Multiple Distributed Alarm System (DAS)
Use Case Scenarios

The following diagrams discuss various multiple Distributed Alarm System (DAS) without/with Confirmation (CDAS) use case scenarios.

On the Point-of-Care (PoC) device (PoCD) side, the IEEE 11073 Service-oriented Device Connectivity (SDC) standard is utilized for the communication with the corresponding alarm system with the goal to prove if a particular use case scenario is supported by the standard, or if there are gaps in the standard which have to be addressed.
The communication between the alarm system and the alarm communicator (AC) is considered proprietary in diagrams and out of scope of this document which focuses on the PoCD SDC communication.

Note: in the diagrams, the nomenclature of the IEC 60601-1-8 alarm standard is widely used. Although conformance with the alarm standard is not mandatory, it is highly recommended to conform to the standard since this simplifies the regulatory approval of the DAS/CDAS and its components.
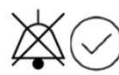
Legend:

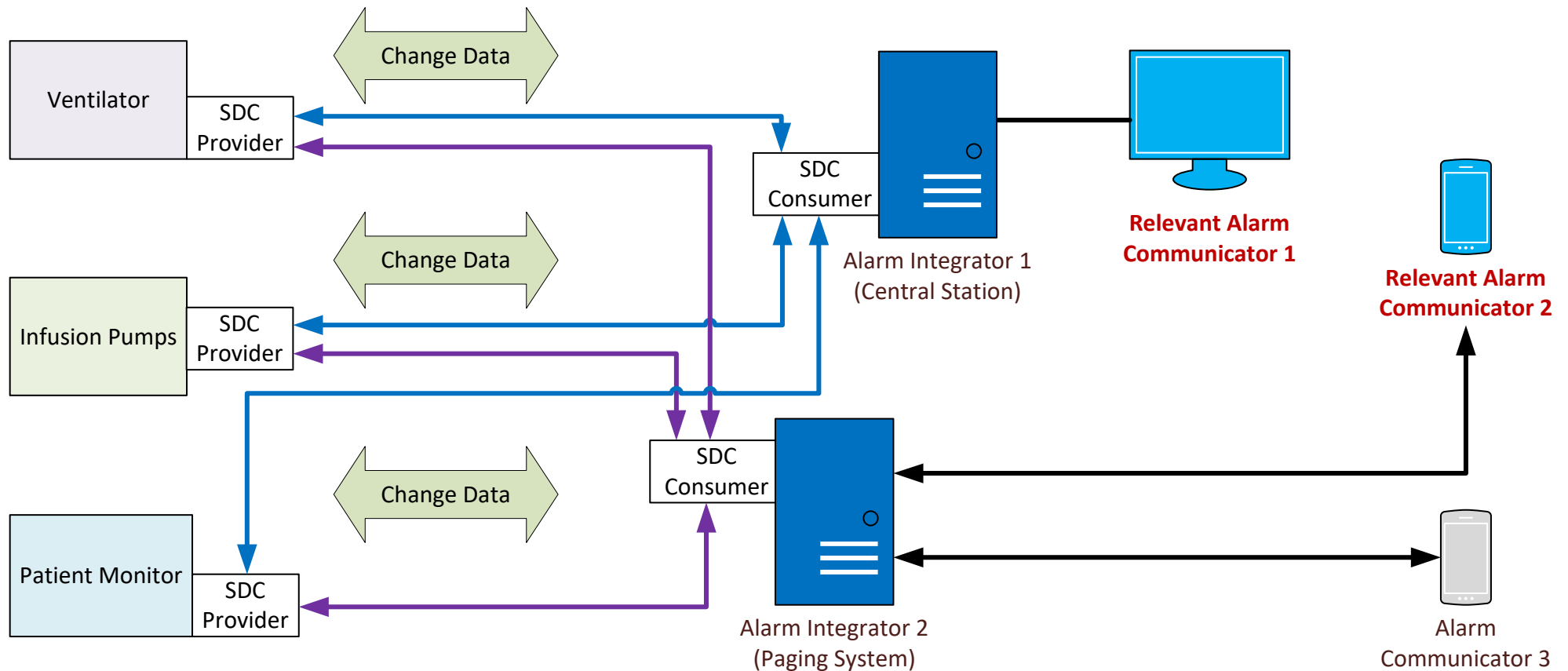|	
⟷	Established data connection between devices and/or systems exchanging alerts, status information, vital signs etc.
⟷ **X** ⟷	Interrupted data connection between devices and/or systems
MinVol Low	Visual alert signal e.g. displayed on patient monitor. The color indicates the severity of the alert e.g. red for high
🔔	Audible alert signal is enabled e.g. sound at the ventilator
🔕	Audible alert signal is disabled e.g. no sound at the ventilator
🔕✓	Alert acknowledged either locally at the PoCD or remotely by the caregiver. The audible alert signal is disabled.
✓	Alert accepted by the caregiver at one of the relevant AC. The PoCD is not involved in the workflow. Usually, this stops the alert escalation to other ACs in the DAS.
⊗	Alert rejected by the caregiver at one of the relevant AC. The PoCD is not involved in the workflow. Usually, this escalates the alert to next AC in the DAS.
🧍	Caregiver that acknowledges, accepts, or rejects an alert at a relevant AC. At the PoCD, the caregiver can only acknowledge an alert.
📱	A relevant alarm communicator is a term from the IEC 60601-1-8 alarm standard. Relevant alarm communicators are the primary remote alarming devices in a DAS.
📱	Other alarm communicators are either not relevant for certain alerts (e.g. alert type filter, PoC location, etc.), or considered as secondary remote alarming devices, and therefore, they are not part of the DAS.

Multiple DAS Scenario 1: DAS is fully operational and there are no device alerts

When the connection to individual PoC devices is established to the alarm integrators by checking the connection state on a regular basis

And the connection to the relevant alarm communicator devices is established to the alarm integrators by checking the connection state on a regular basis

Then no further indication that the DAS is fully operational shall be announced to the user
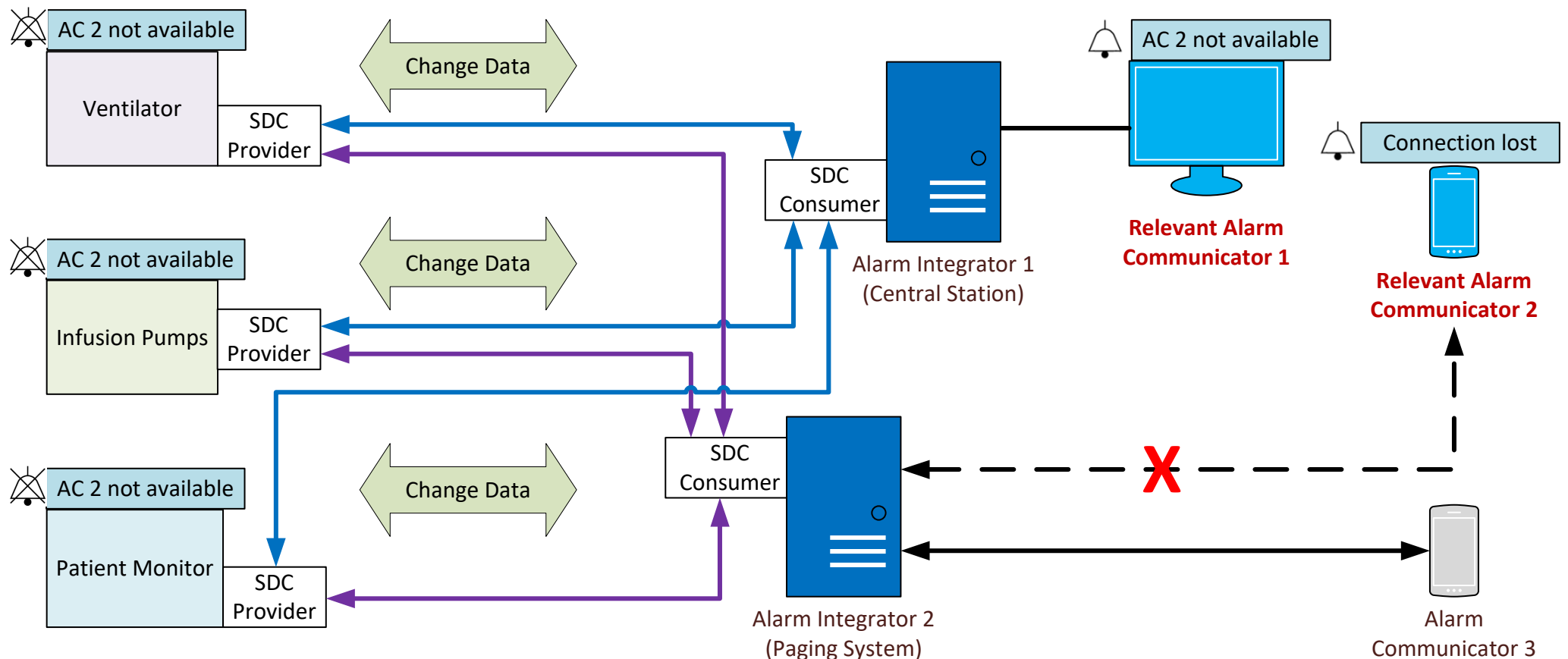
Note: customers may require to have an indicator that the DAS is fully operational. This might be configurable at the PoCD and/or AC (e.g. a notification shown at the display).

