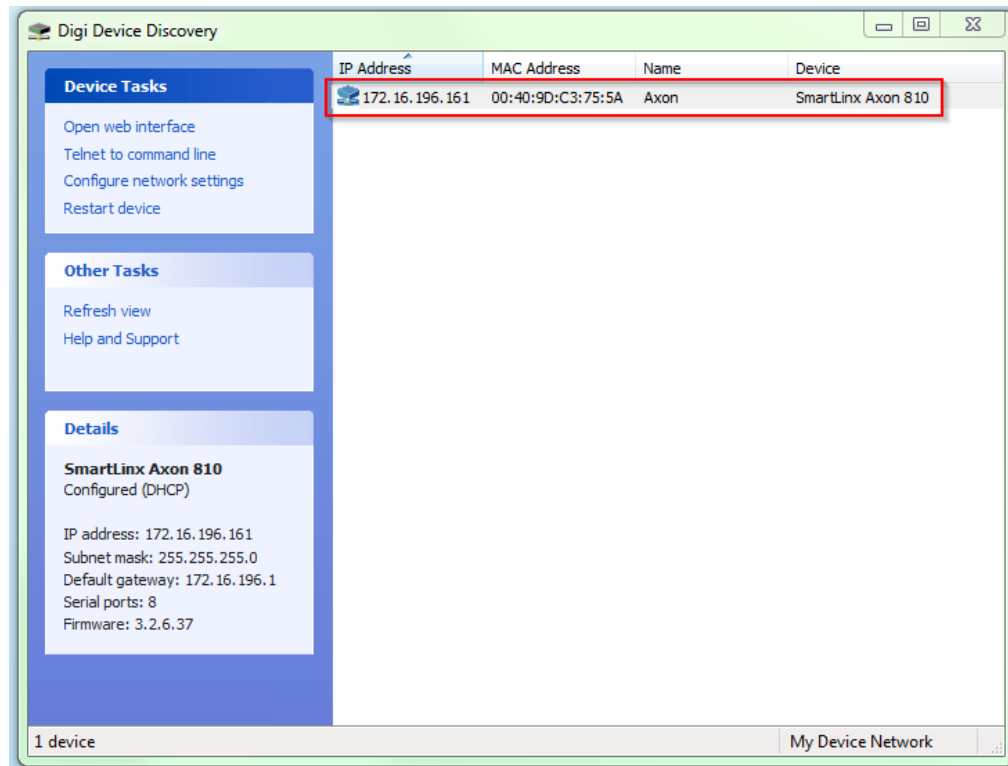
Configuring Axons

- Axons are set to DHCP by default
- Use Digi Device Discovery tool to discover the Axon on the network
 - Digi Tool PC and Axons must be on same subnet for discovery
- Download the tool from the Customer Portal
- If you know the Axon's IP, you can access the configuration directly
 - Open secure https browser connection to Axon IP
 - *Username: admin*
 - *Password: DTSadmin*
 - Password can be changed via Axon Web Interface

No logoff required, as it's a browser-based connection

Run Digi Device Discovery to find your Axons

[Link to Install Digi Device Discovery Tool](#)



1. Power on the axon & connect it to the network
2. Open the Digi Device Discovery tool from a PC on the same VLAN
3. Double-click the axon (this will open the Device Config web page)
 - a. If the axon, doesn't show up click "Refresh view"
4. Click Advanced and Proceed to...
5. Login
 - a. Username: admin
 - b. Password: DTSadmin
6. Configure the hostname
 - a. Click Ethernet Network.
 - b. Enter the axon hostname. Do not include the ".partners.org" If it is a spare axon, give it the next sequential spare hostname so it will be easier to swap in the future.
 - c. Click Apply.

Home

Configuration

Ethernet Network

Wireless Network

Serial Ports

Network Services

SNMP

Time

Admin Password

Administration

Certificate Management

Backup/Restore

Firmware Update

Factory Default Settings

Network Status

Serial Port Status

System Log

Find Me LED

Legal Notices

Reboot

Ethernet Network Configuration

Current IP Parameters

Automatic address assignment via DHCP is **enabled**.

IP Address: 172.16.196.161
Subnet Mask: 255.255.255.0
Default Gateway: 172.16.196.1

Interface Configuration

Enable this network interface

Speed: Duplex Mode:

Stored IP Configuration

Obtain an IP address automatically using DHCP

Enable AutoIP address assignment

Use the following IP address:

IP Address:
Subnet Mask:
Default Gateway:

Host Name Configuration

Host Name:

