MASSACHUSETTS GENERAL HOSPITAL
BIOMEDICAL ENGINEERING

Epic Biomedical Device Integration with Capsule

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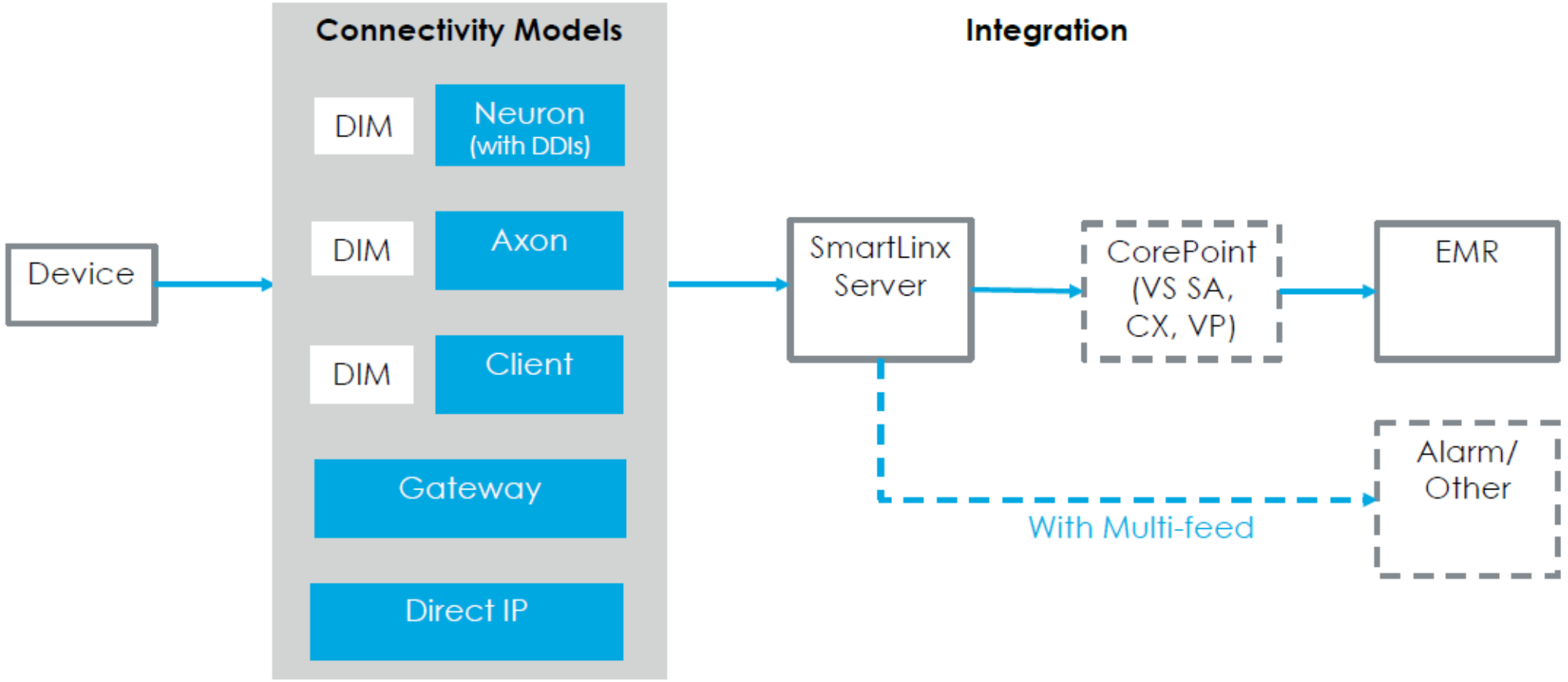
Agenda

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

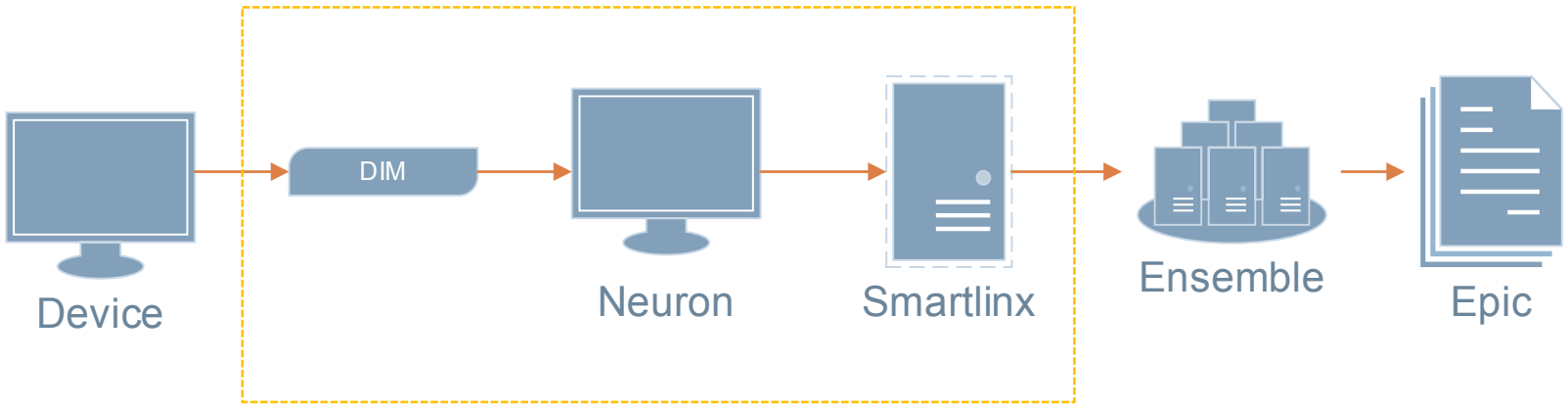
Data path from device to EMR



DIM = Device Identification Module (DIM)

capsule

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

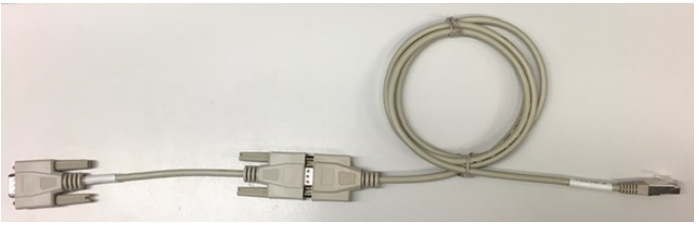
Device Identification Module (DIM)

- 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.