Multiple DAS Scenario 2: Connection to relevant alarm communicator lost, other ACs are available, and there are no device alerts

- **When** the connection to individual PoC devices is established to the alarm integrators by checking the connection state on a regular basis
  And the connection to the relevant alarm communicator device has been lost
  And other alarm communicators are available
- **Then** the user shall be notified on all connected, relevant alarm communicators that the connection to one or more ACs has been lost
  And the user may be notified on all PoC devices that the connection to one or more ACs has been lost
  And the audio alarm at all PoC devices shall be disabled
  And the audio alarm at all connected, relevant alarm communicators shall be enabled
  And the alarm communicator which is not connected to an alarm integrator shall notify the user visually and audibly about the lost connection
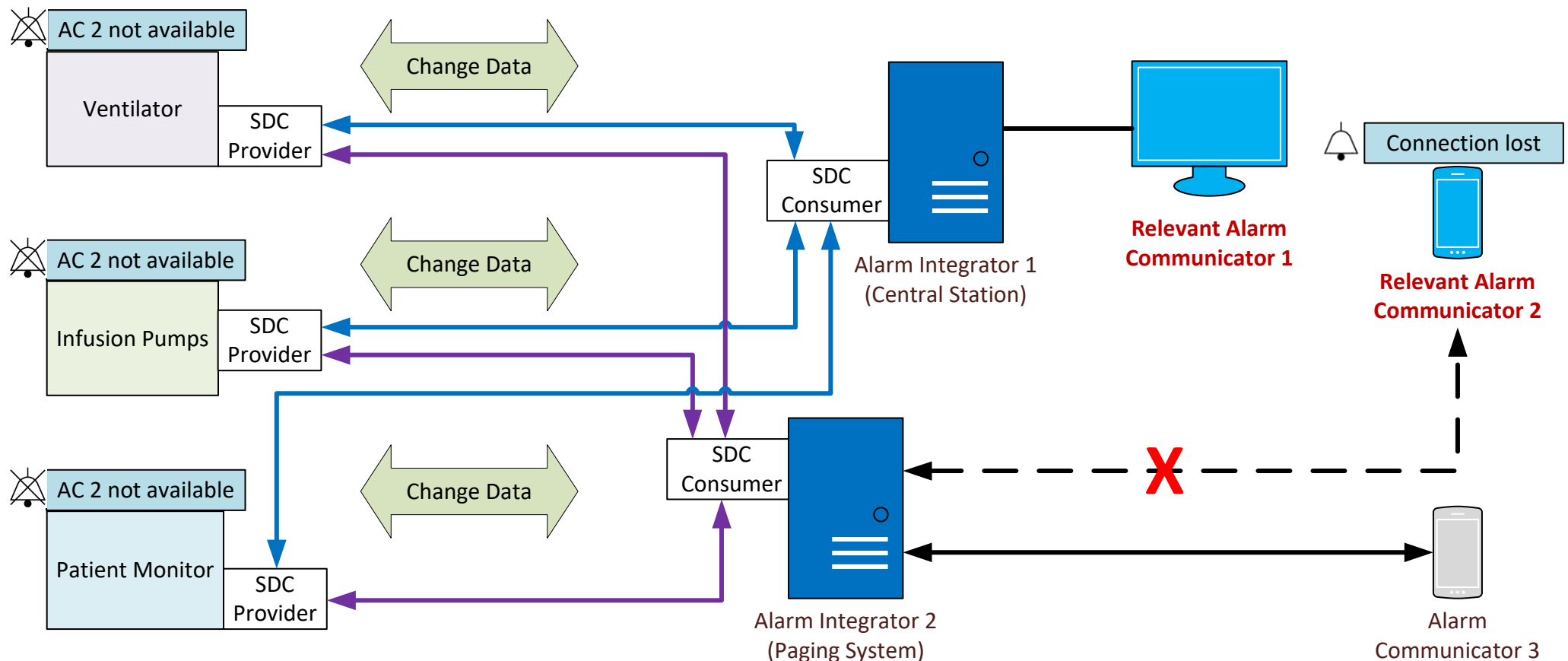
Note: this depicts a worst case scenario. The current AI products address those failure scenarios by redirection, escalation, etc. when an AC is not available any longer. How individual AI products handle those failure scenarios in detail is not subject of this document. It is the responsibility of the AI, if a corresponding status message is shown on the PoCD as well.

Multiple DAS Scenario 2.1: Connection to relevant alarm communicator lost, other ACs are available, and there are no device alerts

- **When** the connection to individual PoC devices is established to the alarm integrators by checking the connection state on a regular basis
  And the connection to the relevant alarm communicator device assigned to one of the AIs has been lost
  And other alarm communicators are available
- **Then** the user shall be notified on all connected relevant alarm ACs assigned to the same AI that the connection to one or more ACs has been lost
  But the user shall not receive any notification about the lost connection on relevant alarm ACs which are not assigned to the same AI
  And the user may be notified on all PoC devices that the connection to one or more ACs has been lost
  And the audio alarm at all PoC devices shall be disabled
  And the audio alarm at all connected relevant alarm communicators assigned to the same AI shall be enabled
  And the alarm communicator which is not connected to an alarm integrator shall notify the user visually and audibly about the lost connection

Note: this depicts a worst case scenario. The current AI products address those failure scenarios by redirection, escalation, etc. when an AC is not available any longer. How individual AI products handle those failure scenarios in detail is not subject of this document. It is the responsibility of the AI, if a corresponding status message is shown on the PoCD as well.

Multiple DAS Scenario 2.2: Connection to relevant alarm communicator lost, other ACs are available, and there are no device alerts

- **When** the connection to individual PoC devices is established to the alarm integrators by checking the connection state on a regular basis
  And the connection to the relevant alarm communicator device assigned to one of the AIs has been lost
  And other alarm communicators are available
- **Then** the user shall be notified on all connected relevant alarm ACs that the connection to one or more ACs has been lost
  And the audio alarm at all connected relevant alarm communicators shall be enabled
  And the alarm communicator which is not connected to an alarm integrator shall notify the user visually and audibly about the lost connection
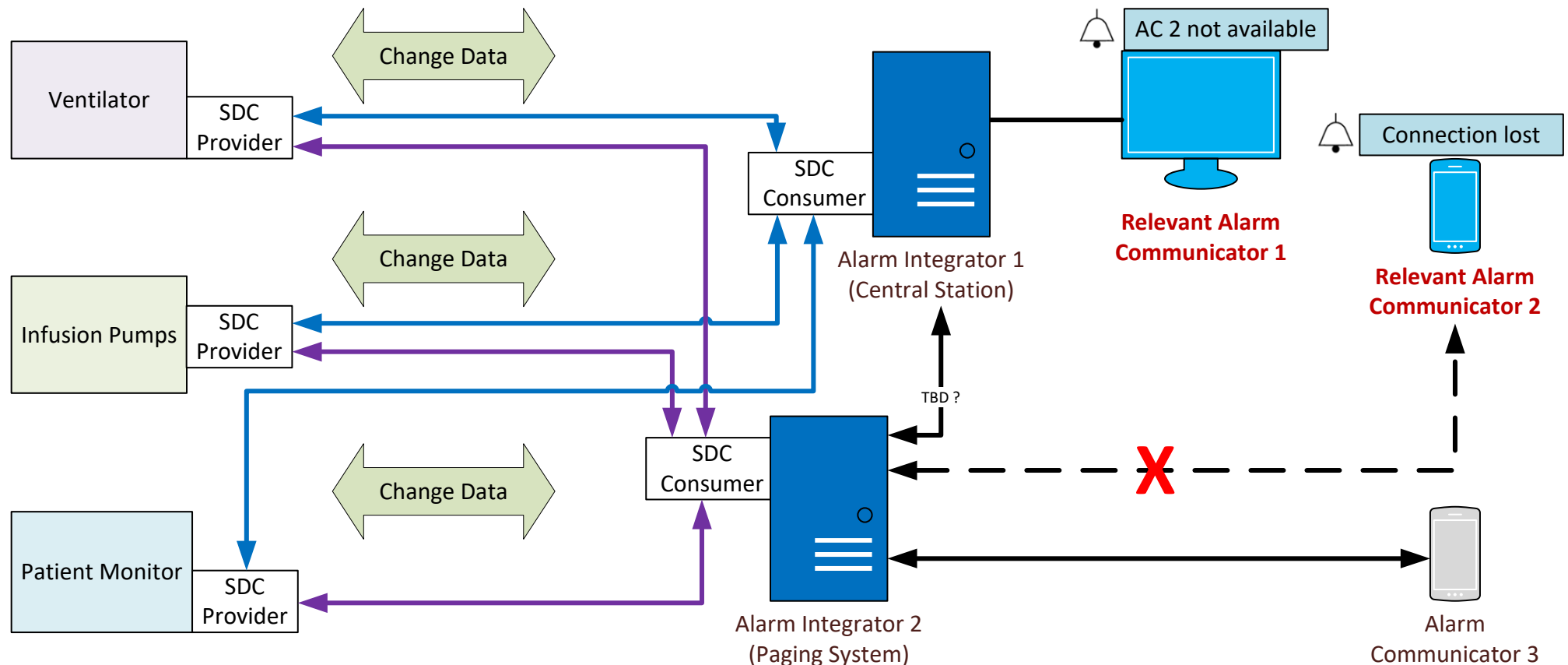
Note: this depicts a worst case scenario. The current AI products address those failure scenarios by redirection, escalation, etc. when an AC is not available any longer. How individual AI products handle those failure scenarios in detail is not subject of this document. It is the responsibility of the AI, if a corresponding status message is shown on the PoCD as well.

Multiple DAS Scenario 3: Connection to relevant alarm communicators lost, other ACs are unavailable, and there are no device alerts