Domain Name Service Configuration

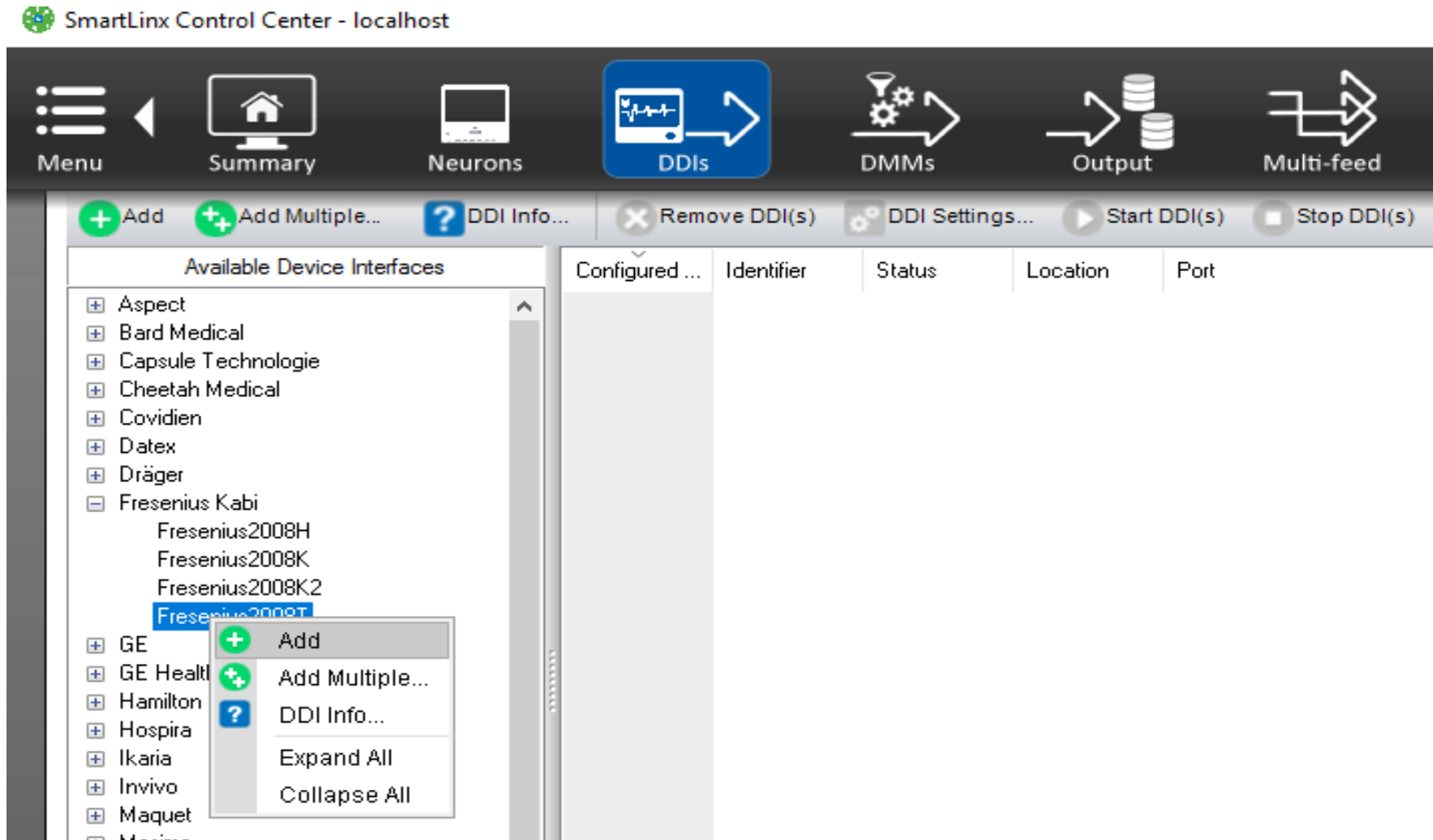
Primary DNS:
Secondary DNS:

big10dialysis1-axon

edmri-axon

Configuring Axons in SmartLinx

SmartLinx Control Center - localhost



The interface displays a navigation bar with icons for Menu, Summary, Neurons, **DDIs**, DMMs, Output, and Multi-feed. Below the navigation bar is a toolbar with buttons: Add, Add Multiple..., DDI Info..., Remove DDI(s), DDI Settings..., Start DDI(s), and Stop DDI(s).

The main area is divided into two panes. The left pane, titled "Available Device Interfaces", lists various manufacturers and their models. The right pane, titled "Configured ...", is currently empty.

Configured ...	Identifier	Status	Location	Port
----------------	------------	--------	----------	------

The "Available Device Interfaces" list includes:

- Aspect
- Bard Medical
- Capsule Technologie
- Cheetah Medical
- Covidien
- Datex
- Dräger
- Fresenius Kabi
 - Fresenius2008H
 - Fresenius2008K
 - Fresenius2008K2
 - Fresenius2008T
- GE
- GE Health
- Hamilton
- Hospira
- Ikaria
- Invivo
- Maquet
- Medison

A context menu is open over the "Fresenius2008T" item, showing the following options:

- Add
- Add Multiple...
- DDI Info...
- Expand All
- Collapse All

Configuring Axons in SmartLinx

SmartLinx Control Center - localhost

The screenshot displays the SmartLinx Control Center interface. At the top, a navigation bar includes icons for Menu, Summary, Neurons, DDI (highlighted), DMMs, Output, and Multi-feed. Below this is a toolbar with buttons for Add, Add Multiple..., DDI Info..., Remove DDI(s), DDI Settings..., Start DDI(s), Stop DDI(s), Start All, Stop All, and Output Stream... The main area is divided into two panes. The left pane, titled 'Available Device Interfaces', lists various manufacturers and models, including Fresenius Kabi with sub-items Fresenius2008H, Fresenius2008K, Fresenius2008K2, and Fresenius2008T. The right pane shows a table of configured DDIs. A context menu is open over the 'Fresenius Ka' entry, which is currently 'Stopped'. The context menu options are: DDI Settings..., DDI Info..., Start DDI(s), Stop DDI(s), Remove DDI(s), Start All, and Stop All.

Configured ...	Identifier	Status	Location	Port
Fresenius Ka	None	Stopped		



+ Add
+ Add Multiple...
? DDI Info...
✖ Remove DDI(s)
⚙ DDI Settings...
▶ Start DDI(s)
⏸ Stop DDI(s)
▶▶ Start All
⏸⏸ Stop All
📄 Output Stream...