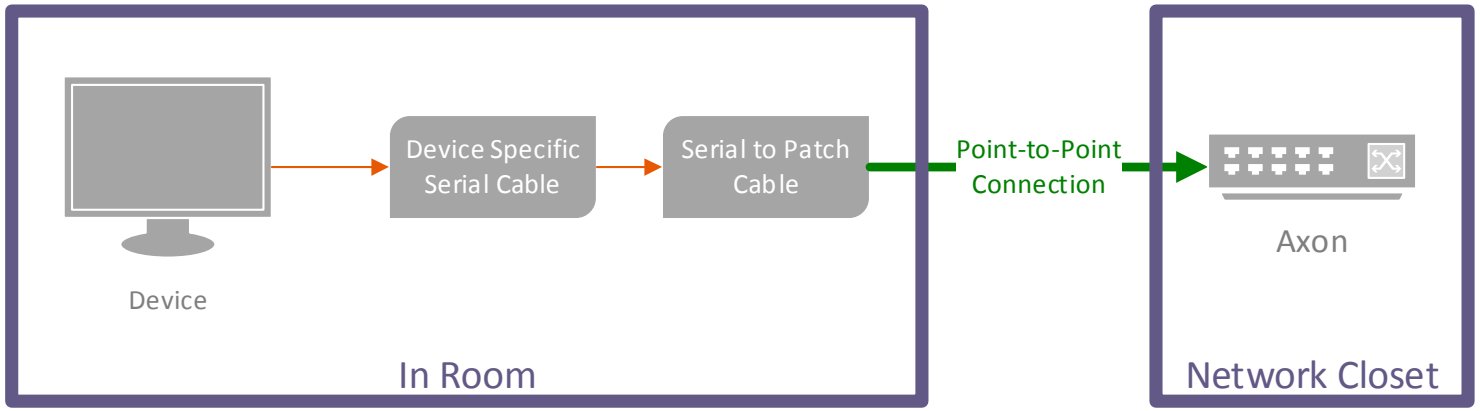
Axons

- 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

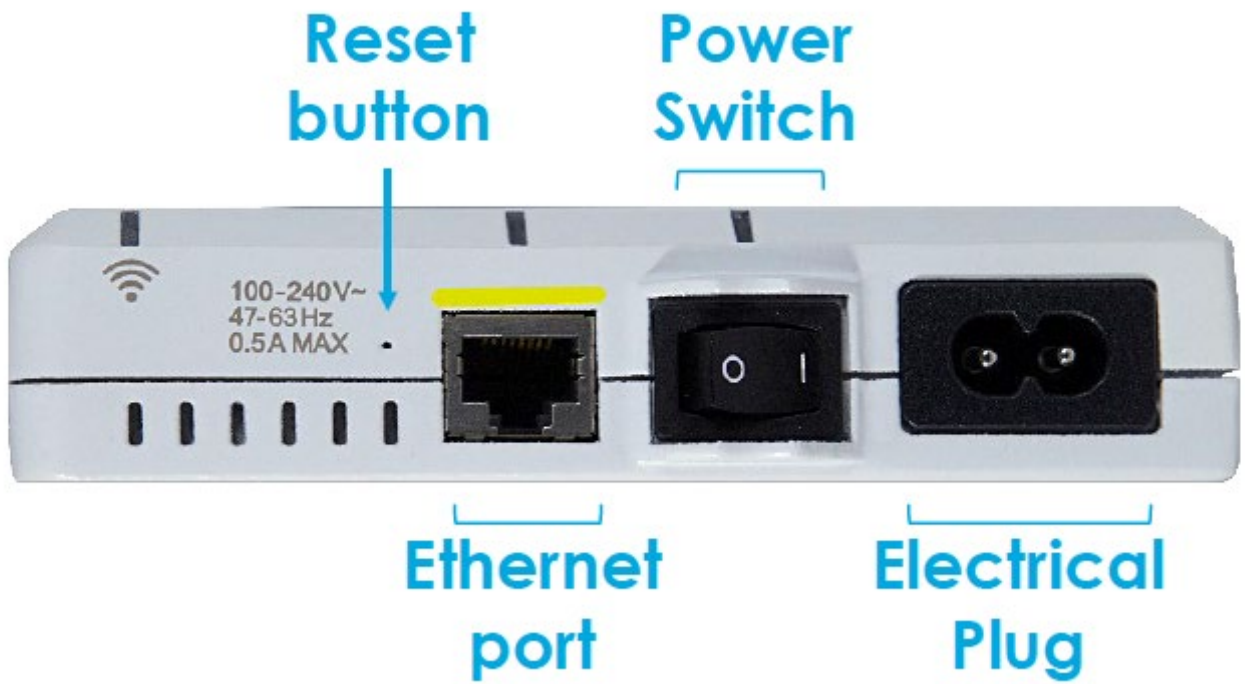


Device Specific Serial Cable

Serial to Patch Cable



Axons


Reset button
Power Switch
100-240V~
47-63Hz
0.5A MAX
O I
Ethernet port
Electrical Plug

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)

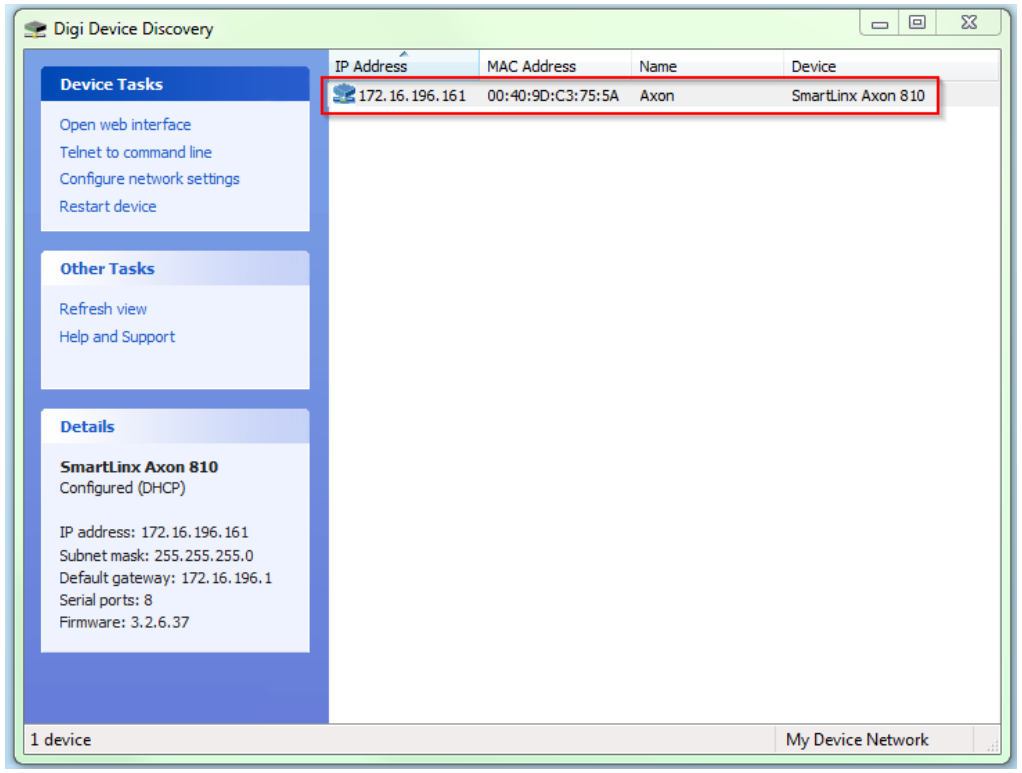
Configuring Axons

- 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.

Device Configuration and Management

SmartLinx Axon 810

Home

Configuration
1
- 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: Auto Duplex Mode: Auto

Stored IP Configuration

◉ Obtain an IP address automatically using DHCP

☑ Enable AutoIP address assignment

○ Use the following IP address:

IP Address:	0.0.0.0
Subnet Mask:	0.0.0.0
Default Gateway:	0.0.0.0

2
Host Name Configuration

Host Name: Axon

Domain Name Service Configuration

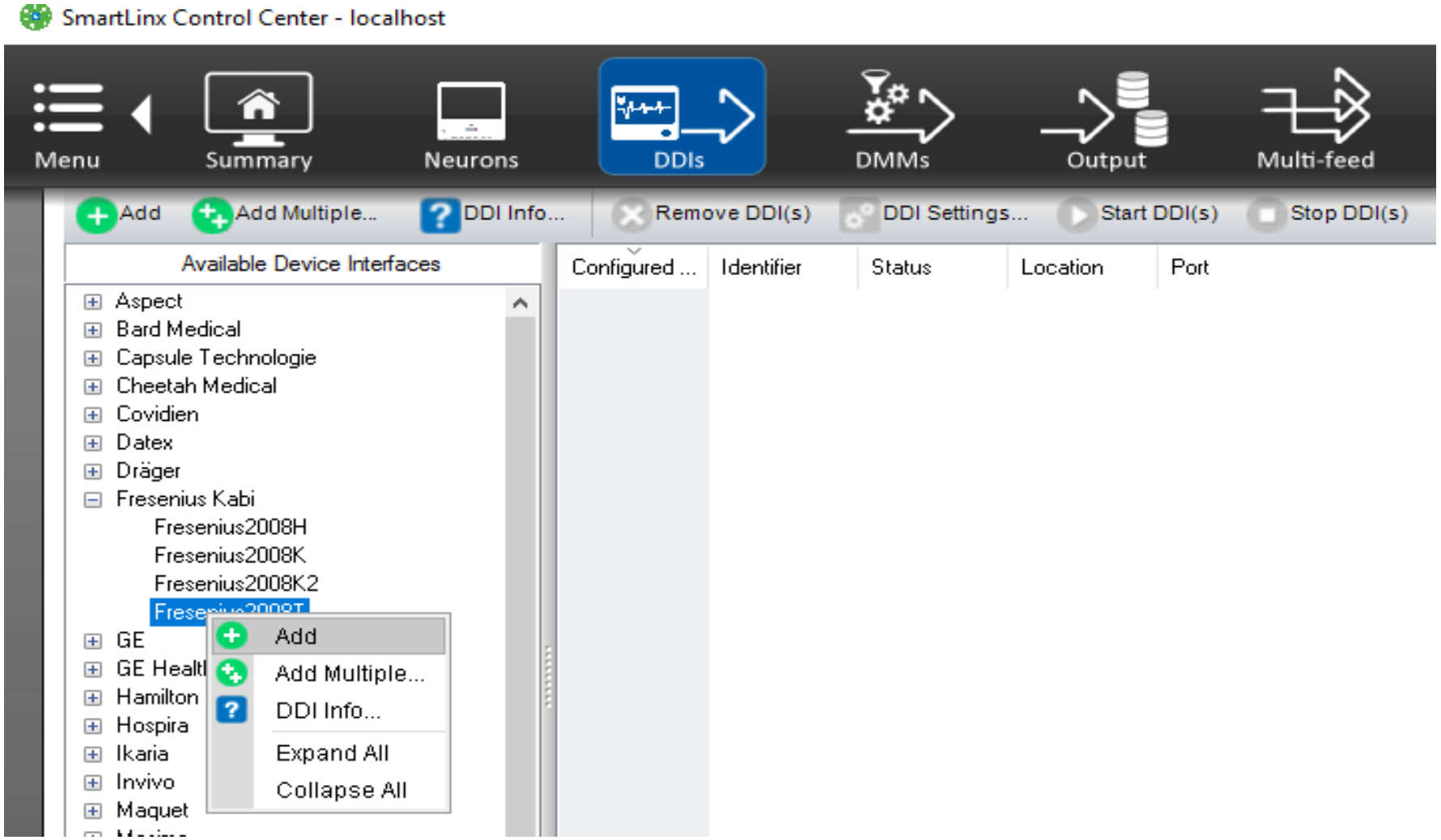
Primary DNS:	8.8.8.8
Secondary DNS:	0.0.0.0