- **When** the connection to individual PoC devices is established to the alarm integrators by checking the connection state on a regular basis
  And the connection to all relevant alarm communicator device have been lost
  And other alarm communicators are unavailable
- **Then** the user may be notified on all PoC devices that the connection to one or more ACs has been lost
  And the audio alarm at all PoC devices may be enabled
  And the alarm communicator which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection
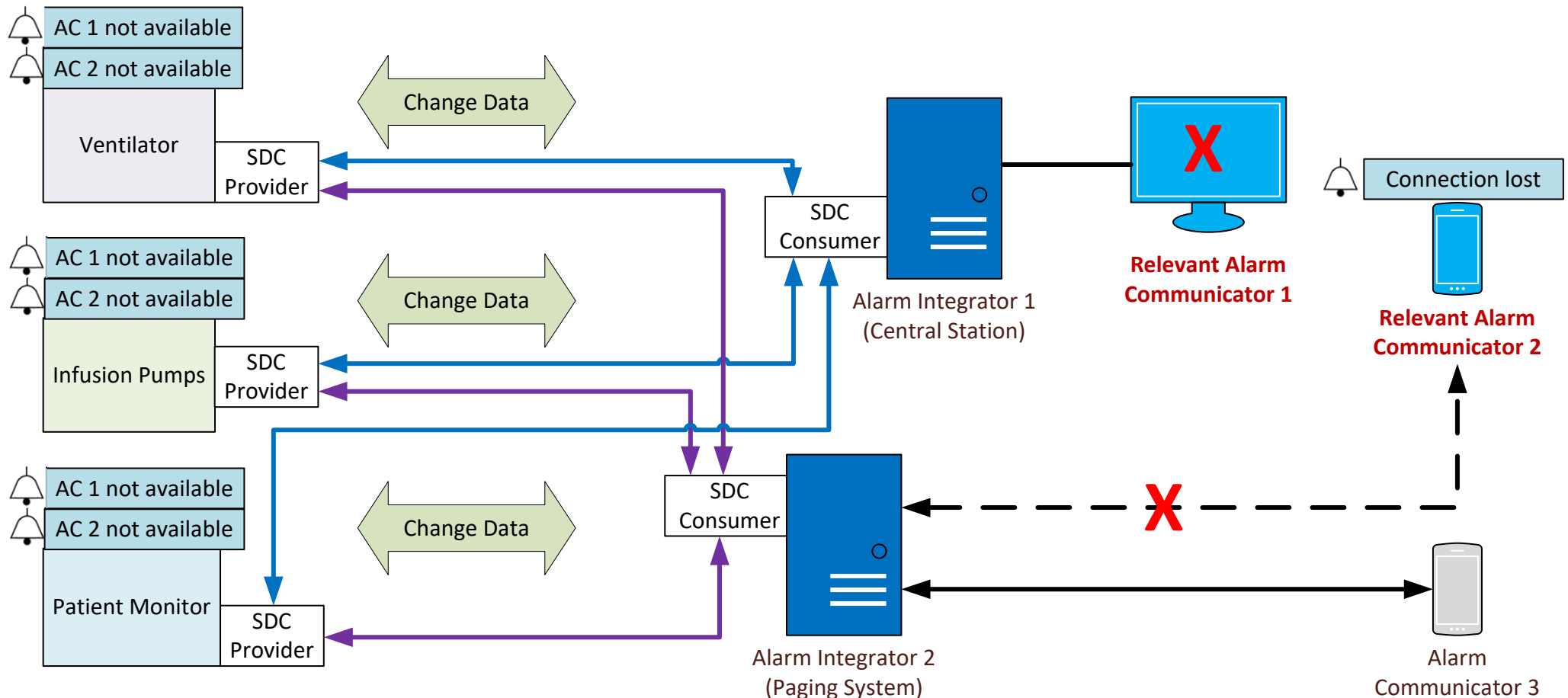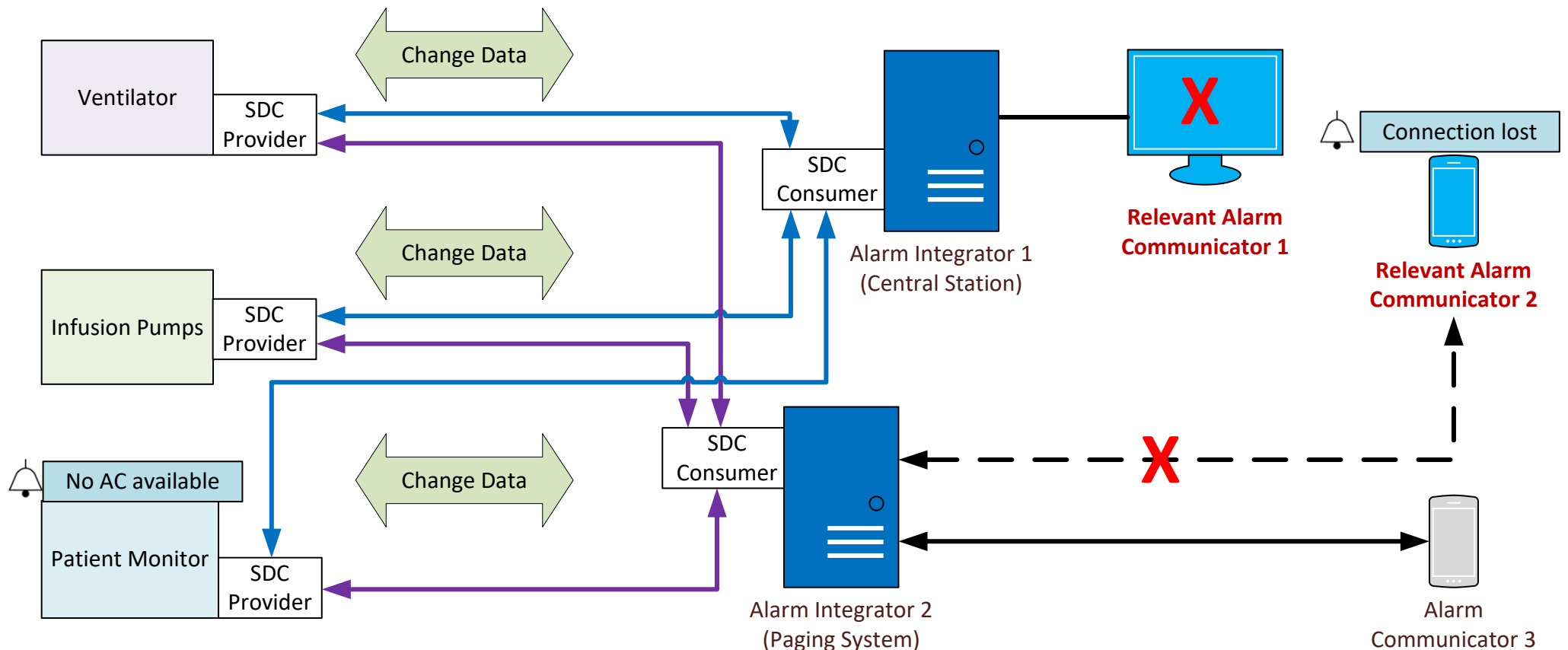
Note: this depicts a worst case scenario. The current AI products address those failure scenarios by redirection, escalation, etc. when an AC is not available any longer. How individual AI products handle those failure scenarios in detail is not subject of this document. It is the responsibility of the AI, if a corresponding status message is shown on the PoCD as well.

Multiple DAS Scenario 3.1: Connection to relevant alarm communicators lost, other ACs are unavailable, there are no device alerts, and alert is only shown on one PoC device
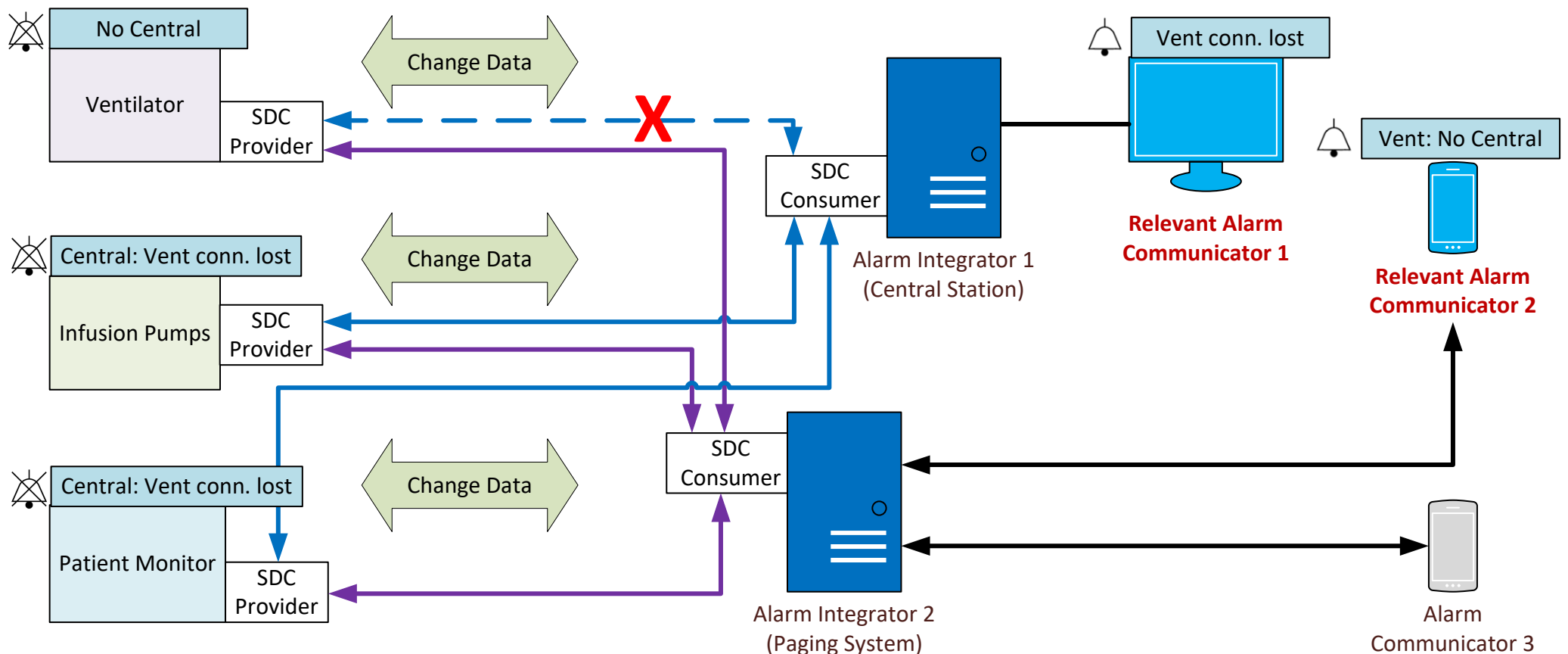
- **When** the connection to individual PoC devices is established to the alarm integrators by checking the connection state on a regular basis
  And the connection to all relevant alarm communicator device have been lost
  And other alarm communicators are unavailable
  And there is a prioritization on which PoC devices the alert shall be signaled
- **Then** the user may only be notified on the PoC device with the highest priority that the connection to one or more ACs has been lost
  And the audio alarm at all PoC devices may be enabled
  And the alarm communicator which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection

Note: this depicts a worst case scenario. The current AI products address those failure scenarios by redirection, escalation, etc. when an AC is not available any longer. How individual AI products handle those failure scenarios in detail is not subject of this document. It is the responsibility of the AI, if a corresponding status message is shown on the PoCD as well.

