

OR BLACK BOX[®]

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OR Black Box Technology Implementation

Prepared for Amsterdam UMC

Confidential



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Technology Implementation

This document provides an overview for the implementation of OR Black Box technology at Amsterdam UMC across 20 operating rooms.

The implementation includes all aspects of installing the OR Black Box technology within the Hospital operating rooms and within the Hospital's IT network. When the implementation is complete, the technology will provide all necessary capabilities for the acquisition, synchronization, de-identification, and encryption of the required OR Black Box information.

To ensure no impact to Hospital clinical operations, the technology implementation has been designed to ensure minimal time required in the Operating Room. Aside from physically affixing OR Black Box sensors to the walls in the operating room and creating Ethernet wall jacks (where necessary), all other major aspects of the implementation do not require access to the operating room.

To simplify implementation for the Hospital, SST provides all sensors pre-configured and ready for installation, along with installation instructions, technical documentation, on-call and on-site support, and implementation project management. Infection Prevention teams can be assured that OR Black Box sensors that are introduced into an operating room are always located well outside of the sterile operating field (i.e. attached to walls).

Implementation Phases

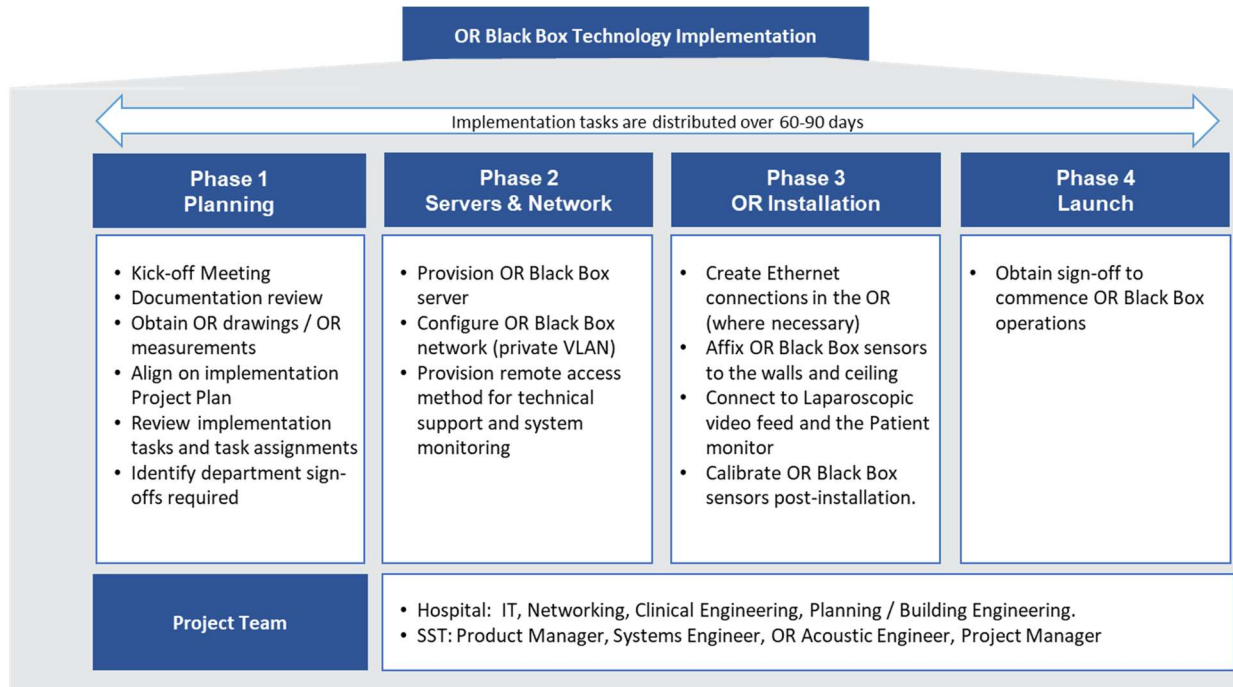
The implementation is separated into four phases and further described below:

1. Planning
2. Servers and Networking
3. Operating Room Sensorization
4. Launch / commencement of OR Black Box autonomous information capture.

To ensure adequate time for planning, documentation reviews, and acquiring internal department sign-offs, the implementation tasks will be spread over a calendar time of approximately 60-90 days.

SST will provide implementation Project Management as well as the supply, configuration and delivery of all OR Black Box sensors and technology (that reside within the OR) to the Hospital.