3
Apply

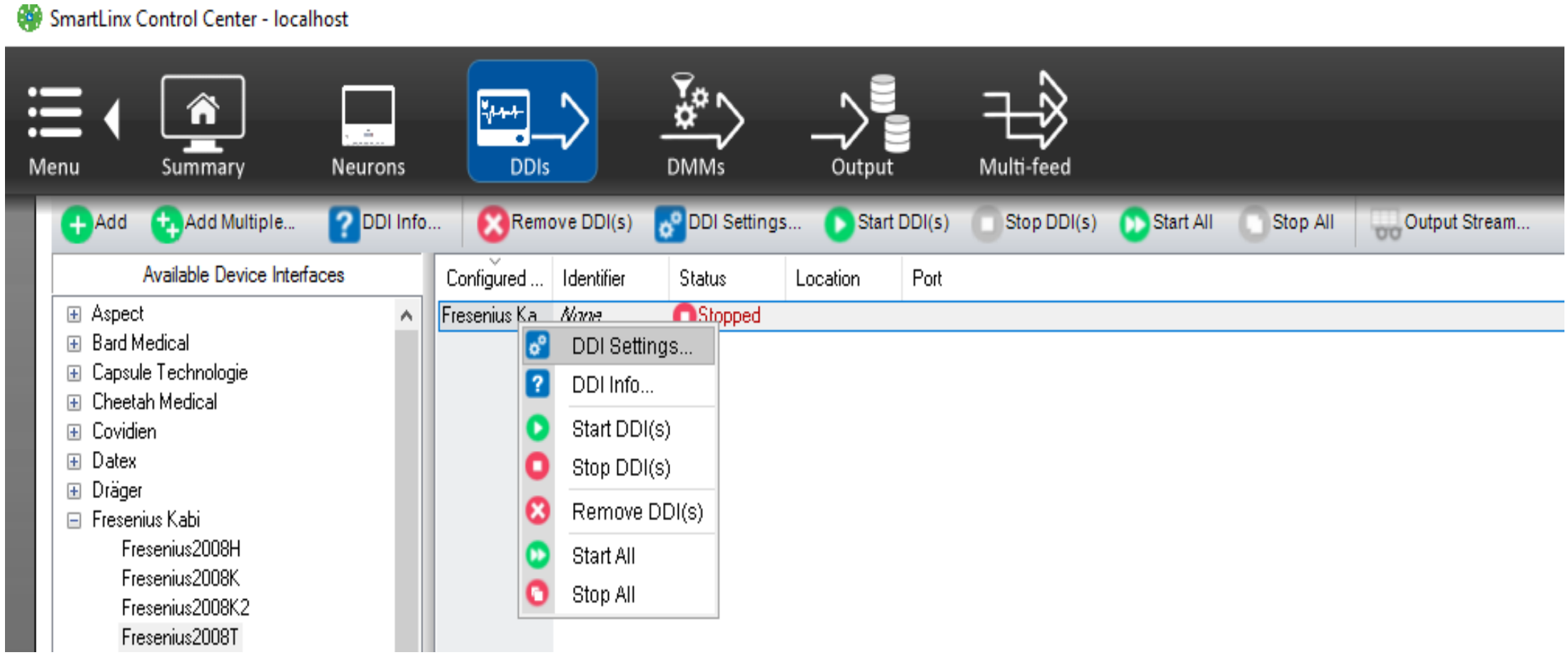
big10dialysis1-axon

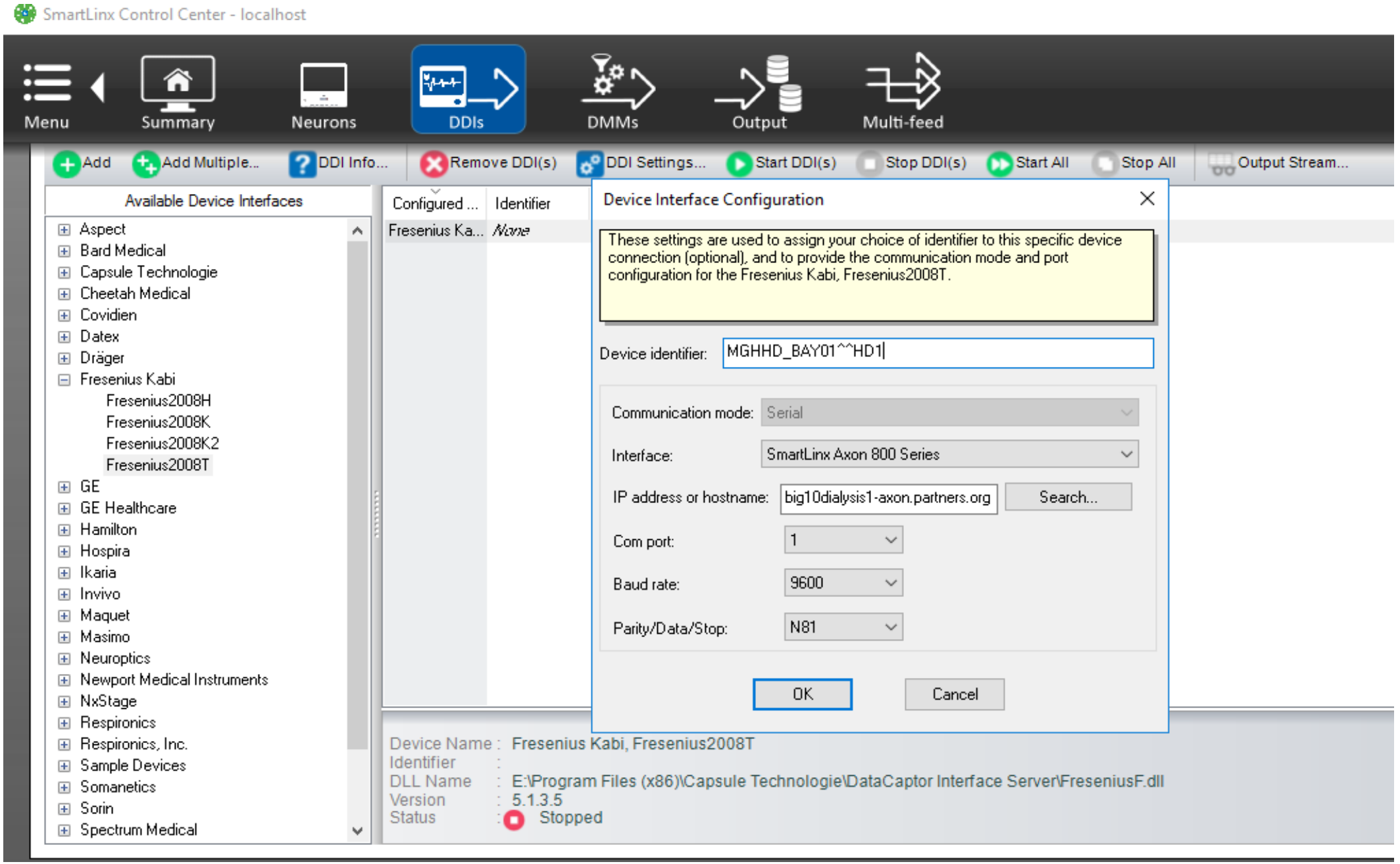
edmri-axon

Configuring Axons in SmartLinx



Configuring Axons in SmartLinx




SmartLinx Control Center - localhost
Menu
Summary
Neurons
DDIs
DMMs
Output
Multi-feed
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
Fresenius2008K2
Fresenius2008T
GE
GE Healthcare
Hamilton
Hospira
Ikaria
Invivo
Maquet
Masimo
Neuroptics
Newport Medical Instruments
NxStage
Respironics
Respironics, 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:
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 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