Multiple DAS Scenario 4: Connection between one PoC device and one AI is lost, relevant alarm communicators are available, and there are no device alerts

- **When** the connection between one PoC device and one AI is lost
  And the connection to the relevant alarm communicator devices are available
- **Then** the user shall be notified on all connected relevant alarm communicators that the connection between one or more PoC devices and the AI has been lost
  And the user may be notified on all PoC devices that the connection between one or more PoC devices and the AI has been lost
  And the audio alarm at all connected PoC devices shall be disabled
  And the audio alarm at all connected relevant alarm communicators shall be enabled
  And the PoC device which is not connected to the alarm integrator shall notify the user visually about the lost connection

Multiple DAS Scenario 4.1: Connection between PoC device and one AI is lost, relevant alarm communicators are available, and there are no device alerts
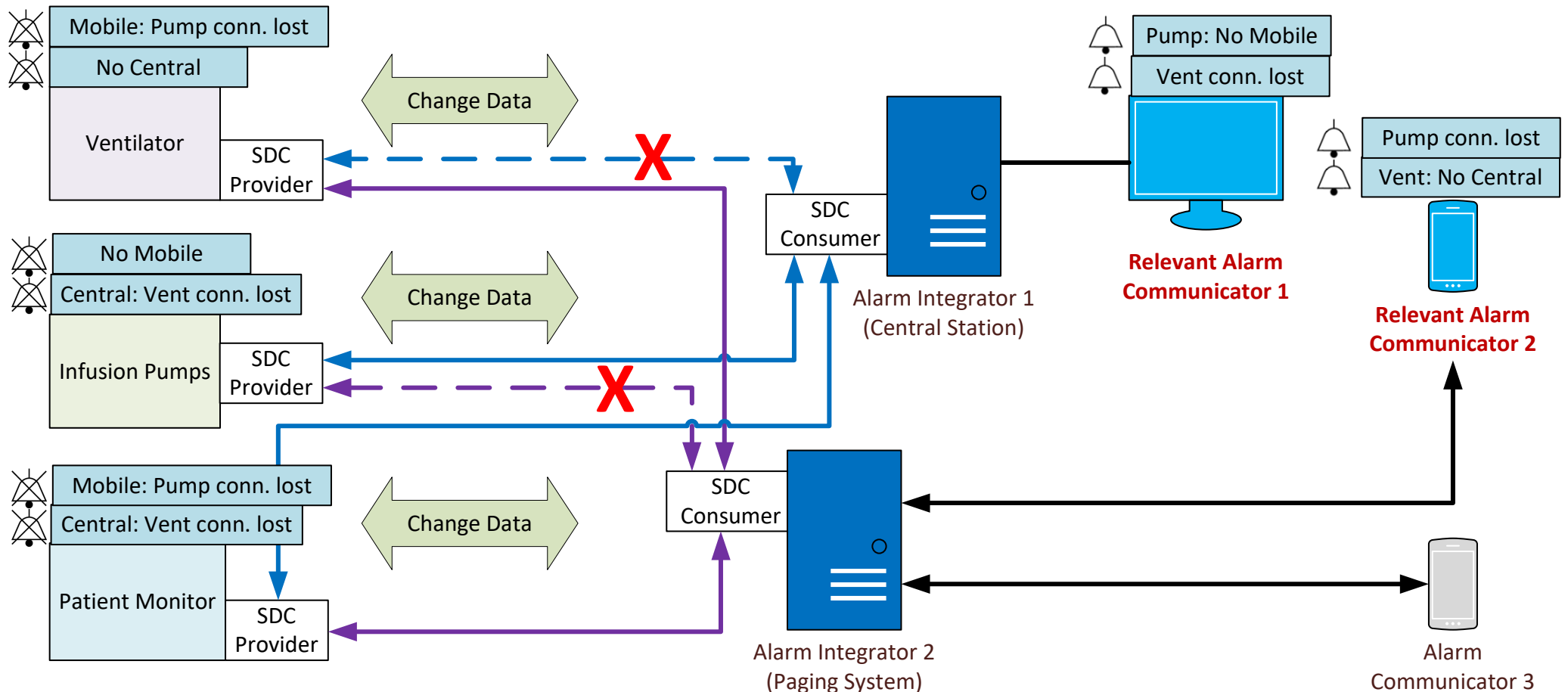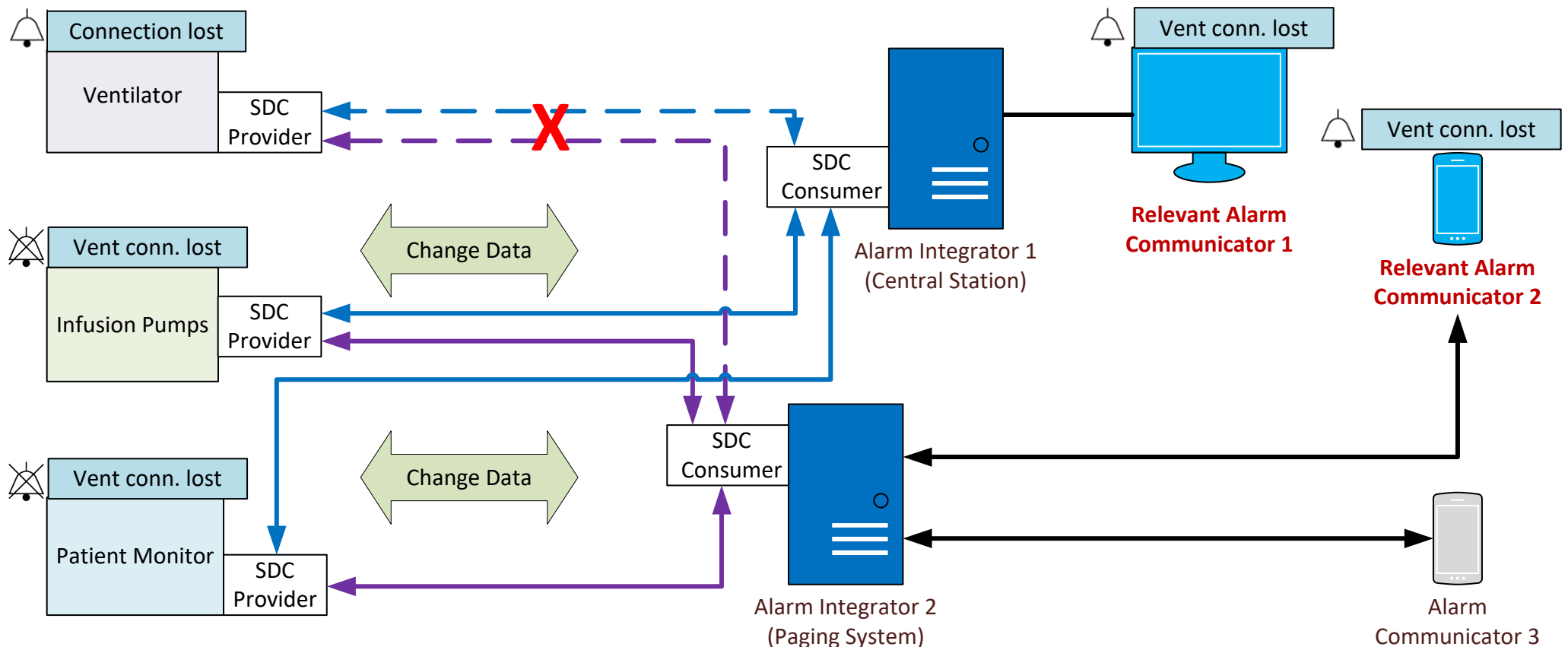
- **When** the connection between PoC device and one AI is lost
  And the connection to the relevant alarm communicator devices are available
- **Then** the user shall be notified on all connected relevant alarm communicators that the connection between one or more PoC devices and the AI has been lost
  And the user may be notified on all PoC devices that the connection between one or more PoC devices and the AI has been lost
  And the audio alarm at all connected PoC devices shall be disabled
  And the audio alarm at all connected relevant alarm communicators shall be enabled
  And the PoC device which is not connected to the alarm integrator shall notify the user visually about the lost connection

Mobile: Pump conn. lost

No Central

Ventilator

SDC Provider

Change Data

No Mobile

Central: Vent conn. lost

Infusion Pumps

SDC Provider

Change Data

Mobile: Pump conn. lost

Central: Vent conn. lost

Patient Monitor

SDC Provider

Change Data

SDC Consumer

Alarm Integrator 1 (Central Station)

SDC Consumer

Alarm Integrator 2 (Paging System)

Pump: No Mobile

Vent conn. lost

Relevant Alarm Communicator 1

Pump conn. lost

Vent: No Central

Relevant Alarm Communicator 2
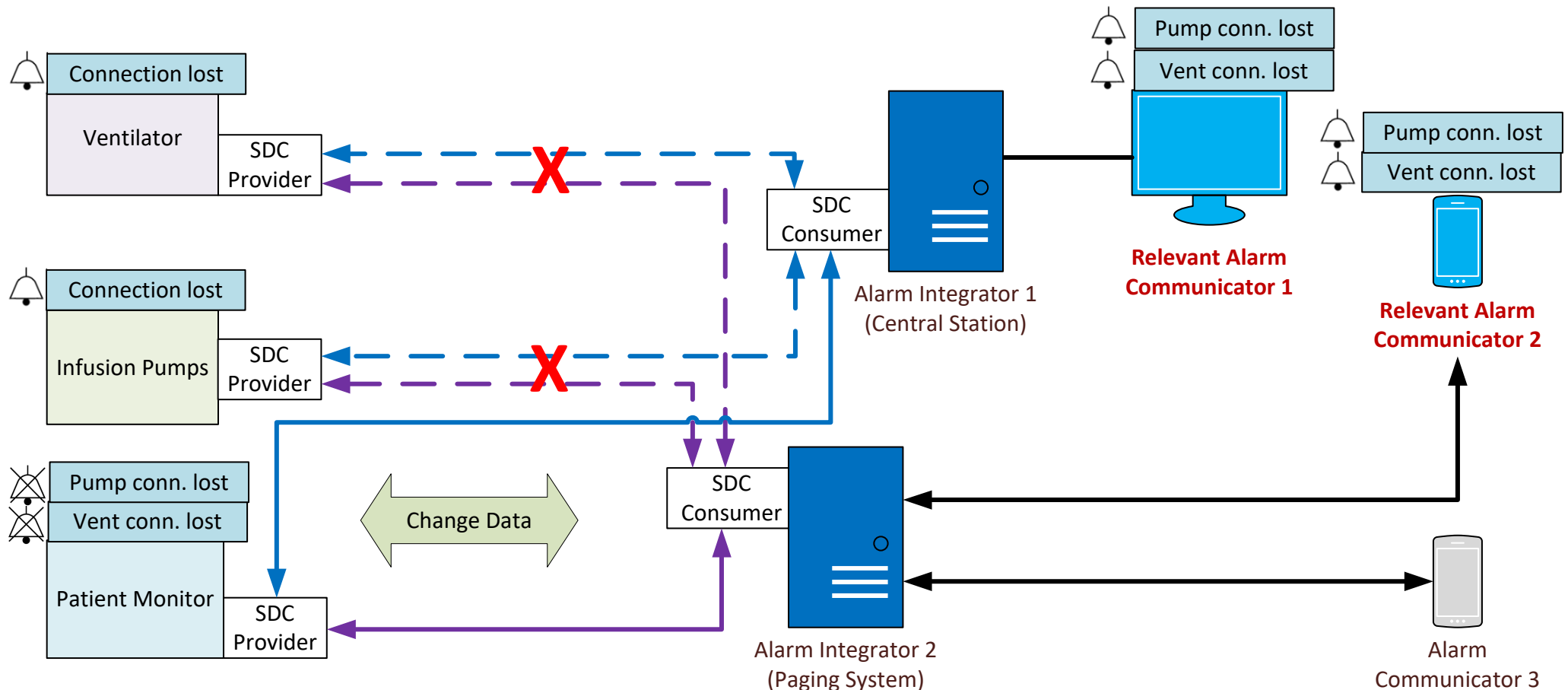
Alarm Communicator 3