- Available Device Interfaces
- + Aspect
 - + Bard Medical
 - + Capsule Technologie
 - + Cheetah Medical
 - + Covidien
 - + Datex
 - + Dräger
 - Fresenius Kabi
 - Fresenius2008H
 - Fresenius2008K
 - Fresenius2008K.2
 - Fresenius2008T
 - + GE
 - + GE Healthcare
 - + Hamilton
 - + Hospira
 - + Ikaria
 - + Invivo
 - + Maquet
 - + Masimo
 - + Neuroptics
 - + Newport Medical Instruments
 - + NxStage
 - + Respirationics
 - + Respirationics, Inc.
 - + Sample Devices
 - + Somanetics
 - + Sorin
 - + Spectrum Medical

Configured ...	Identifier
Fresenius Ka...	None

Device Interface Configuration

These settings are used to assign your choice of identifier to this specific device connection (optional), and to provide the communication mode and port configuration for the Fresenius Kabi, Fresenius2008T.

Device identifier:

Communication mode:

Interface:

IP address or hostname:

Com port:

Baud rate:

Parity/Data/Stop:

Device Name : Fresenius Kabi, Fresenius2008T
 Identifier :
 DLL Name : E:\Program Files (x86)\Capsule Technologie\DataCaptor Interface Server\FreseniusF.dll
 Version : 5.1.3.5
 Status : ● Stopped

“MPI ID”^^DIM Name

MGHHD_BAY01^^HD1
MGHENDO_HOLD01^^MON1

HOSTNAME

big10dialysis1-axon.partners.org
big10dialysis1-axon.partners.org

****Please reference the below document
for device identifiers and hostnames****

[Axon port configurations](#)

Device Interface Configuration

These settings are used to assign your choice of identifier to this specific device connection (optional), and to provide the communication mode and port configuration for the Fresenius Kabi, Fresenius2008T.

Device identifier: MGHHD_BAY01^^HD1

Communication mode: Serial

Interface: SmartLinx Axon 800 Series

IP address or hostname: big10dialysis1-axon.partners.org

Search...

Com port: 1

Baud rate: 9600

Parity/Data/Stop: N81

OK

Cancel

Device Interface Configuration



These settings are used to assign your choice of identifier to this specific device connection (optional), and to provide the communication mode and port configuration for the Fresenius Kabi, Fresenius2008T.

Device identifier:

Communication mode:

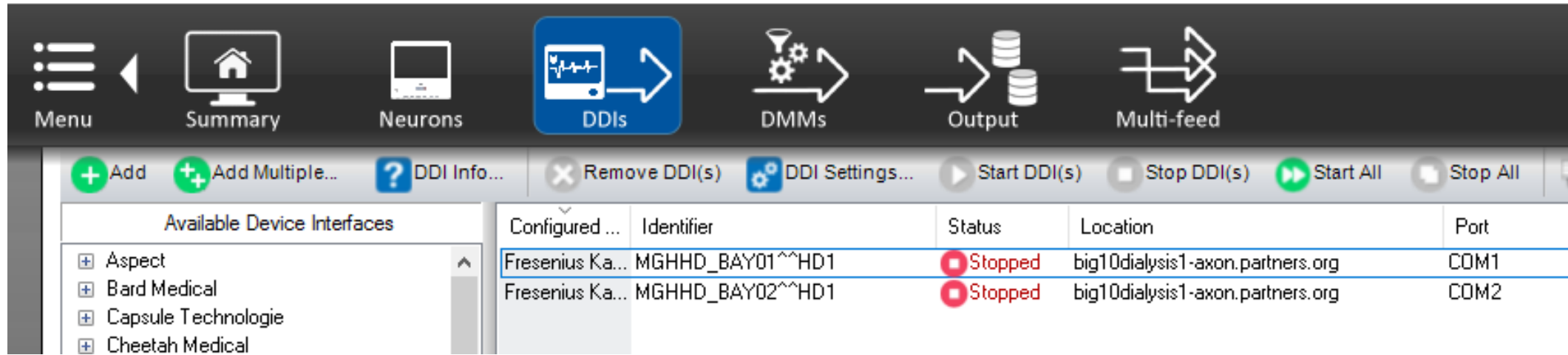
Interface:

IP address or hostname:

Com port:

Baud rate:

Parity/Data/Stop:



The screenshot displays the SmartLinx Control Center interface. At the top, there is a navigation bar with icons for Menu, Summary, Neurons, DDI (highlighted), DMMs, Output, and Multi-feed. Below this is a toolbar with buttons for Add, Add Multiple..., DDI Info..., Remove DDI(s), DDI Settings..., Start DDI(s), Stop DDI(s), Start All, and Stop All. The main area is divided into two panes. The left pane, titled 'Available Device Interfaces', lists manufacturers: Aspect, Bard Medical, Capsule Technologie, and Cheetah Medical. The right pane is a table with columns: Configured..., Identifier, Status, Location, and Port. Two rows are visible, both with a status of 'Stopped'.

Configured ...	Identifier	Status	Location	Port
Fresenius Ka...	MGHHD_BAY01^^HD1	Stopped	big10dialysis1-axon.partners.org	COM1
Fresenius Ka...	MGHHD_BAY02^^HD1	Stopped	big10dialysis1-axon.partners.org	COM2

Once the Axon is connected to the IS network and the DDI's are started in SmartLinx, Production Validation testing must be done for each bed/location. Two minutes of data must be confirmed and recorded on the below tracker.