The Hospital will be required to supply servers and networking equipment (technical specifications in Appendix A) and perform the physical installation of OR Black Box sensors in the operating room, with SST's support.



Phase 1: Planning

The purpose of the Planning phase is to allow the Hospital and SST implementation project teams to connect, establish a shared understanding of the implementation tasks, identify and plan for Hospital specific protocols (e.g. department sign-offs), and align on a Project Plan/Timeline.

The Planning phase will include an on-site kick-off meeting, but all other aspects will be performed remotely (i.e. through email and web conference).

The Hospital implementation project team will include a representative from:

- IT / Systems Administration
- Networking
- Clinical Engineering (also referred to as Bio-Med)
- Planning / Building Engineering (to obtain drawings, etc.)

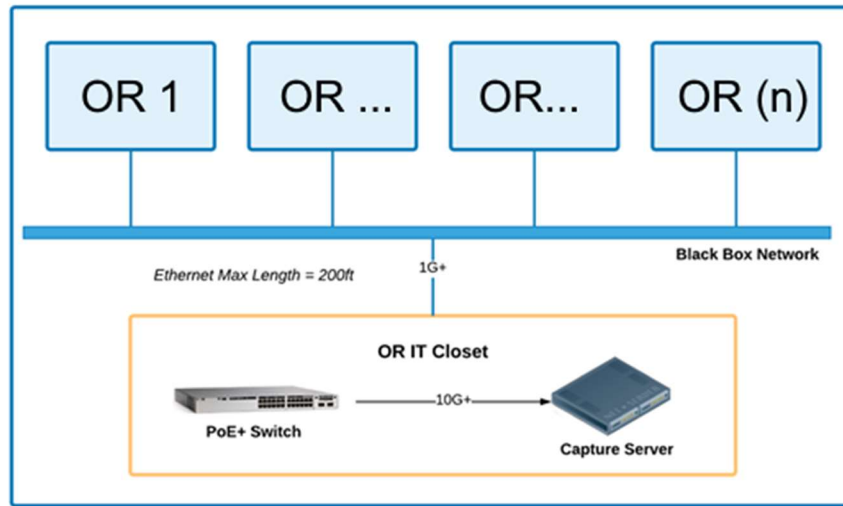
SST will provide the Hospital implementation project team with comprehensive documentation, and SST will be responsible for enhancing that documentation with any specific Hospital requirements.

Phase 2: Servers and Networking

The purpose of the Servers and Network phase is to configure the Hospital's existing IT infrastructure for the OR Black Box technology. The primary tasks achieved in this phase are the:

- Provisioning and configuring a Hospital Server (i.e. the "Capture Server) where OR Black Box software can be installed.
- Configuring a private OR Black Box sub-network (private VLAN) within the existing Hospital Network (since OR Black Box sensors are all Ethernet based).
- Provisioning a Hospital approved remote connection method for authorized SST personnel to provide technical support and monitor the system.

The tasks in this phase will be performed by representatives from Hospital IT and Networking, using detailed technical documentation and specifications provided by SST.



Representation of an example network configuration of OR Black Box

Phase 3: Operating Room Sensorization

The physical installation of OR Black Box sensors in the Operating Room will be performed by the Hospital (i.e. cabling and attaching sensors to walls/ceiling). The installation will involve representatives from IT/Networking and Clinical Engineering.

SST will provide detailed installation guidelines and will have technical resources available 24/7 to provide support during the installation.

Installation can be performed whenever the OR Schedule allows (e.g. after hours) and possibly incorporated within planned OR maintenance schedules. Additionally, the installation can be performed in its entirety at one time, or performed as separate tasks, as per the preference of Clinical Engineering and Perioperative Services. This will ensure that any OR downtime for the installation can be planned to have no impact on Hospital operations.