Multiple DAS Scenario 4.2: Connection between one PoC device and all AIs is lost, relevant alarm communicators are available, and there are no device alerts

- **When** the connection between one PoC device and all AIs is lost
  And the connection to the relevant alarm communicator devices are available
- **Then** the user shall be notified on all connected relevant alarm communicators that the connection between one or more PoC devices and the AIs has been lost
  And the user may be notified on all PoC devices that the connection between one or more PoC devices and all AIs has been lost
  And the audio alarm at all connected PoC devices shall be disabled
  And the audio alarm at all connected relevant alarm communicators shall be enabled
  And the PoC device which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection

Multiple DAS Scenario 4.3: Connection between PoC devices and all AIs is lost, relevant alarm communicators are available, and there are no device alerts
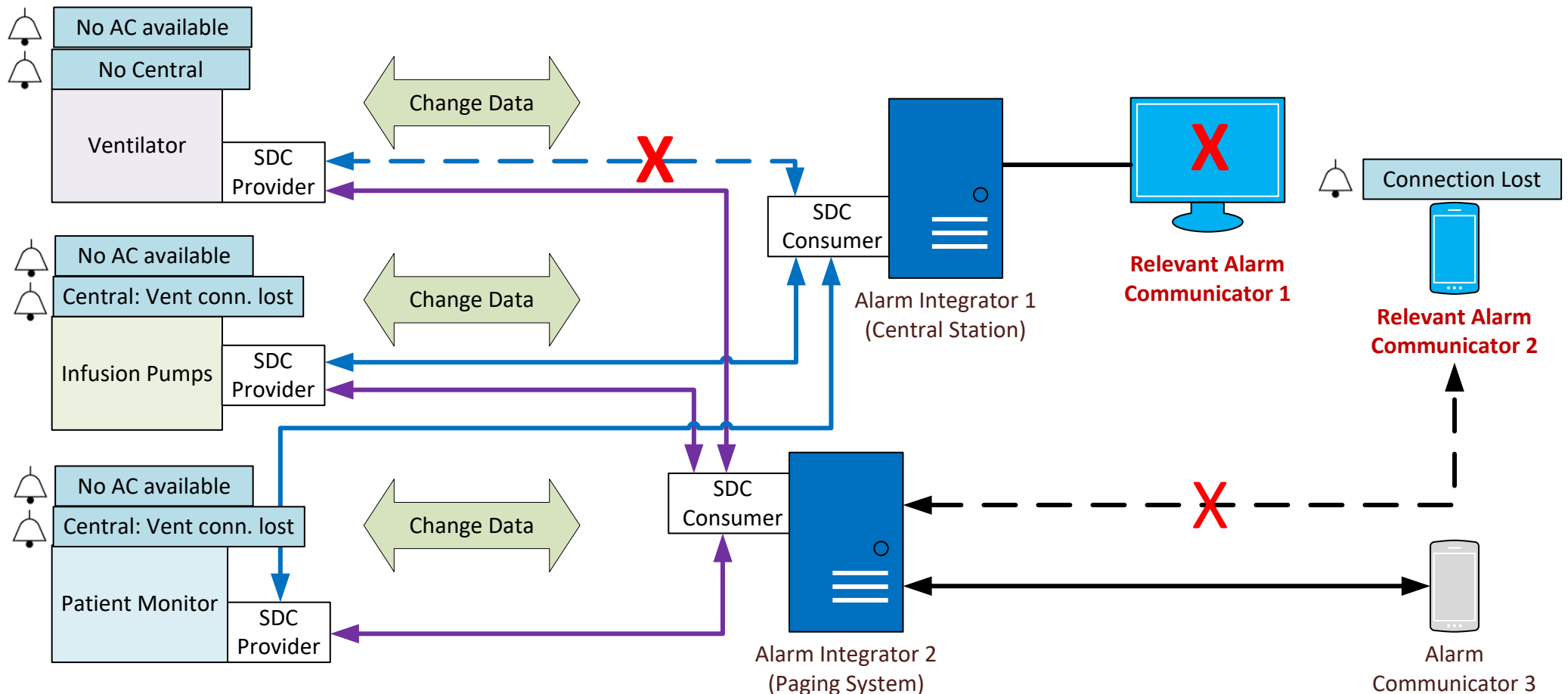
- **When** the connection between PoC devices and all AIs is lost
  And the connection to the relevant alarm communicator devices are available
- **Then** the user shall be notified on all connected relevant alarm communicators that the connection between one or more PoC devices and the AIs has been lost
  And the user may be notified on all PoC devices that the connection between one or more PoC devices and all AIs has been lost
  And the audio alarm at all connected PoC devices shall be disabled
  And the audio alarm at all connected relevant alarm communicators shall be enabled
  And the PoC device which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection

Multiple DAS Scenario 5: Connection between one PoC device and one AI is lost, relevant alarm communicators are unavailable, and there are no device alerts alerts

- **When** the connection between one PoC device and one AI is lost
  And the connection to the relevant alarm communicator devices are unavailable
- **Then** the user may be notified on all PoC devices that the connection to all relevant ACs has been lost
  And the user may be notified on all PoC devices that the connection between one or more PoC devices and the AI has been lost
  And the audio alarm at all connected PoC devices shall be enabled
  And the alarm communicator which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection
  And the PoC device which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection
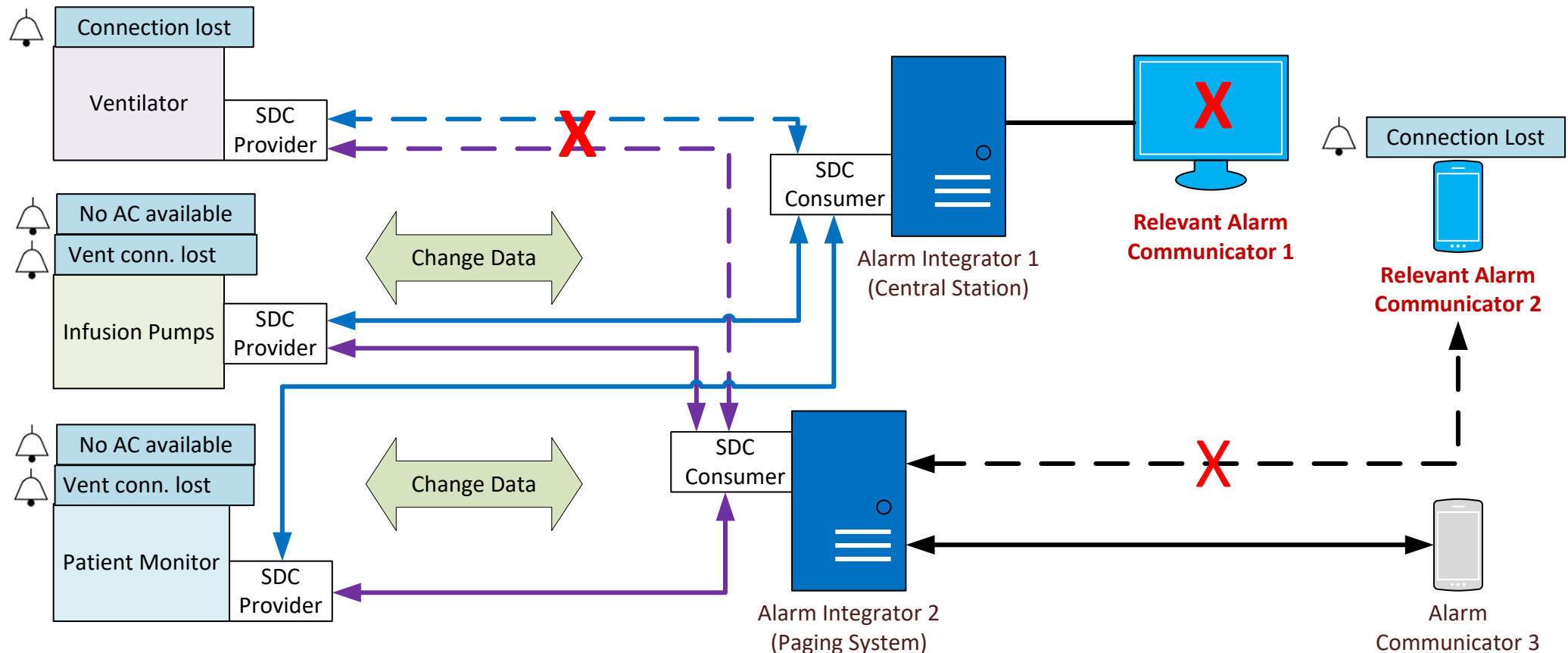
Note: this depicts a worst case scenario. The current AI products address those failure scenarios by redirection, escalation, etc. when an AC is not available any longer. How individual AI products handle those failure scenarios in detail is not subject of this document. It is the responsibility of the AI, if a corresponding status message is shown on the PoCD as well.