[Production Validation Tracker](#)

Safe Medical Device Zone

- The axons and neurons are required to be within an SMDZ subnet
 - Required to be behind a firewall
 - Firewall exceptions were submitted to IS security
- The MGH Capsule team is working with IS/Network engineering to convert the ports to an SMDZ subnet after deployment
 - Jared and I will be providing the MAC addresses to Network Engineering at a later date

MPI ID's and DEV Record Names (examples)

Department	Neuron/Axon Name	DIM Name	MPI-ID	DEV Name
Endoscopy Holding	MGHENDO_HOLD01	MON1	MGHENDO_HOLD01-MON1	MON ENDO-HOLD01 MGH
Endoscopy PEDI	MGHENDO_PEDI01	MON1	MGHENDO_PEDI01-MON1	MON ENDO-PEDI01 MGH
Endoscopy Proc	MGHENDO_PROC01	MON1	MGHENDO_PROC01-MON1	MON ENDO-PROC01 MGH
Endoscopy Recovery	MGHENDO_RECS	MON1	MGHENDO_RECS-MON1	MON ENDO-RECS MGH
Endoscopy CRP HOLD	MGHENDO_CRPHOLD11	MON1	MGHENDO_CRPHOLD11-MON1	MON HOLD-CRPHOLD11 ENDOSCO
CRP Recovery	MGHENDO_CRPREC01	MON1	MGHENDO_CRPREC01-MON1	MON ENDO-CRPREC01 MGH
Ellison MRI	MGHMRI_ELL201	MON1	MGHMRI_ELL201-MON1	MON MRI-ELL201 MGH
EP/Pacer Lab	MGHEP_01	MON1	MGHEP_01-MON1	MON EP-01 MGH
Lunder MRI	MGHMRI_LUNPROC01	MON1	MGHMRI_LUNPROC01-MON1	MON MRI-LUNPROC01 MGH
Emergency	MGHED_MRI01	MON1	MGHED_MRI01-MON1	MON ED-MRI01 MGH
MGH Yawkey Onc	MGHYAWPEDI_07	MON1	MGHYAWPEDI_07-MON1	MON Onc-07 MGH YAW
MGH Waltham Imaging	MGHWALIR_01A	MON1	MGHWALIR_01A-MON1	MON IR-01A MGH WAL
Dialysis	MGHHD_BAY01	HD1	MGHHD_BAY01-HD1	HD HD-BAY01 MGH

SmartLinx

- Communicates to Ensemble for Epic integration
- Interface / Application server configured in clusters of 3 servers

“Perioperative” cluster

Server	Ensemble DNS	Ensemble Port	Ensemble Interface
PHSWEB1517	HSBIOOX.PARTNERS.ORG	55373	3283a
PHSWEB1512*	HSBIOOX.PARTNERS.ORG	55374	3283b
PHSWEB1515	HSBIOOX.PARTNERS.ORG	55375	3283c

“Inpatient/ICU” cluster

Server	Ensemble DNS	Ensemble Port	Ensemble Interface
PHSWEB2464	HSBIOOX.PARTNERS.ORG	55376	3283d
PHSWEB1551	HSBIOOX.PARTNERS.ORG	55377	3283e
PHSWEB1511	HSBIOOX.PARTNERS.ORG	55378	3283f



SmartLinx

- Runs two applications:
 - Smartlinx Command Console – data and output management
 - Capsule Command Console (C3) – Neuron management
- Inputs:
 - Raw medical device data
- Outputs:
 - Filtered and transformed device data as HL7 messages