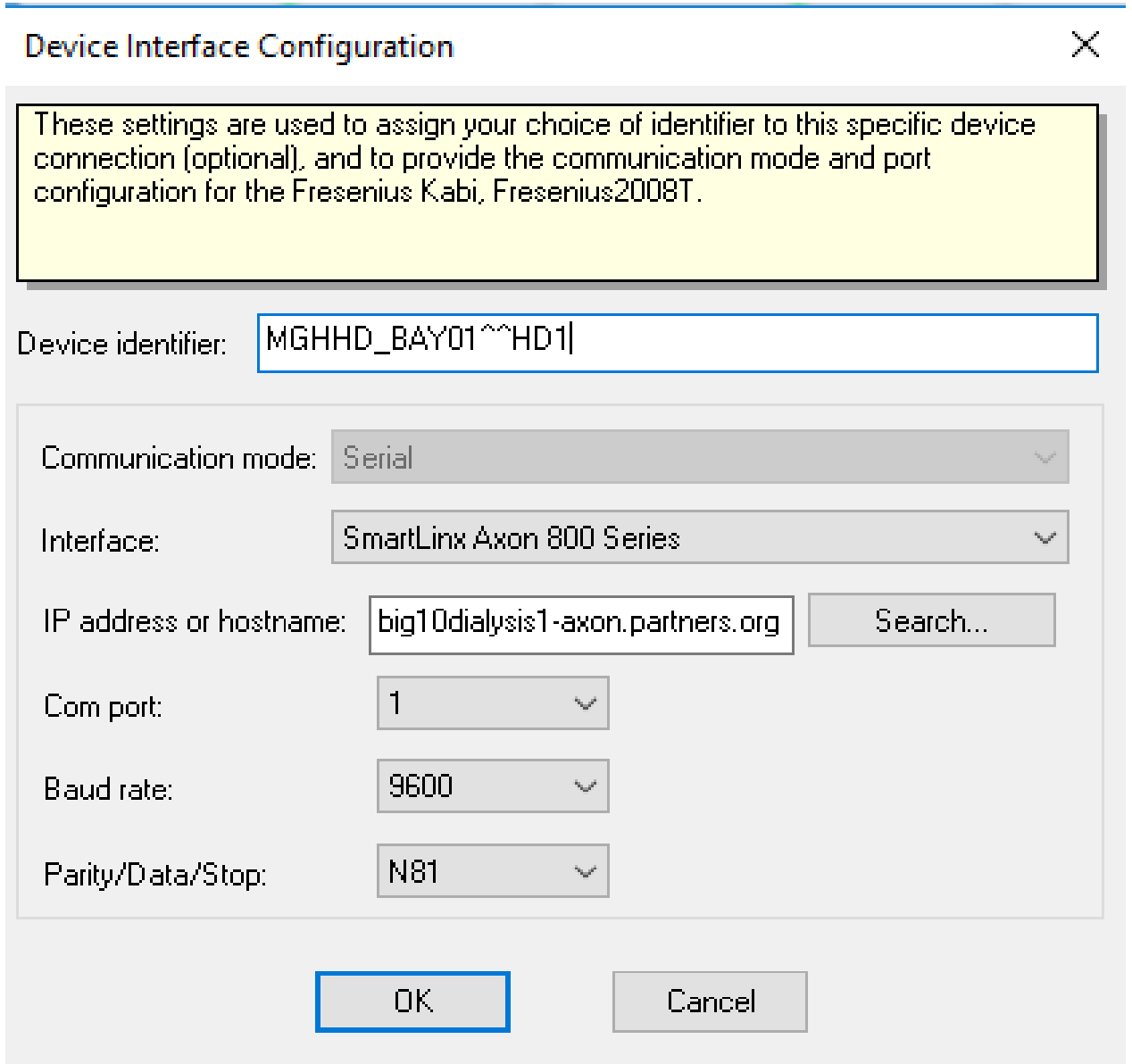
HOSTNAME

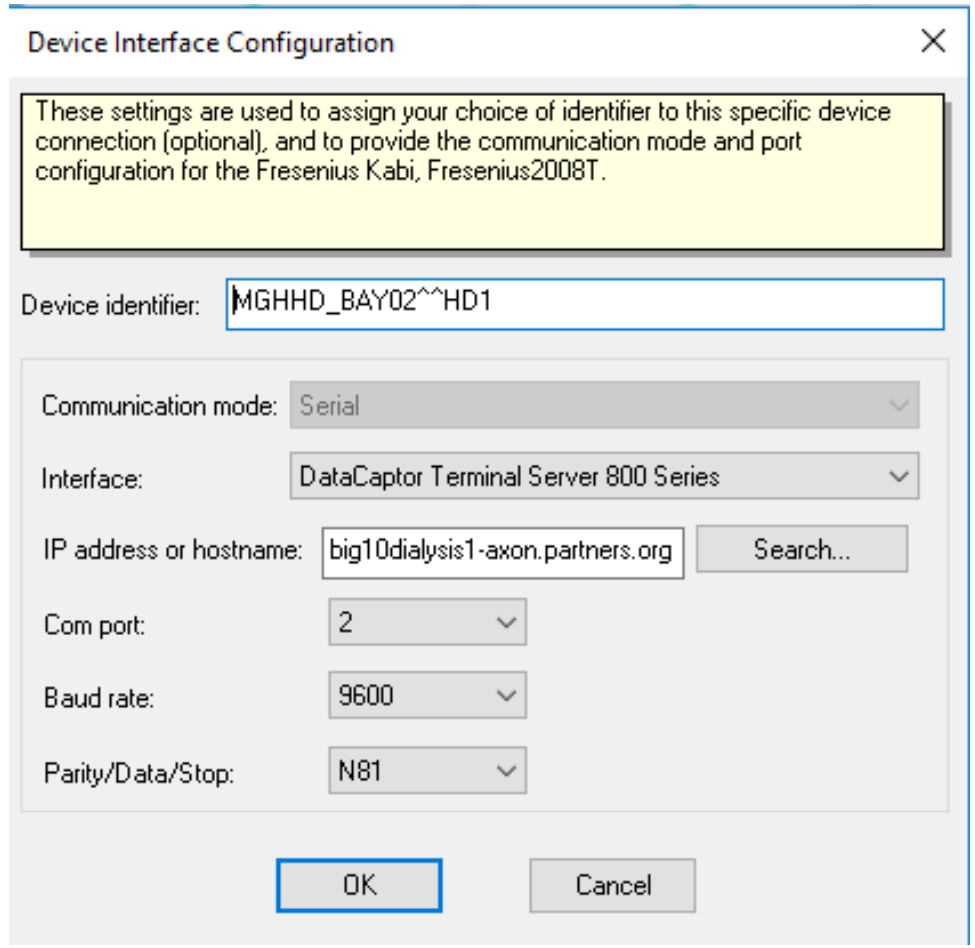
big10dialysis1-axon.partners.org

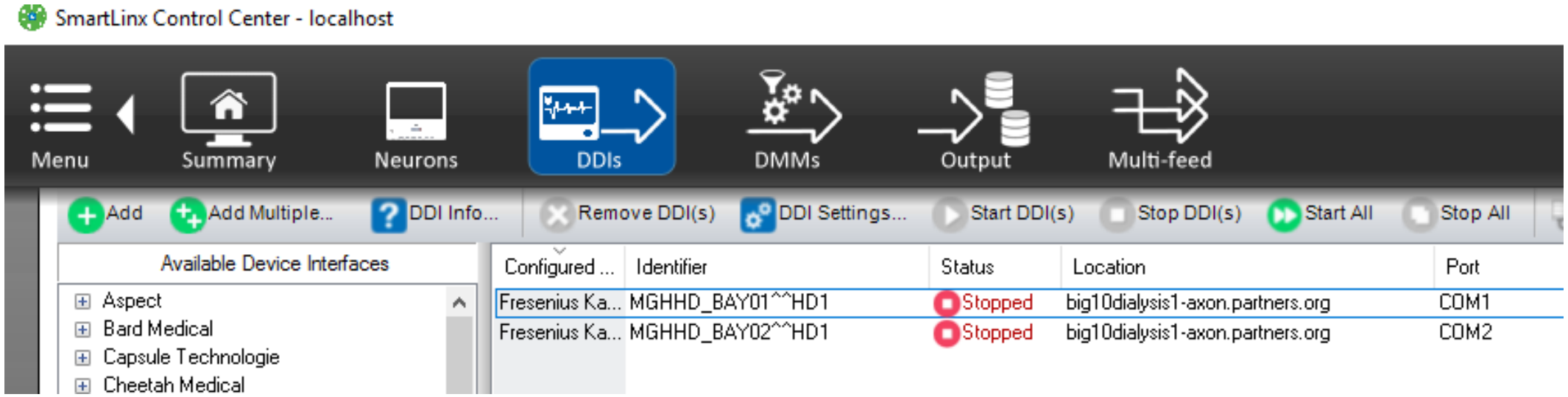
big10dialysis1-axon.partners.org

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_BAY02^^HD1
Communication mode:
Serial
Interface:
DataCaptor Terminal Server 800 Series
IP address or hostname:
big10dialysis1-axon.partners.org
Search...
Com port:
2
Baud rate:
9600
Parity/Data/Stop:
N81
OK
Cancel