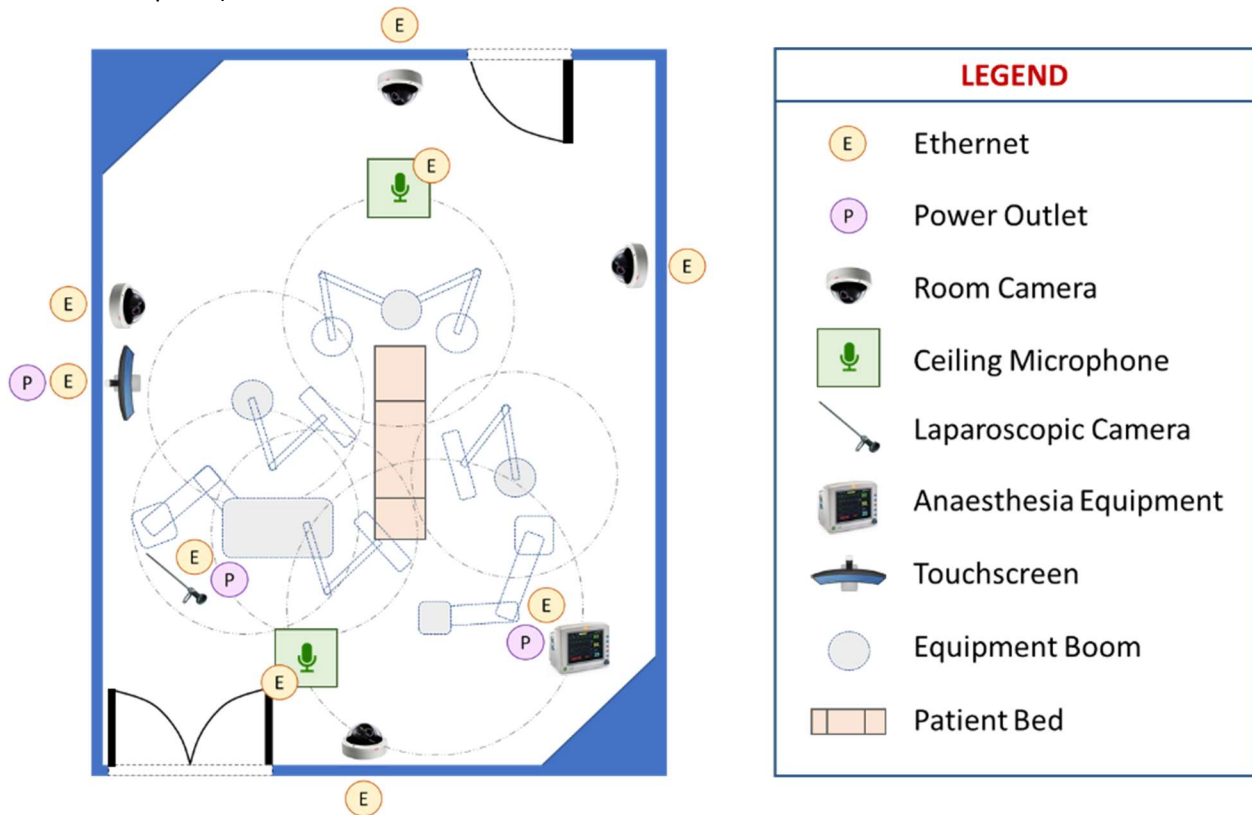
The tasks required for the OR installation include:

- Creating network wall jacks, in the OR, if not already available
- Attaching room cameras to the wall, and microphones to the ceiling, using mounting kits and location specifications supplied by SST.
- Connecting to the Laparoscopic video feed and the Patient monitor.

For illustration purposes, the below figure depicts a representation of a minimally invasive surgical unit that has been sensorized for OR Black Box. In this representation, the following OR Black Box sensors are illustrated:

1. OR Black Box Room Cameras
2. OR Black Box Microphones
3. Interface to Laparoscopic camera video feed

4. Interface to the physiological monitor and anesthesia equipment
5. OR Black Box Touchscreen (wall or desk mounted, all-in-one, medical grade, medically certified computer)



Representation of a minimally invasive surgical unit that has been sensorized for OR Black Box.

Following the installation, SST technical resources will be on-site to perform a calibration of OR Black Box sensors. The calibration will take approximately one hour per operating room and can be performed after hours.

Phase 4: Launch

With the appropriate sign-off (typically provided by perioperative services leadership), the OR Black Box can commence autonomous information capture.