Axon Troubleshooting

Physical Connections

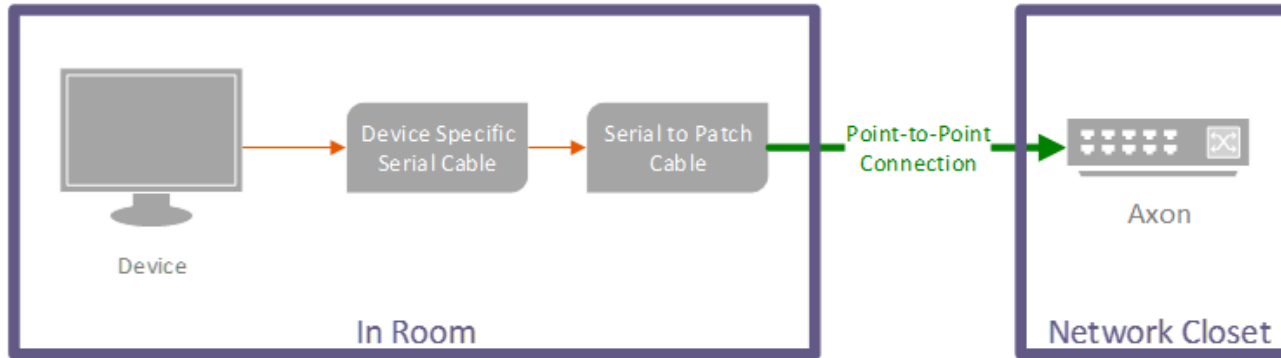


Figure 1 General Device Connection Setup in Areas using Axons

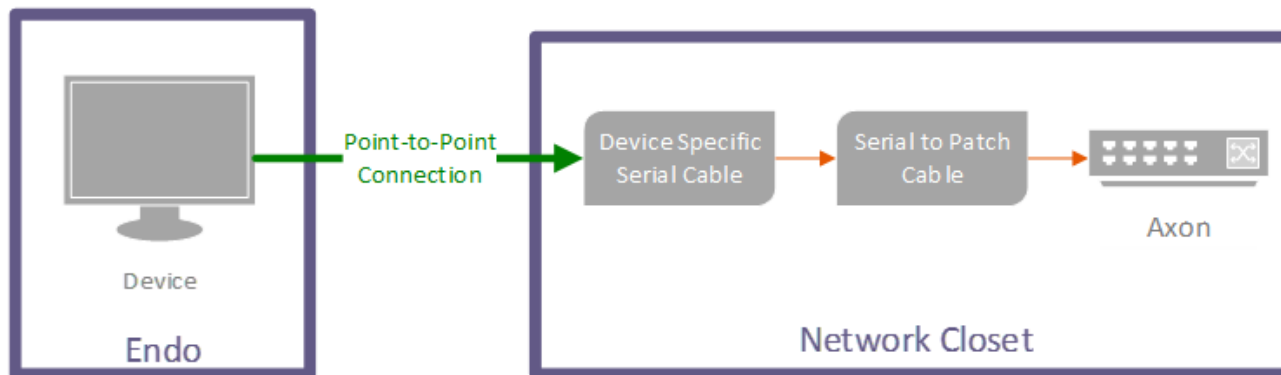


Figure 2 Endo Axon Setup

Axon Troubleshooting



Figure 3 Device Specific Serial Cable & Serial to Patch Cable

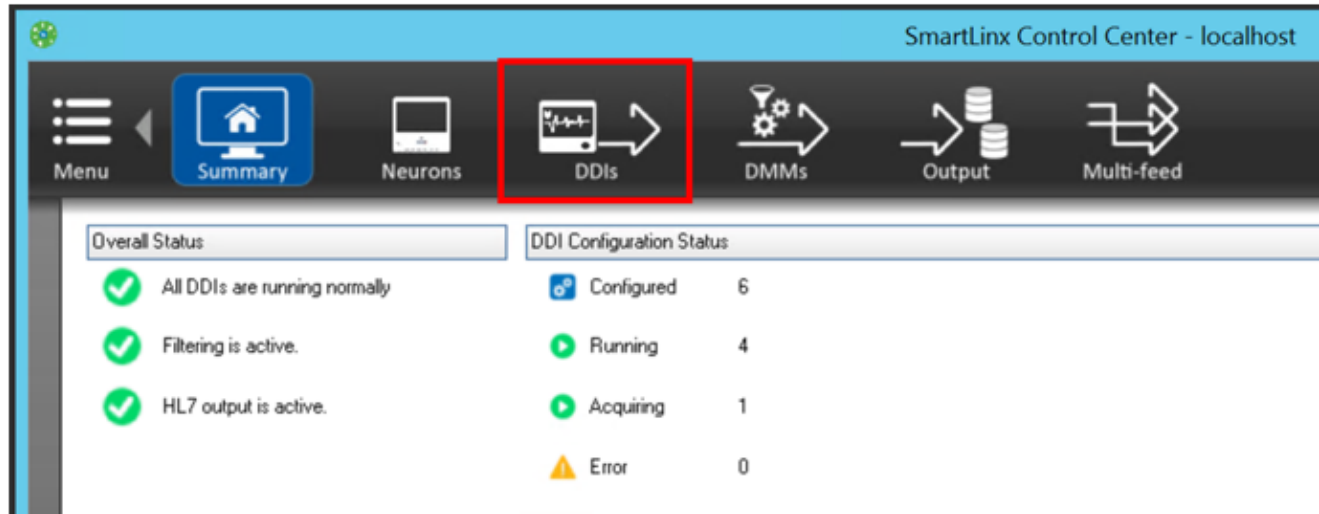
Device Specific Serial Cables

Device	Serial Cable
Dash	B1-CAQ
<u>Invivo Expression</u>	B1-CFA
Solar	B1-CFB
<u>Tiro</u>	B1-CFB
B450	B1-CFT
Fresenius 2008T	B1-CFH

Axon Troubleshooting

Restart DDIs

1. Remote into server phsweb1512
2. Launch the SmartLinx Control Center.
3. Click DDIs. Each room is programmed as an individual DDI.



4. Select the room(s), showing issues.
5. Ensure that the Status is set to "Acquiring"
6. If the DDI says "Stopped", select it & then click "Start DDI"

GE, Dash 4000 MGHENDO_HOLD01^^MON1 Stopped 172.16... COM7

7. If the DDI says "Acquiring", you can stop and then start it again.

GE, Dash 4000 MGHENDO_HOLD01^^MON1 Acquiring 172.16... COM7

8. To check if data is being received by the Axon, select the room(s) and click Output stream.

Axon Troubleshooting

Rebooting an Axon Remotely

1. Login into server phsweb1512
 - a. *Note:* You can only access axons from server because of SMDZ restrictions
2. In Chrome, navigate to the axon's hostname.
3. Click Advanced and Proceed to x.x.x.x (unsafe)
4. Login using:
 - a. Username: admin
 - b. Password:
5. Under Administration, go to Reboot and click Reboot.
 - a. *Note:* Unlike the Neurons, the Axons do not have memory so the user will lose data while the device reboots.

The screenshot displays the Capsule web interface for a SmartLinux Axon 810. The main content area shows a 'System Reboot Confirmation' dialog box with the text: 'The reboot process will take approximately 1 minute to complete. Click Reboot now to reboot the device.' A red box highlights the 'Reboot' button in this dialog. On the left sidebar, under the 'Administration' section, the 'Reboot' link is also highlighted with a red box. The sidebar menu includes: Home, Configuration (Ethernet Network, Wireless Network, Serial Ports, Network Services, SNMP, Time, Admin Password), and Administration (Certificate Management, Backup/Restore, Firmware Update, Factory Default Settings, Network Status, Serial Port Status, System Log, Find Me LED, Legal Notices, and Reboot).