Multiple DAS Scenario 5.1: Connection between one PoC device and all AIs is lost, relevant alarm communicators are unavailable, and there are no device alerts alerts

- **When** the connection between one PoC device and all AIs is lost
  And the connection to the relevant alarm communicator devices are unavailable
- **Then** the user may be notified on all PoC devices that the connection to all relevant ACs has been lost
  And the user may be notified on all PoC devices that the connection between one or more PoC devices and all AIs has been lost
  And the audio alarm at all connected PoC devices shall be enabled
  And the alarm communicator which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection
  And the PoC device which is not connected to the alarm integrator shall notify the user visually and audibly about the lost connection
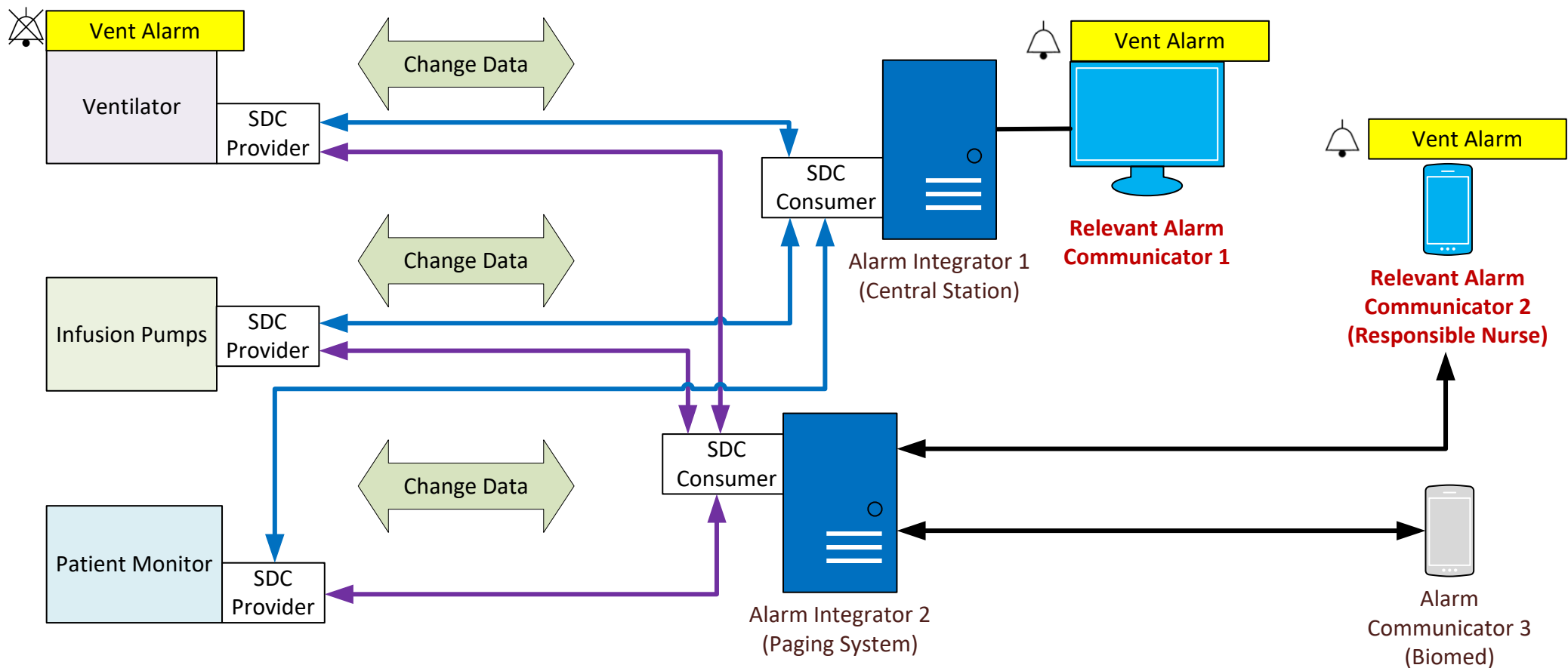
Note: this depicts a worst case scenario. The current AI products address those failure scenarios by redirection, escalation, etc. when an AC is not available any longer. How individual AI products handle those failure scenarios in detail is not subject of this document. It is the responsibility of the AI, if a corresponding status message is shown on the PoCD as well.

Multiple DAS Alarm Scenario 1: Alarm is active at PoC
- **When** there is an active physiological alarm at a PoC device
- **Then** the alarm shall visually shown at the PoC device
  And the audio alarm shall be disabled at the PoC device
  And the alarm shall visually and audibly shown on all relevant remote alerting devices that have physiological alarms assigned
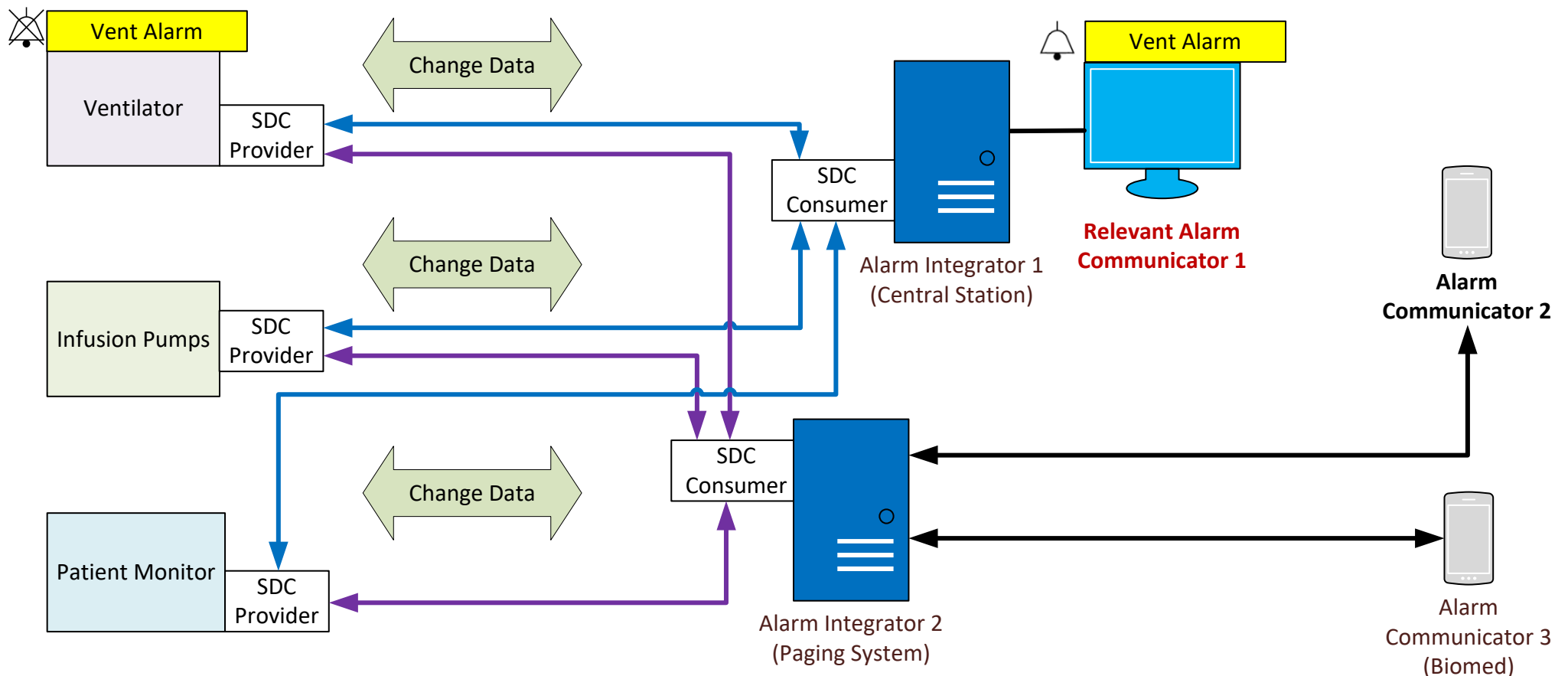
Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.

Multiple DAS Alarm Scenario 1.1: Alarm is active at PoC and only one of the AIs has a relevant alarm communicator assigned

- **When** there is an active physiological alarm at a PoC device
  And only one of the AIs has a relevant alarm communicator assigned
- **Then** the alarm shall visually shown at the PoC device
  And the audio alarm shall be disabled at the PoC device
  And the alarm shall visually and audibly shown on all relevant remote alerting devices that have physiological alarms assigned
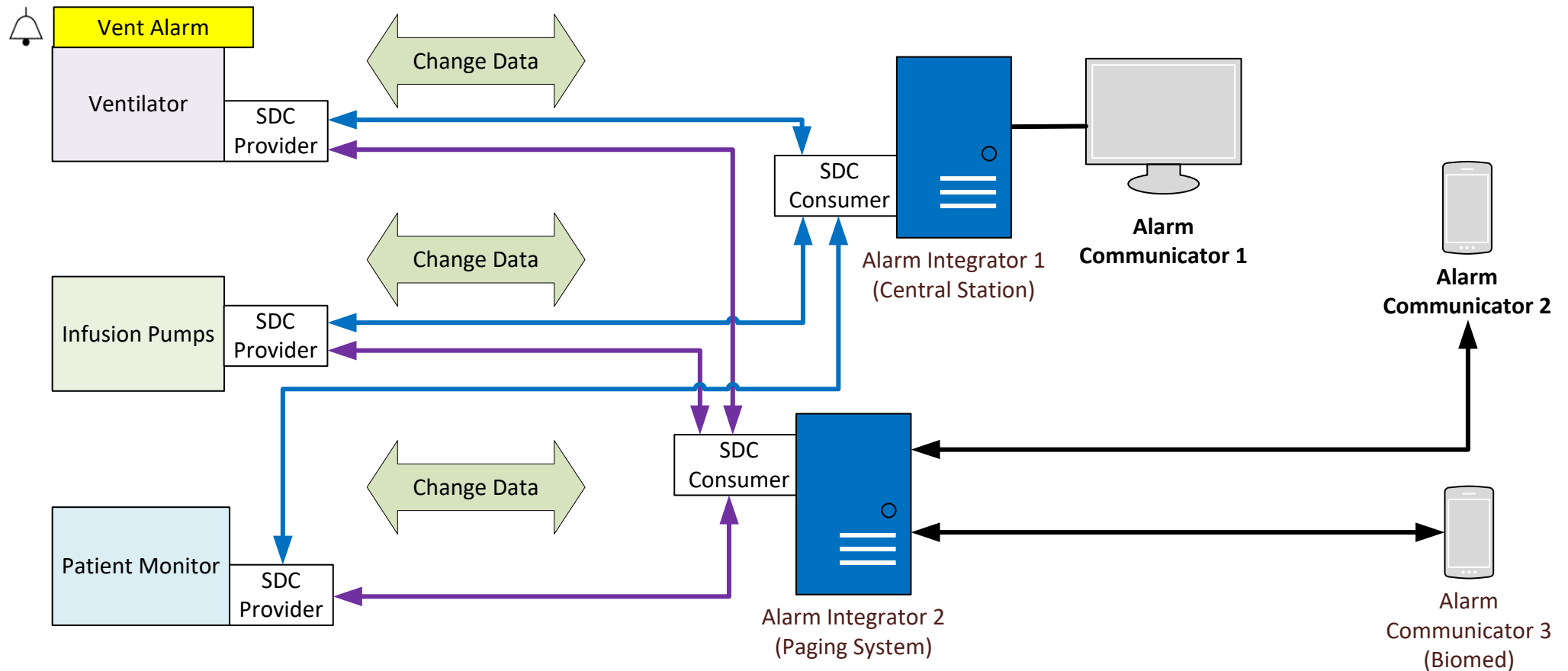
Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.