Appendix A – Technical Specifications

Servers and Networking

The following tables outline the specifications and estimated cost for the Hospital provided equipment (servers and switches):

- PoE+ Network Switch
- Capture Server
- Black Box AI Server
- Outbound Server

PoE+ Network Switch Specifications (*subject to change)	
Type	• PoE+
Available PoE	• 100 W available per OR
# of Ports	• Minimum: 12 ports per OR (pending site assessment), stackable
Ethernet Cables	• Switch located in close proximity to Black Box PoE sensors • If CAT6 cable is used up to 37m (120ft) from PoE sensors. If CAT6A cable is used, up to 90m (300ft) from PoE sensors • 1G+ between switch & all Black Box PoE sensors • 10G+ between switch and Capture Server
Additional Note(s)	• Requires a UPS for persistent power • Power requirements and total number of devices/ports will be dependent on size of Operating Rooms
Estimated Cost	• \$1,000 US

Capture Server Specifications (*subject to change)	
Purpose	• The Capture Server is a physical rack server that resides in the A/V or IT Closet • The Capture Server should be configured such that internet access is disabled; however, remote access to this server is required for SST software updates and maintenance purposes. • OR Black Box proprietary capture software will be installed and configured on this server.
Operating System	• Windows Server 2016 or greater
CPU	• Xeon Silver 4116 or equivalent/greater
RAM	• 32 GB minimum
Hard Drive	• 250 GB minimum per OR to be integrated • Mainstream SSD on RAID 0 (e.g. S4600 or equivalent), hot-swappable
Network Card	• 10G (2 ports: one active, one standby)

Installed Software	OR Black Box Capture Software (and related dependencies), installed by SST
Internet Access	Disabled
Additional Note(s)	- Requires a UPS for persistent power - Authentication using LDAP/S can be configured if desired - SST will require remote access to this server for software updates and configuration changes - Multiple Servers may be required depending on number of OR's, number of sensors per OR, and distances between IT Closet and OR Black Box sensors
Estimated Cost	\$5,000 US

Black Box AI Server Specifications (*subject to change)	
Purpose	- The Black Box AI server is a physical server that can reside in the Hospital's Data Centre or Server Room. - The server is specifically designed for executing Black Box AI models (e.g. de-identification by AI) on premise. - The server will require high I/O capabilities and include multiple GPU's to execute several Deep Learning algorithms. - The OR Black Box AI Engine will be installed and configured on this server.
Specifications	- Due to the rapidly evolving market for Deep Learning servers, detailed specifications will be provided in advance of project planning to latest technology available. - As of time of writing, suggested specifications include: 128 GB RAM, NVMe Flash, and several Deep Learning GPU's. - Specifications can be tailored to local hardware availability and SST can leverage existing Hospital hardware wherever possible to minimize procurement.
Installed Software	OR Black Box AI Engine and AI Algorithms
Internet Access	Disabled
Additional Note(s)	- Requires a UPS for persistent power - SST will require remote access to this server for software updates and configuration changes - Multiple servers may be required depending on hardware selected
Estimated Cost	\$12,000 US

Outbound Server Specifications (*subject to change)	
(* it should be noted that an Outbound server has already been provisioned at AMC as part of the "Version 1" OR Black Box).	
Purpose	- The Outbound Server is a temporary holding area for all captured files and can be either a virtual or physical server located in the Hospital's Data Centre Infrastructure. - In most implementations, this has been a Virtual Server.
Operating System	Windows Server 2016

CPU	• Xeon Silver 4116 or equivalent/greater
RAM	• 32 GB minimum
Hard Drive	• 500 GB minimum per OR to be integrated
Installed Software	• Enterprise grade secure file transfer solution
Internet Access	• Optional
Additional Note(s)	• This Outbound Server should be configured to be on the same VLAN as the Capture Server • SST will require remote access to this Outbound Server
Estimated Cost	\$0 – assumed virtual server will be provided from existing Hospital virtualization resources and not require new expenditure.

Operating Room Ethernet and Power

The following table describes the recommended Ethernet and Power requirements for the OR Black Box sensorization of each operating room.

Description	Mounting Location	Per Operating Room		Notes
		Data (Ethernet) Drops	Power Source / Type	
PoE Sensors	Wall or ceiling	6x	PoE	• Data drops should be plate-terminated and near sensors • SST provides all sensors, mounting options and placement guidelines. • Ethernet Cables: CAT6 up to 37m (120ft), CAT6A up to 90m (300ft)
Non PoE Sensors	Wall or desk	1x	120/240V	
Interfaces and Integrations	Equipment Booms	2x per boom	2x 120/240V per boom	
Server Rack / Cabinet Space Reservation	A/V Rack or Network Closet or Server Closet	See Notes	120/240V with battery backup (preferred, but not mandatory)	• 4RU required for patch panel / patch field, Capture Server and PoE+ switch(es) • 1x PoE+ (1G, 24 ports) switch for every 2 OR's • 1x 10G uplink port per switch to Hospital network