Axon Troubleshooting

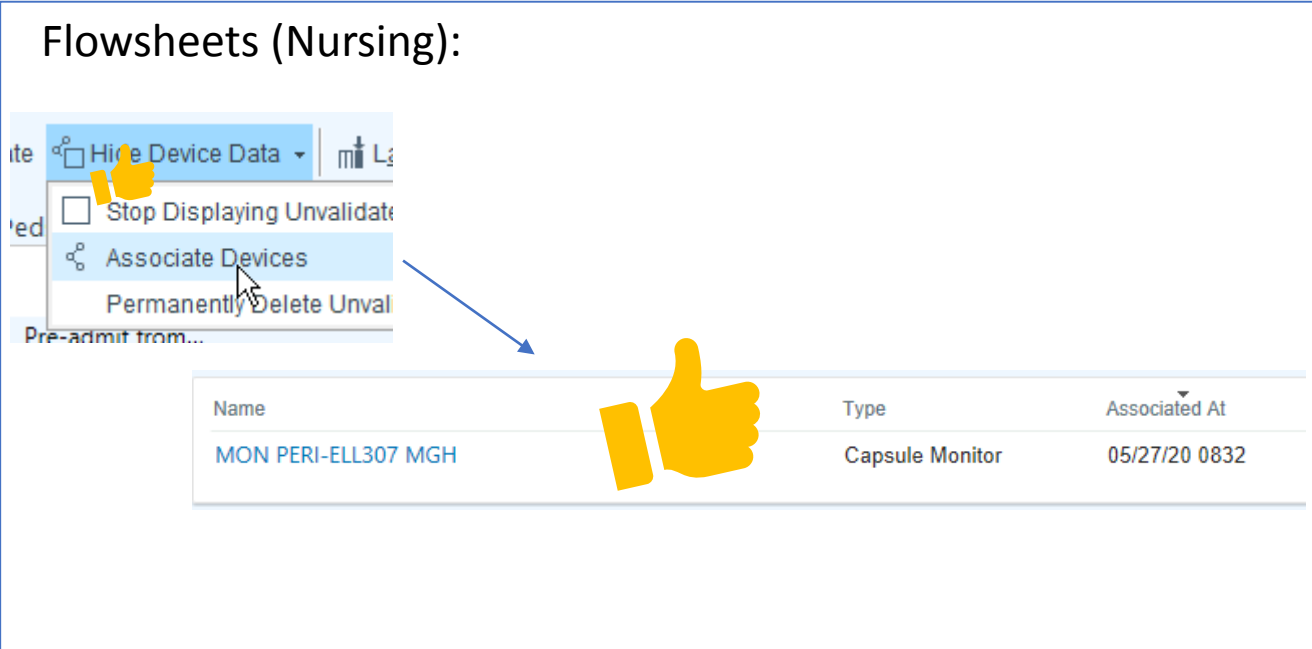
Swapping an Axon

1. Connect the Spare axon to a regular IS jack.
2. In Chrome, navigate to the axon's hostname.
3. Click Advanced and Proceed to...(unsafe)
4. Login using:
 - a. Username: admin
 - b. Password: White401
5. Click Ethernet Network.
6. Change the hostname to the hostname of the axon you're replacing.
7. Click apply.
8. You can shutdown the axon and swap it out with the broken one.
9. After installing it, check if data is being received in Ensemble. It may take a few minutes. If not, try stopping & starting the DDIs for that axon.

Troubleshooting: Data in Epic

- Check Epic first: Make sure the device is associated in EPIC and check data interval time (i.e. 1 minute versus 1 hour)
- Confirm:
 - Correct DEV record is attached
 - In flowsheets: device data is not hidden

Flowsheets (Nursing):



The screenshot shows a context menu with the following options:

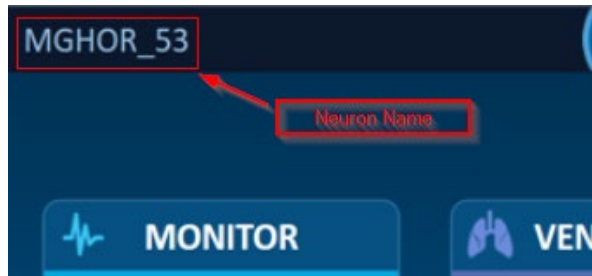
- Hide Device Data
- Stop Displaying Unvalidated
- Associate Devices
- Permanently Delete Unvalidated

Below the menu is a table with the following data:

Name	Type	Associated At
MON PERI-ELL307 MGH	Capsule Monitor	05/27/20 0832

Troubleshooting: Neuron Data in Ensemble

- Ensemble MDEV Message View: <http://ensutils.partners.org/MDEV/Recipients.aspx>
- Search by Neuron name in filter string



Basic Settings

Environment:

Application:

Source:

Basic Settings (Cont.)