Multiple DAS Alarm Scenario 1.2: Alarm is active at PoC but there is no relevant alarm communicator available for this alarm

- **When** there is an active physiological alarm at a PoC device
  And there is no relevant alarm communicator available for this alarm
- **Then** the alarm shall visually shown at the PoC device
  And the audio alarm shall be enabled at the PoC device

Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.
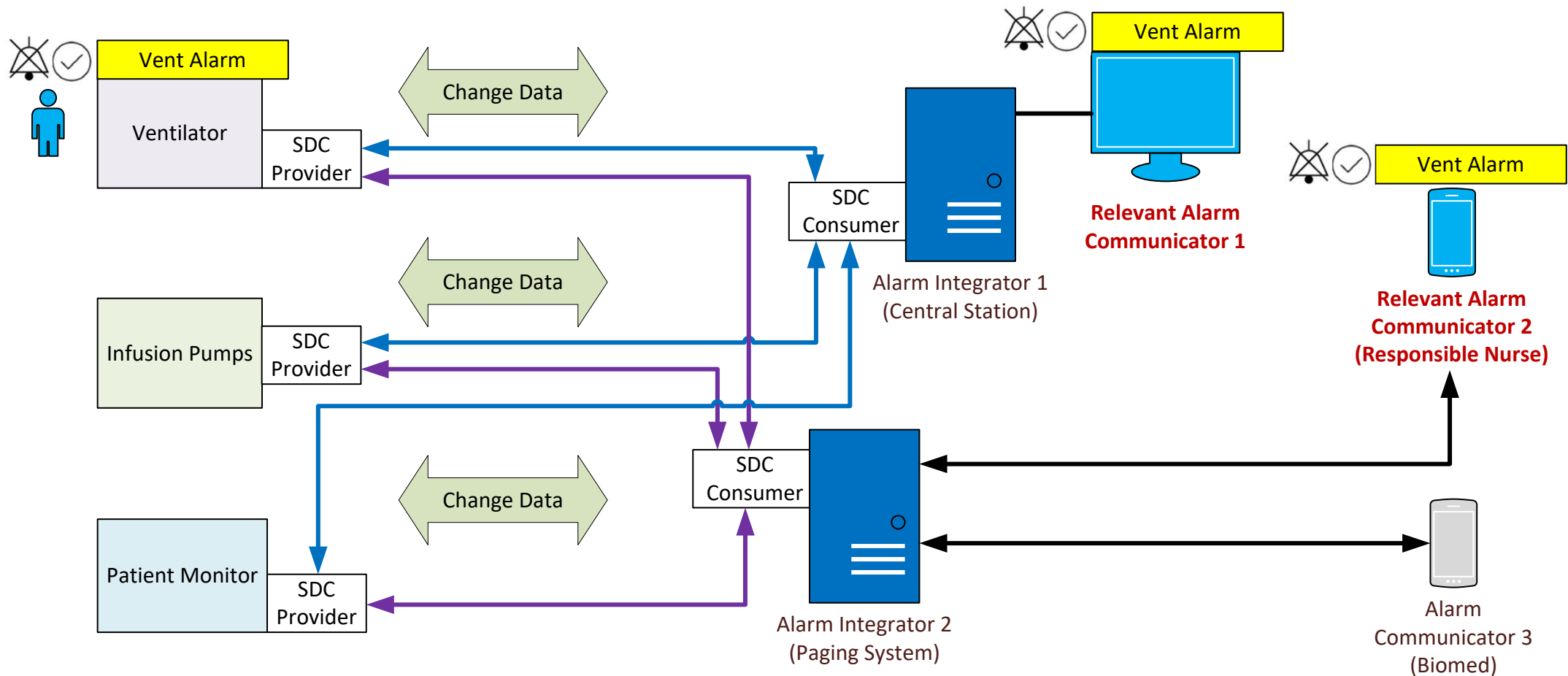
Multiple DAS Alarm Scenario 2: Acknowledge at PoC device

- **When** there is an active physiological alarm at a PoC device
  And the alarm is shown visually and audibly on all relevant remote alerting devices that have physiological alarms assigned
  And the caregiver acknowledges the alarm at the POC device
- **Then** the alarm shall be shown as acknowledged at the PoC device
  And the alarm shall be shown as acknowledged on all relevant alerting devices
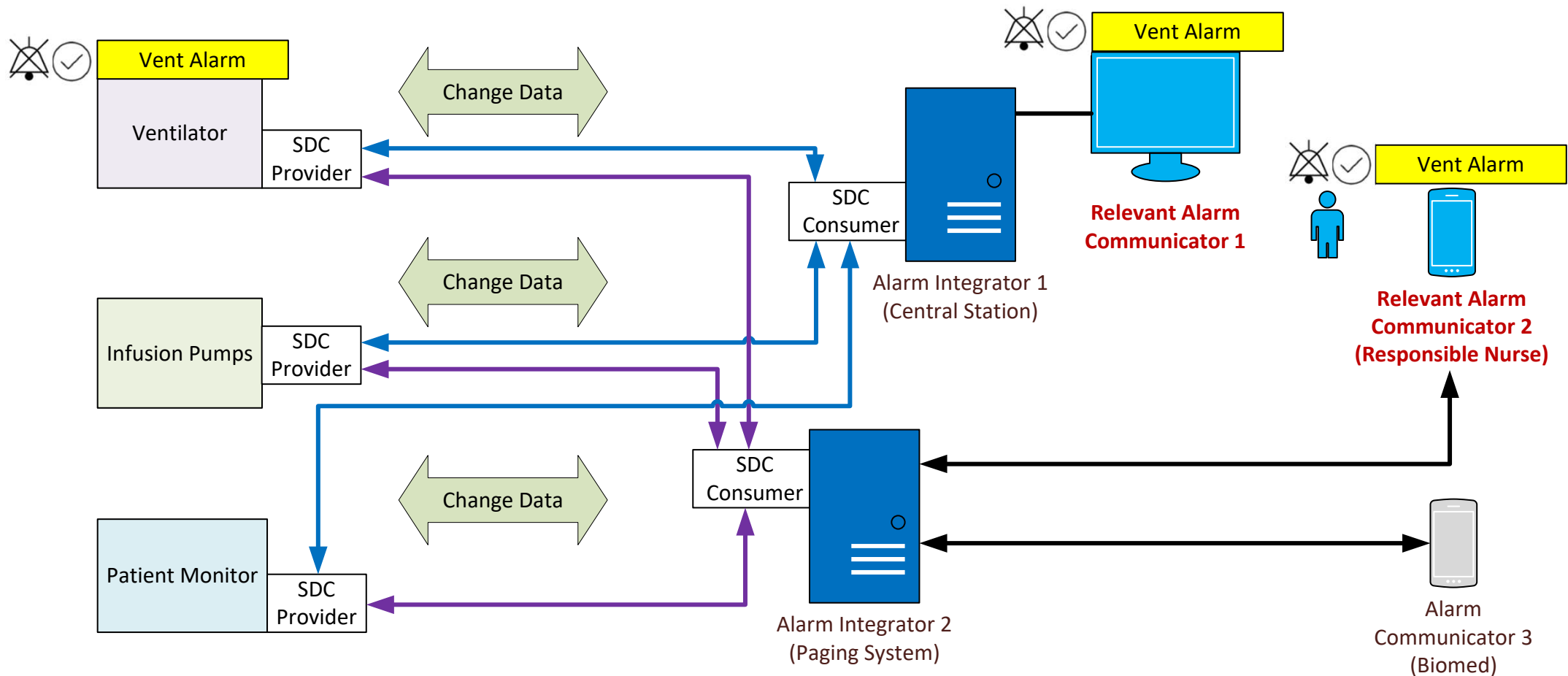 **And** the audio signal for this alarm shall be disabled at the Poc device and all relevant alerting devices

Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.

Multiple DAS Alarm Scenario 3: Acknowledge at remote device

- **When** there is an active physiological alarm at a PoC device
  And the alarm is shown visually and audibly on all relevant remote alerting devices that have physiological alarms assigned
  And the caregiver acknowledges the alarm on any remote alerting device
- **Then** the alarm shall be shown as acknowledged at the PoC device
  And the alarm shall be shown as acknowledged on all relevant alerting devices
  And the audio signal for this alarm shall be disabled at the Poc device and all relevant alerting devices
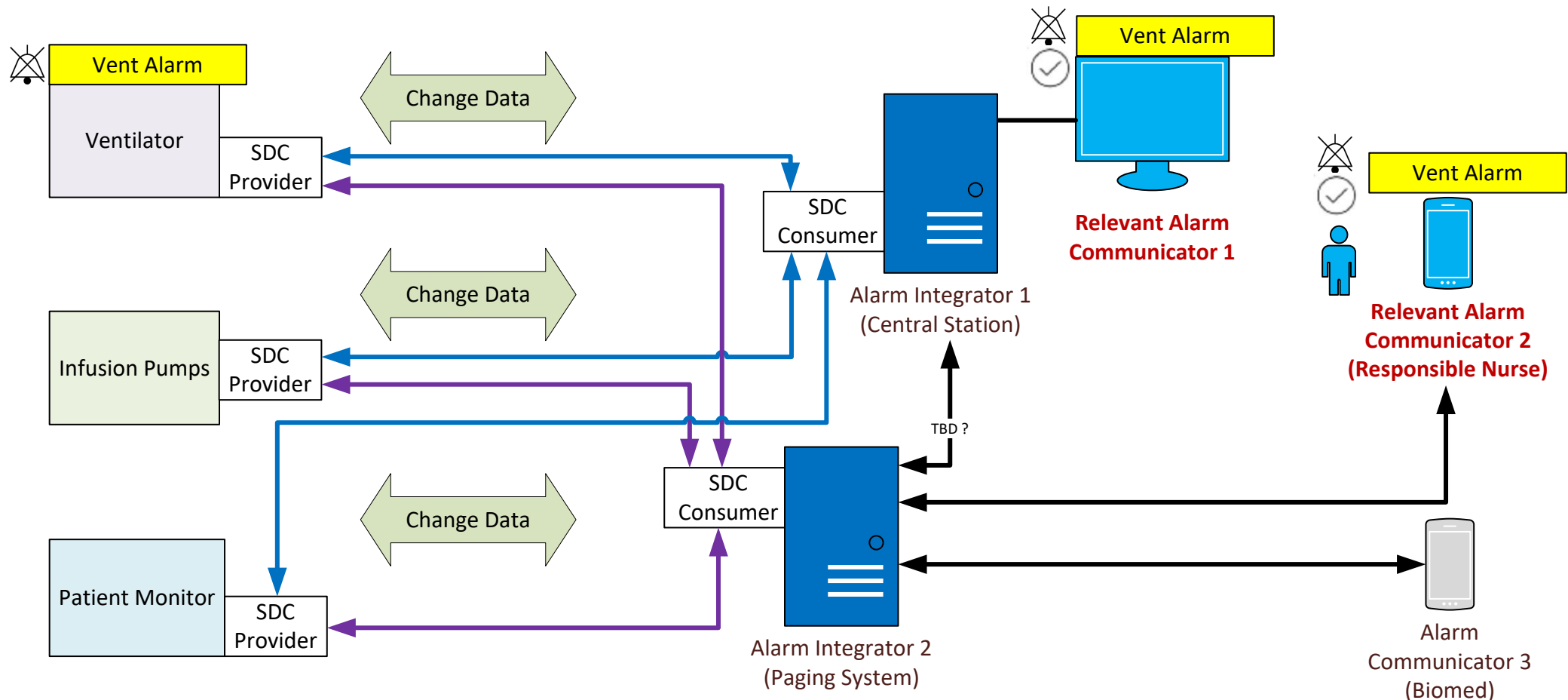
Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.