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

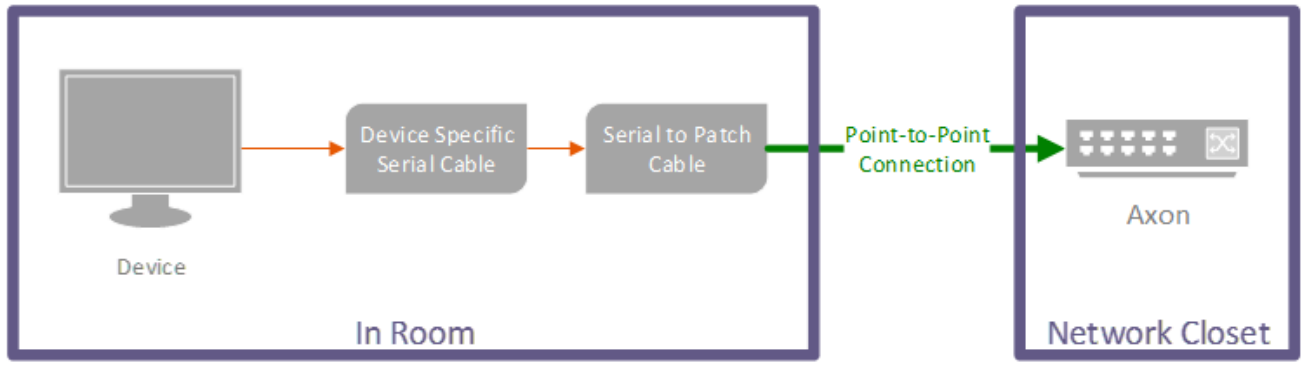


Figure 1 General Device Connection Setup in Areas using Axons

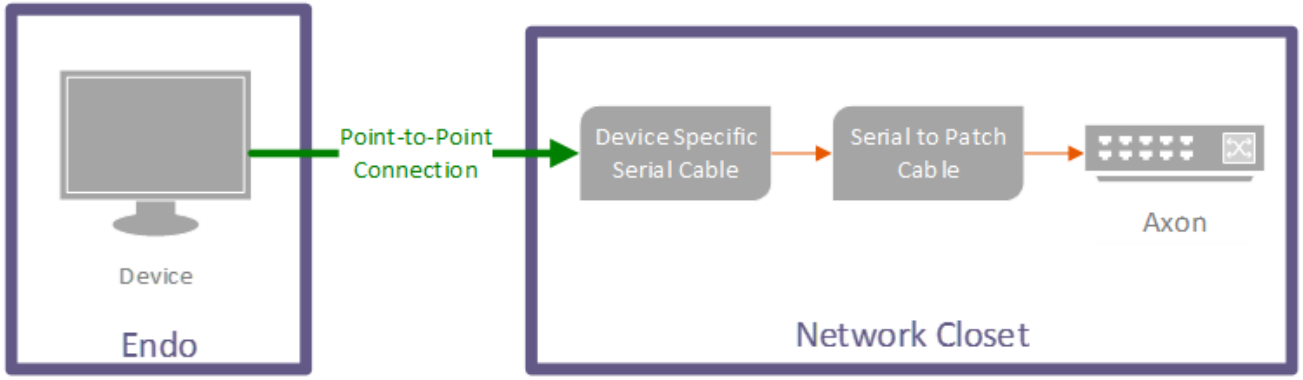


Figure 2 Endo Axon Setup

Axon Troubleshooting

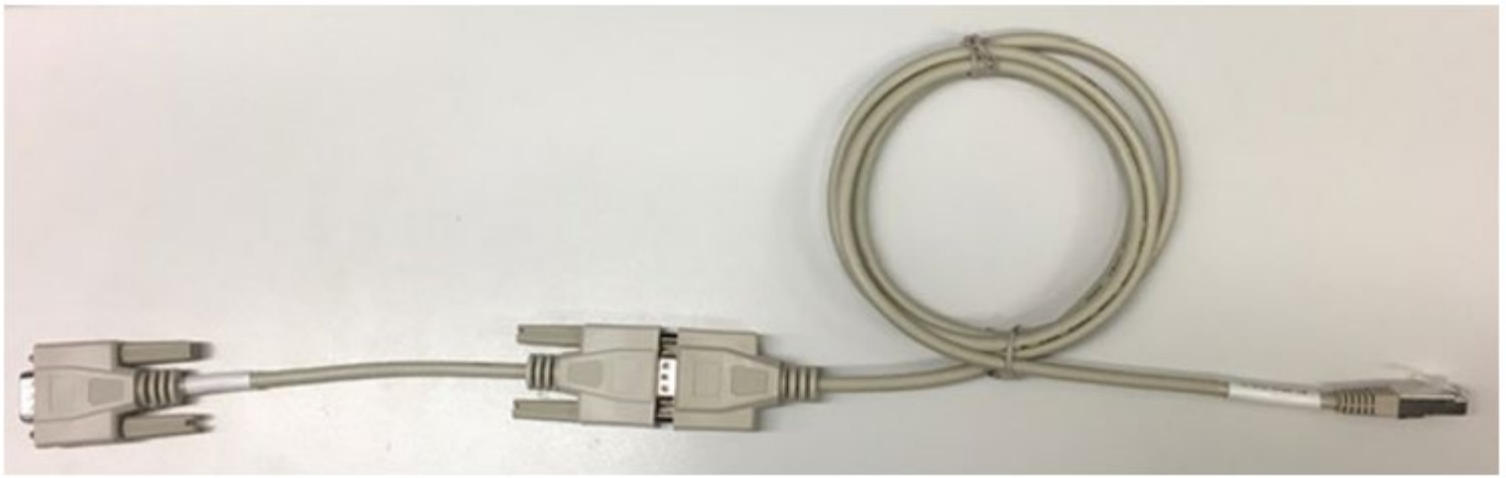


Figure 3 Device Specific Serial Cable & Serial to Patch Cable

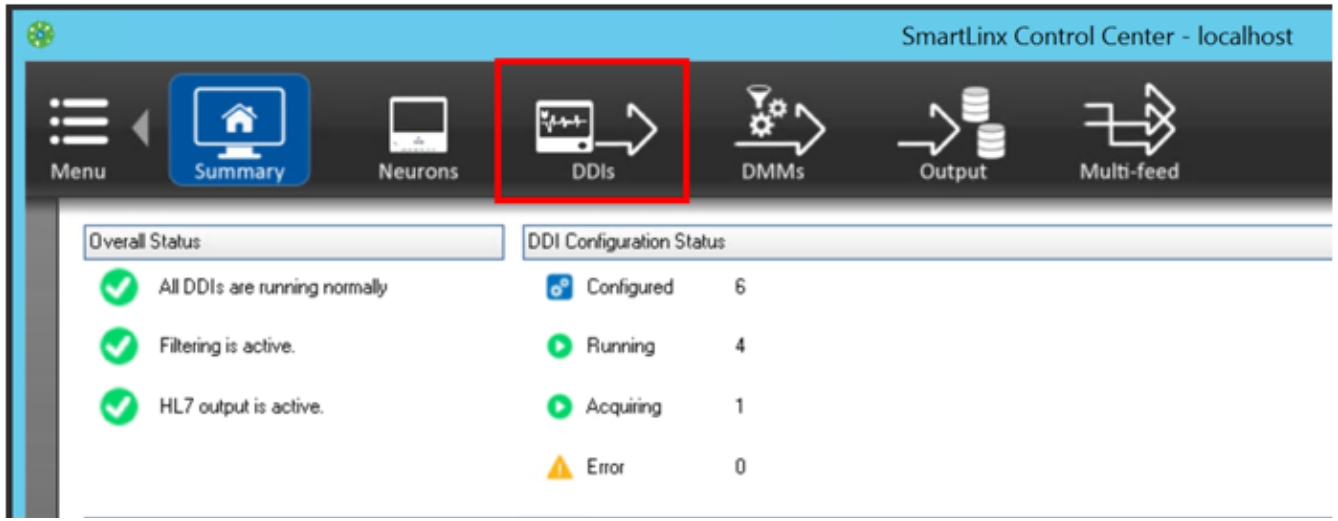
Device Specific Serial Cables

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

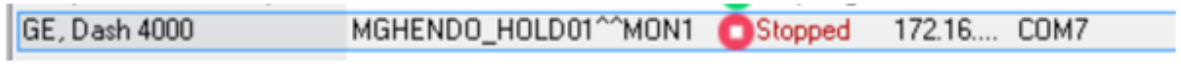
Axon Troubleshooting

Restart DDIs

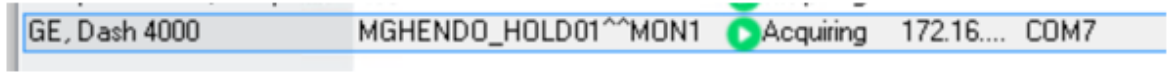
1. Remote into server phsweb1512
2. Launch the SmartLinx Control Center.
3. Click DDIs. Each room is programmed as an individual DDI.



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”



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

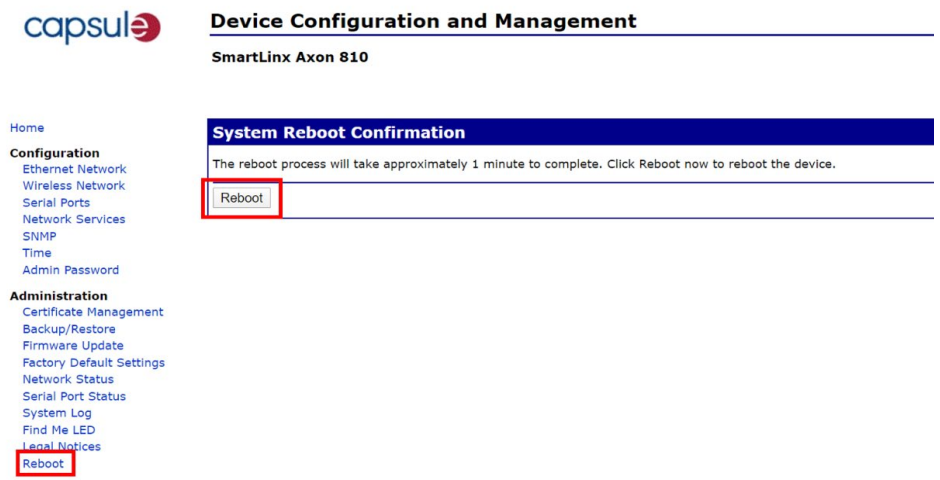


8. To check if data is being received by the Axon, select the room(s) and click Output stream.

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.