Event Type:

Target:

Status:

Dates/Filters

Start Date:

End Date:

Filter String:

Source	Application Service EventType	Target	Date/Time Received Date/Time Sent	Pat_Name_(PID-5) Pat_Id_List_(PID-3) Device	Recipient_Message_Status
Source Message	MGH Capsule 3283a_MGH_Capsule_ORU_HL7_in ORU^R01	541359_Epic_HL7_TCP_out Target Message Target Response	5/27/2020 8:47:00 AM 5/27/2020 8:47:00 AM	N/A N/A MGHOR_53^ANES1	*Sent*
Source Message	MGH Capsule 3283a_MGH_Capsule_ORU_HL7_in ORU^R01	541359_Epic_HL7_TCP_out Target Message Target Response	5/27/2020 8:46:00 AM 5/27/2020 8:46:00 AM	N/A N/A MGHOR_53^ANES1	*Sent*



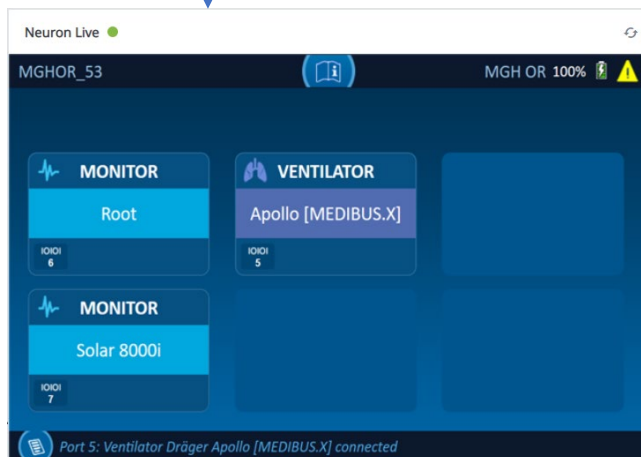
Troubleshooting: Axon Data in Ensemble

- Ensemble MDEV Message View: <http://ensutils.partners.org/MDEV/Recipients.aspx>
- Search by Axon/Port name in filter string

Troubleshooting: Neuron connected

- Neurons can be updated and viewed through the Capsule Command Console (C3)
- C3 hub view allows you to confirm the Neuron (hub) is active and devices are connected

Hub ID	Location	Status	Devices
00187DC8F97C	MGHOR_53	Connected	3



Clicking on the "Hub ID" link will take you to a page showing the current configuration of the Neuron, including a live view of the Neuron display

Advanced Troubleshooting

Advanced: Neuron MPI ID Conventions

- “MPI ID” is the unique identifier for a device
- The identifier is sent in two separate parts out of Smartlinx: PV1-3.1 and 3.3.
- 3.1 contains the Neuron name and 3.3 has the DIM Tag
- Those two components are put together on receipt into Epic to be read as the MPI ID

Ensemble message:

```
1MSH|^~\&|DATACAPTOR|. . . |20200603082200.498-0400|. . |ORU^R01|0603082
2PID|. . .
3PV1|. . |I|MGHOR_53^ . ^ANES1|.
4OBR|. . . |20200603082200.000-0400|. . |MGHOR_53|. . |MGHOR_53|. .
```

Annotations: "Neuron name" points to MGHOR_53, "DIM ID Tag" points to ANES1.

MGH_B08_B0874A VENT1

Epic DEV build:

Rel	5000-MPI: ID TYPE	5001-MPI: ID
0	1. 1	1. 1 Combined
1	1. DEVICE [12]	1. MGHOR_53-ANES1

MGH_B08_B0874A-VENT1

Advanced: Neuron MPI ID Conventions

- “MPI ID” is the unique identifier for a device
- Both parts of the identifier are sent out of Smartlinx in PV1-3.1 as the configured name of the port in for the axon DDI
- Those two components are put together on receipt into Epic to be read as the MPI ID

Ensemble message:

MGH_B08_B0874A-VENT1

MGHHD_BAY02-HD1

Epic DEV build:

VENT BLK08-874 MGH

HD HD-BAY01 MGH

Advanced: Neuron data view

- Data captured from the device at the Neuron can be viewed
- Must connect from C3 on the server hosting the Neurons current connection
- Previewing live data is available from the Neuron Details page in C3

Port	Device ID	Status	Manufacturer	Model	Type
5	{10546248-2D...	Connected	Dräger	Apollo [MEDIB...	-



Preview Live Data



Variable IDs in the DDI Output live view can be referenced in the Help File available on the Capsule customer portal.

DDI Output

Menu Grid View XML View

Original Data Filtered Data Pipeline: All

Variable ID	Variable Name	Address	Value	Unit	Unit Description
169	????	Pipeline: Default se...	40	71	-
625	????	Pipeline: Default se...	0	4	-
754	????	Pipeline: Default se...	Apollo	139	-
2255	????	Pipeline: Default se...	20200529123559	139	-
3425	????	Pipeline: Default se...	1021	44	-