Multiple DAS Alarm Scenario 4: Responsibility Accepted at any of the relevant alarm communicators

- **When** there is an active physiological alarm at a PoC device
  And the alarm is shown visually and audibly on all relevant remote alerting devices that have physiological alarms assigned
  And the caregiver accepts the alarm on any remote alerting device
- **Then** the alarm shall visually be shown as accepted on all remote alerting device
  And the alarm audio shall be disabled on all other relevant remote alerting devices
  And the alarm shall be shown at the PoC device
  And the audio signal for this alarm shall be disabled at the Poc device

Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.
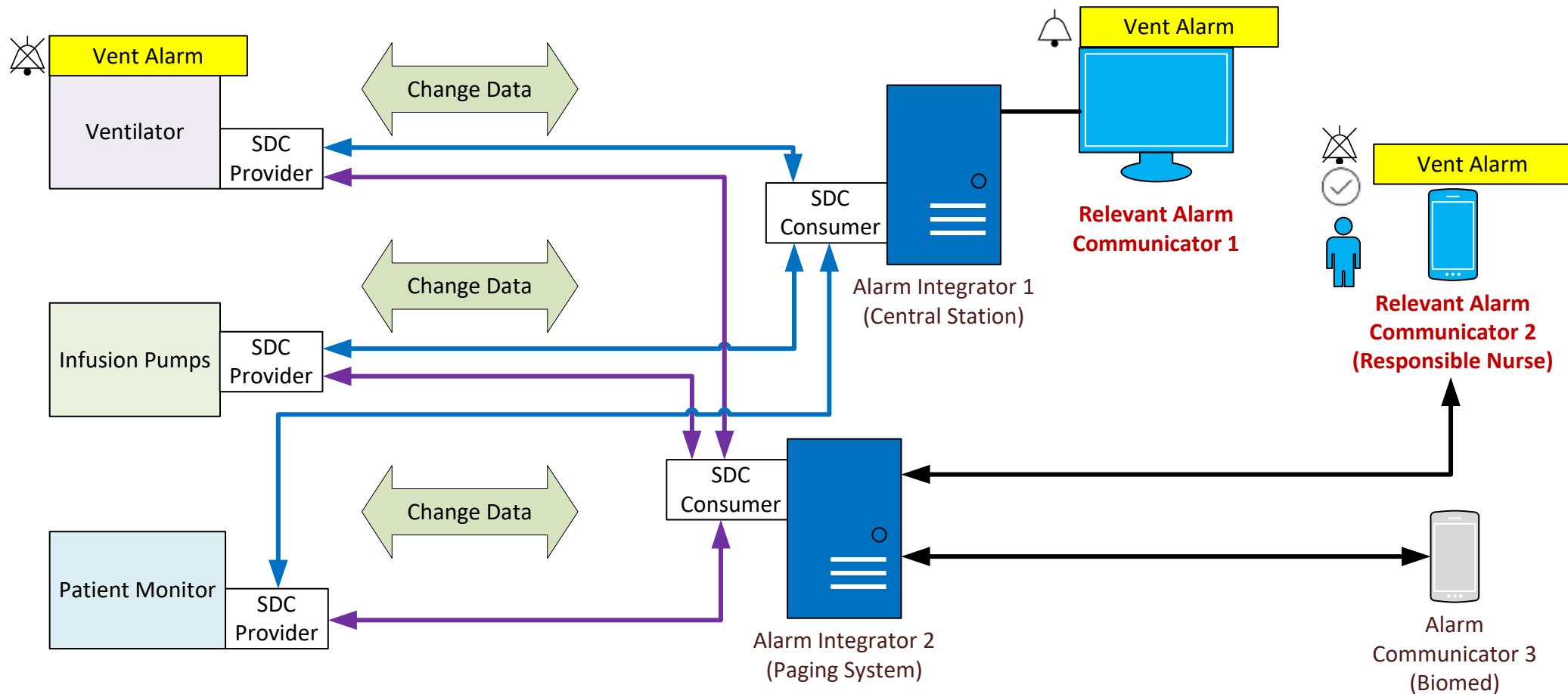
Multiple DAS Alarm Scenario 4.1: Responsibility Accepted at any of the relevant alarm communicators connected to one of the AIs

- **When** there is an active physiological alarm at a PoC device
  And the alarm is shown visually and audibly on all relevant remote alerting devices that have physiological alarms assigned
  And the caregiver accepts the alarm on any remote alerting device connected to one of the AIs
- **Then** the alarm shall visually be shown as accepted on all remote alerting device connected to the same AI
  And the alarm audio shall be disabled on all other relevant remote alerting devices connected to the same AI
  And the alarm shall still be signaled visually and audibly on all relevant remote alerting devices connected to a different AI
  And the alarm shall be shown at the PoC device
  And the audio signal for this alarm shall be disabled at the Poc device

Note: the alarm escalation is limited to the alarm communicators connected to the same AI since all AIs are independent systems.
Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.
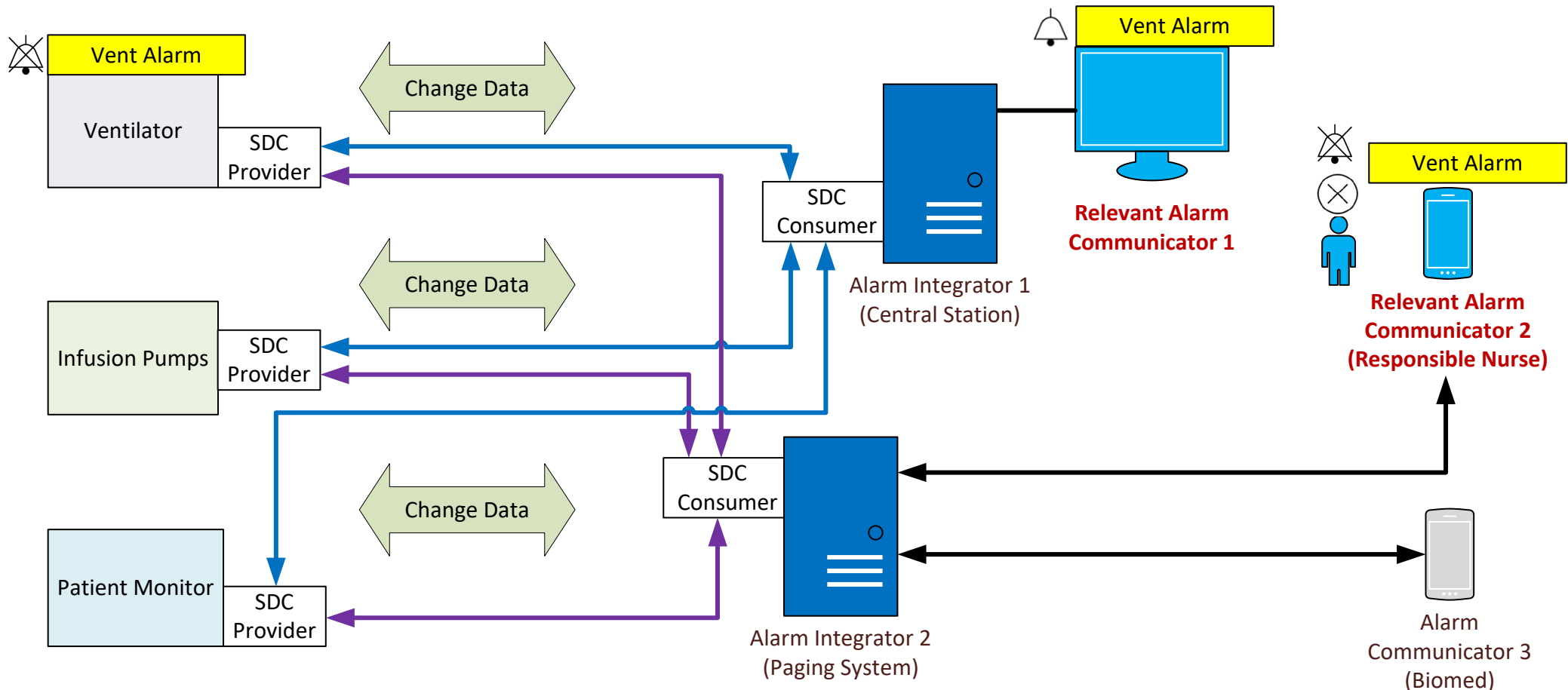
Multiple DAS Alarm Scenario 5: Responsibility Rejected at any of the relevant alarm communicators

- **When** there is an active physiological alarm at a PoC device
  And the alarm is shown visually and audibly on all relevant remote alerting devices that have physiological alarms assigned
  And the caregiver rejects the alarm on any remote alerting device
- **Then** the alarm shall visually be shown as rejected on this remote alerting device
  And the audio signal for this alarm shall be disabled on this remote alerting device
  And the alarm shall be shown at the PoC device
  And the audio signal for this alarm shall be disabled at the Poc device
  And the alarm shall visually and audibly be shown on all other relevant remote alerting devices

Note: the alarm escalation is limited to the alarm communicators connected to the same AI since all AIs are independent systems.
Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.

Multiple DAS Alarm Scenario 5.1: Responsibility Rejected at all of the relevant alarm communicators

- **When** there is an active physiological alarm at a PoC device
  And the alarm is shown visually and audibly on all relevant remote alerting devices that have physiological alarms assigned
  And the caregiver rejects the alarm on all remote alerting device
- **Then** the alarm shall visually be shown as rejected on all remote alerting device
  And the audio signal for this alarm shall be disabled on all remote alerting device
  And the alarm shall be shown at the PoC device
  And the audio signal for this alarm shall be enabled at the Poc device

Note: the alarm escalation is limited to the alarm communicators connected to the same AI since all AIs are independent systems.
Note: in this scenario, alarm communicator 3 is assigned to technical alarms. Therefore, this alarm communicator is not a relevant alarm communicator for physiological alarms from these PoCDs according to the IEC 60601-1-8 alarm standard.