Axon Troubleshooting

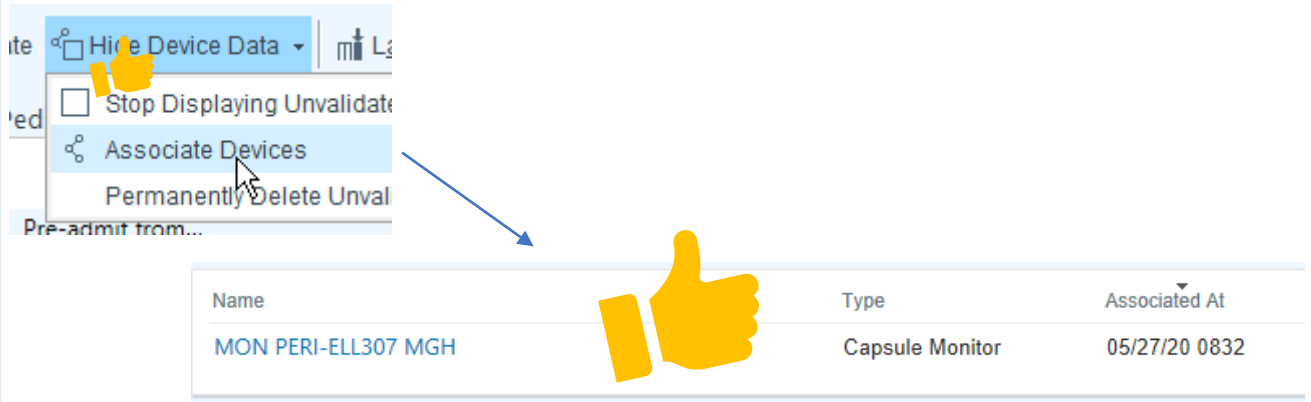
Swapping an Axon

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

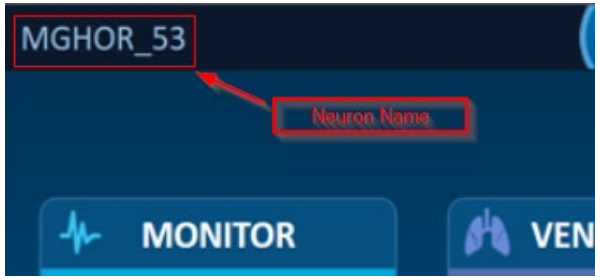
- Check Epic first: Make sure the device is associated in EPIC and check data interval time (i.e. 1 minute versus 1 hour)
- Confirm:
  - Correct DEV record is attached
  - In flowsheets: device data is not hidden

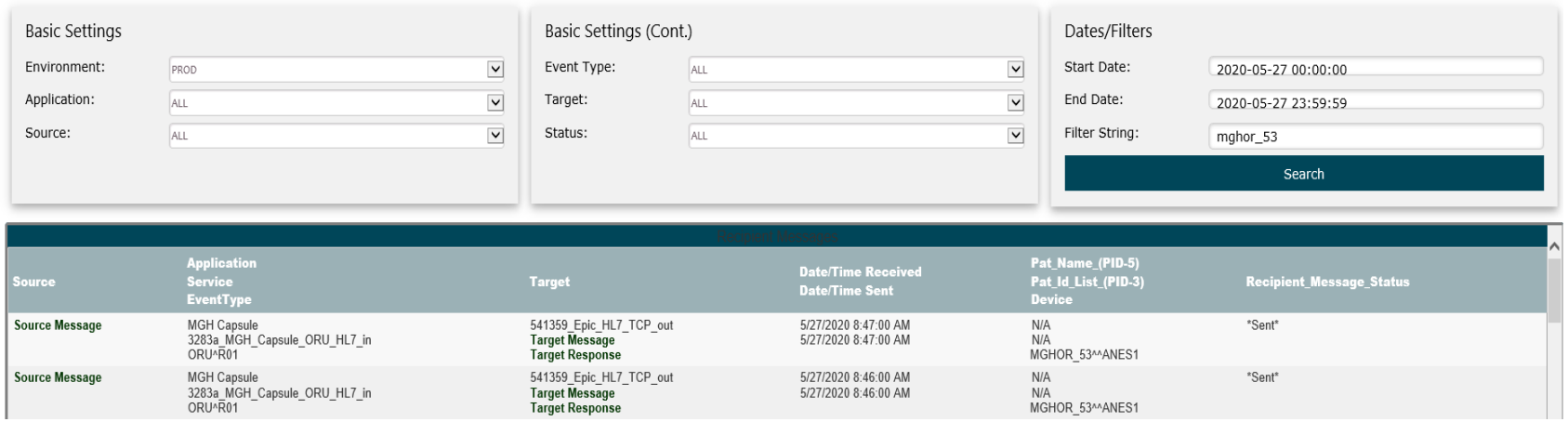
Flowsheets (Nursing):



Troubleshooting: Neuron Data in Ensemble

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



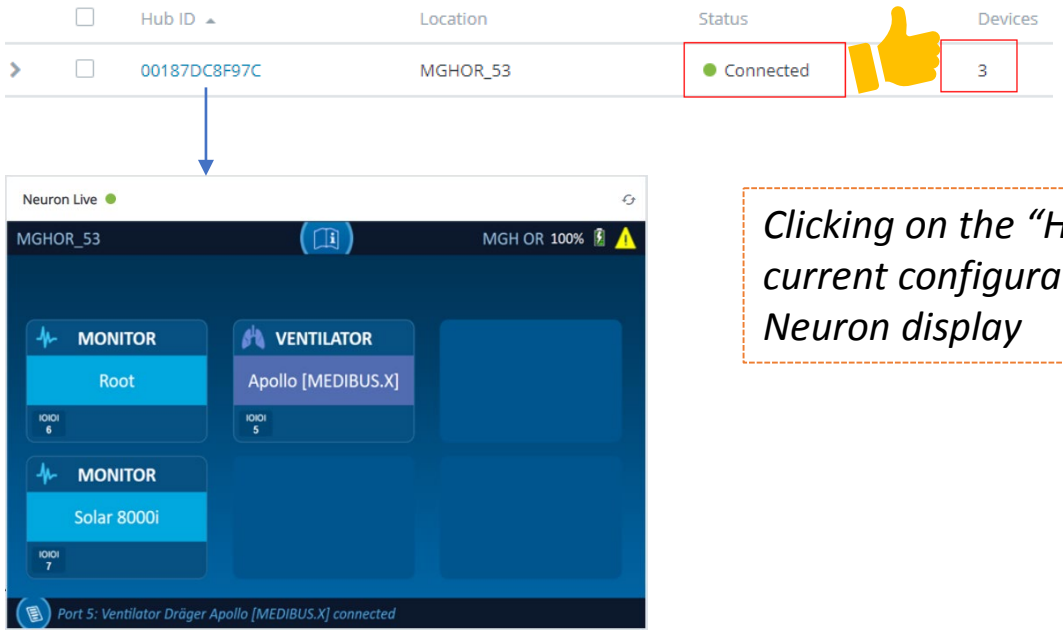


Troubleshooting: Axon Data in Ensemble

- 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 Comand Consule (C3)
- C3 hub view allows you to confirm the Neuron (hub) is active and devices are connected