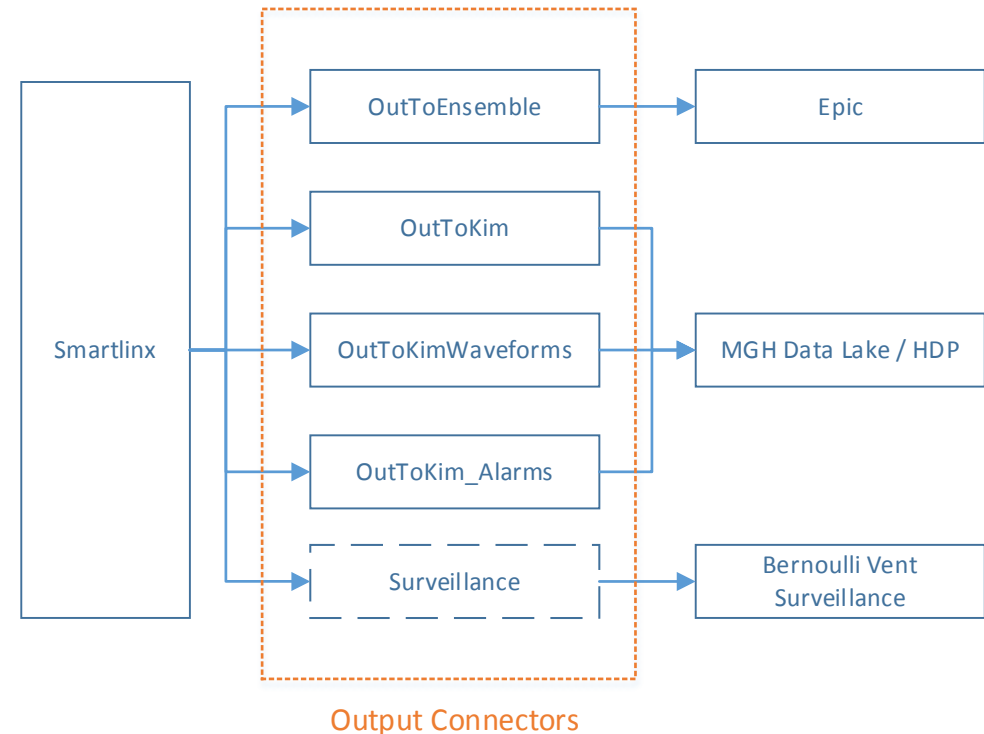
Advanced: SmartLinx DMM Stack

- In SmartLinx, device data from a Neuron or Axon is filtered and transformed by Data Management Modules (DMMs)
- DMMs allow us to set frequency of data collection, parameter selection and other rules that determine final format and volume of data sent to downstream systems
- Rules are additive, with rules on top of GUI applied first

The screenshot displays the SmartLinx DMM Stack interface. The top bar includes controls for 'Save and Apply All', 'Start DMM', 'Stop DMM', 'Start All', and 'Stop All', along with a 'Pipelines' dropdown menu set to 'Default server pipeline'. The main area is divided into two panes. The left pane, titled 'DMMs', lists various modules with their status (activated or disabled) and a 'Filter disabled and up to date' or 'Filter activated and up to date' indicator. The right pane shows the configuration for the 'Data Selection' module, which is currently active. It features a table with columns for 'Variable', 'Device Name', and 'DI'. The table lists various respiratory and gas-related variables such as 'Respiration Rate (CO2)', 'Tidal Volume', and 'Ventilation Mode' across different devices like 'Apollo', 'Fabius Tiro', and 'Fabius MRI'. Below the table, there are control buttons for '+ Add rule', 'Remove rule', 'Remove all rules', 'Copy rule', 'Move rule up', and 'Move rule down'. A small information box at the bottom right of the right pane states: 'Data Selection This DMM selects the variables to remove from or keep in the data stream.'

Advanced: SmartLinx Outputs

- Output connectors send HL7 messages to defined recipients
- Can be configured using a number of different profiles
- Each output has a corresponding “loopback” – a broadcast port that we can view messages in the same configuration as the output.



Advanced: HL7 Loopbacks

- Should be stopped when not in use to conserve resources on the server
- Configured as a “server” listening on a port configured locally with the same output settings as one of the clients sending data to Ensemble, Data Lake or Bernoulli
- Pipeline to Output connector mapping can be seen in the “Multi-feed” tab

The screenshot shows the Ensemble software interface with the 'Output' tab selected. The 'Output Stream...' button is circled in red. Below the toolbar is a table of output configurations:

Name	Type	Communication Settings
AlarmData	Socket Server Transport	Listen on 172.18.101.236 port 7025
EpicProd	Socket Client Transport	Connect to LocalHost port 7001
HighResParams	Socket Server Transport	Listen on 172.18.101.236 port 7030
OutToKim	Socket Client Transport	Connect to PHSQLwEB437 port 7040

To the right, a terminal window titled 'HL7 Output from : HighResParams' displays the following HL7 data:

```
MSH|^~\&|DATACAPTOR|MGH|||20200608085635||ORU^R01|0608085635341d61|P|2.3|||8859/1|
PID||3120756|||19440217|F|||||3307828083|
PV1|||MGH B08^B0878^B0878 A^MGH^B850|
OBR||||20200608085644|||(7780CDBA-F8B0-4F2D-9E42-B0F97C0EEB76)^CARESCAPE B850||MGH_B08_B0878A|
OBX|1|NM|2664|BP1|11|139||||F||20200608085644|
OBX|2|NM|501|BP1|10800|11||||F||20200608085644|
OBX|3|NM|502|BP1|5600|11||||F||20200608085644|
OBX|4|NM|503|BP1|7600|11||||F||20200608085644|
OBX|5|NM|1242|BP1|88|1||||F||20200608085644|
OBX|6|NM|2664|BP2|11|139||||F||20200608085644|
OBX|7|NM|504|BP2|2800|11||||F||20200608085644|
OBX|8|NM|505|BP2|1100|11||||F||20200608085644|
OBX|9|NM|506|BP2|1800|11||||F||20200608085644|
OBX|10|NM|2664|BP3|11|139||||F||20200608085644|
OBX|11|NM|4093|BP3|900|11||||F||20200608085644|
OBX|12|NM|2664|BP4|3|139||||F||20200608085644|
OBX|13|NM|2664|BP5|0|139||||F||20200608085644|
OBX|14|NM|2664|BP6|0|139||||F||20200608085644|
OBX|15|NM|2664|BP7|0|139||||F||20200608085644|
OBX|16|NM|2664|BP8|0|139||||F||20200608085644|
```