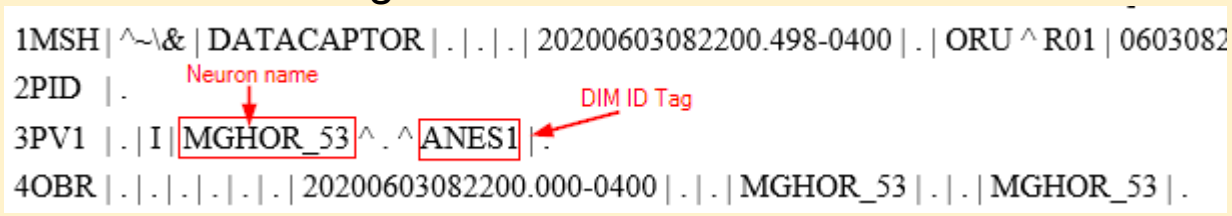
Clicking on the "Hub ID" link will take you to a page showing the current configuration of the Neuron, including a live view of the Neuron display

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:



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

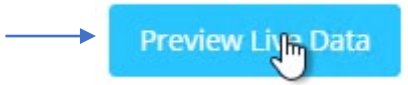
Epic DEV build:

VENT BLK08-874 MGH

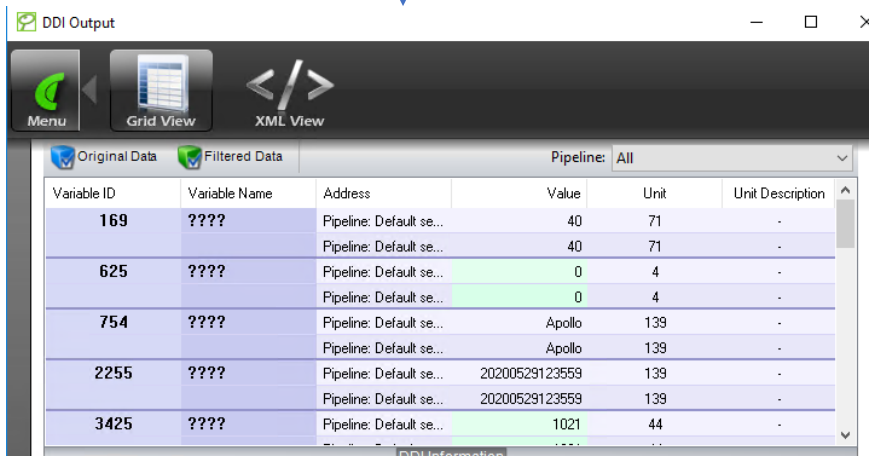
HD HD-BAY01 MGH

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

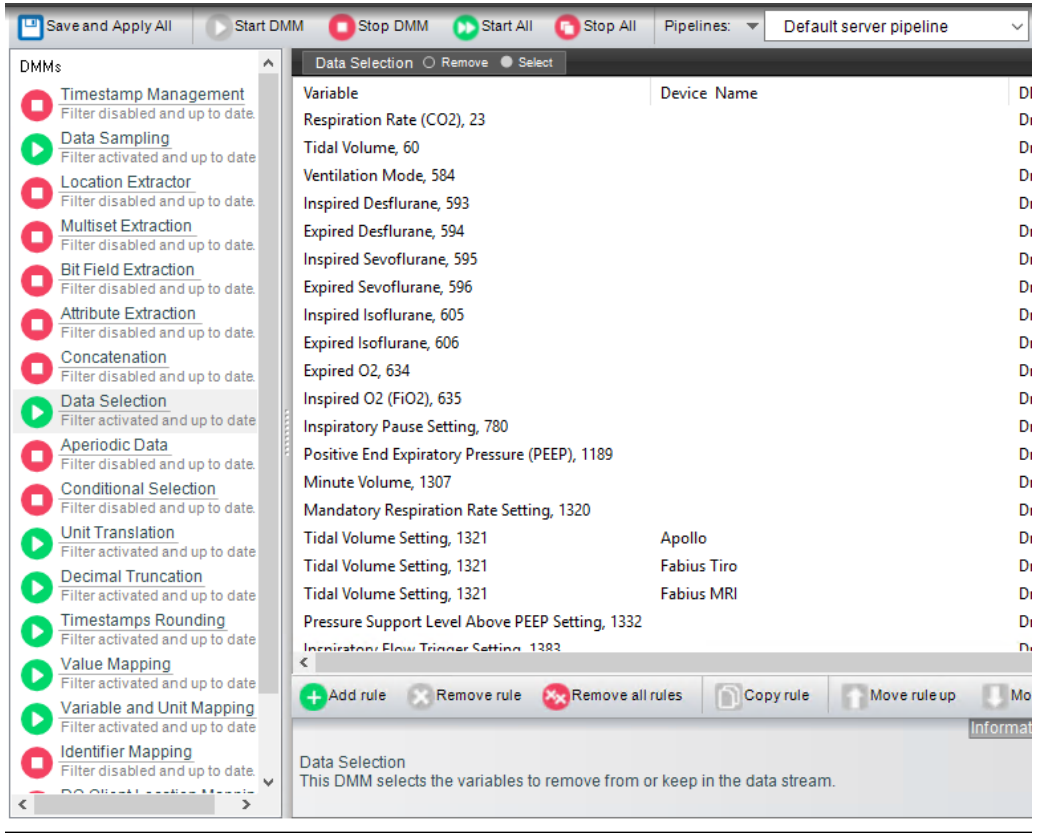


Variable IDs in the DDI Output live view can referenced in the Help File available on the Capsule customer portal.



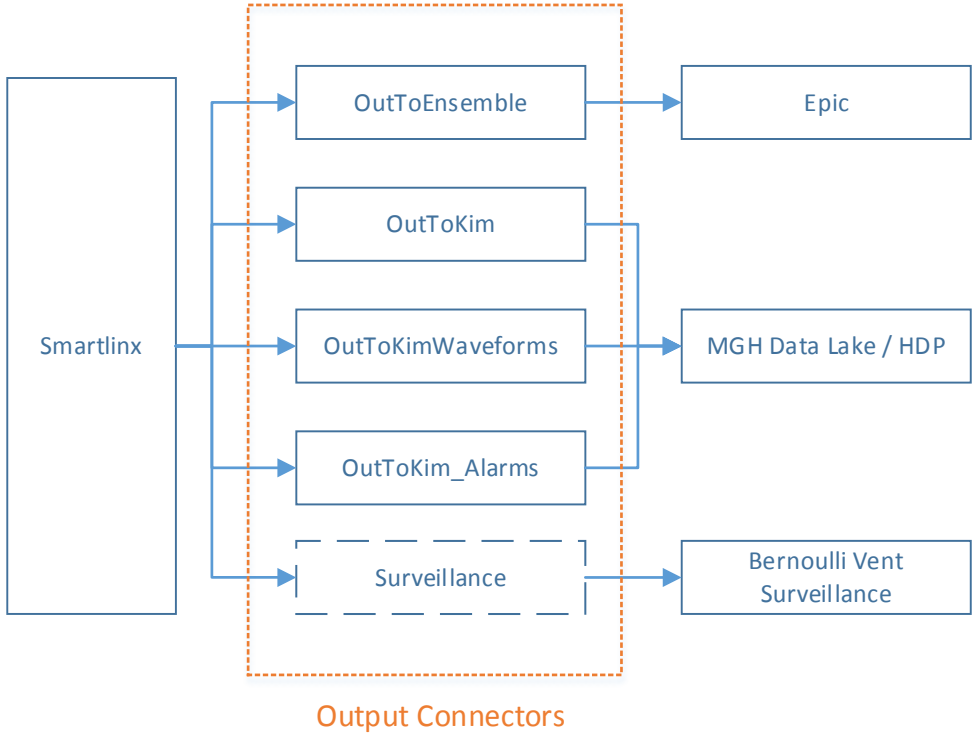
Advanced: SmartLinx DMM Stack

- 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



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 “Muli-feed” tab