GridION X5 IT and Site Requirements

For Site Installation and Operation

v0 Dec 17

GridION X5 IT Requirements

Checklist

This checklist represents the minimal requirements for installing the GridION in your institution. For full explanation of requirements please continue to the document.

Item/Setup Required	Reason	Provided?
Ethernet: RJ45 port running at 1GB with DHCP service running	Connection to IT infrastructure and internet	
Ethernet: HTTPS/port 443 TCP access to AWS eu-west-1 IP ranges listed at http://docs.aws.amazon.com/general/latest/gr/aws-ip-ranges.html	Telemetry feedback, EPI2ME analysis	
Ethernet: HTTPS/port 443 and HTTP/port 80 TCP access to Linode-hosted IP addresses 178.79.175.200, 96.126.99.215 and 106.187.40.102 for software distribution	Software updates	
Peripherals: USB mouse	GridION control	
Peripherals: USB keyboard	GridION control	
Peripherals: DisplayPort/HDMI compatible monitor and Power cable	GridION control	
Power: Power supply capable of delivering 600W	GridION power	

GridION X5 Device

Overview

The GridION^{TM} X5 is a benchtop device for nanopore sequencing designed to run and analyse up to five MinION flow cells. It is ideal for labs with multiple projects that need the advantages of nanopore sequencing:

- Simple library preparation
- Real-time analysis
- Biological insights from long reads

In addition the GridION X5 also allows users to offer nanopore sequencing as a service.

The GridION X5 benefits from the inclusion of on-board compute which permits data acquisition, analysis and feedback, basecalling, data streaming and device control, all without placing any additional burden on existing IT infrastructure.

All control, basecalling, analysis and orchestration on the GridION X5 is carried out by pre-installed custom software created by Oxford Nanopore Technologies and Metrichor. The default data analysis workflow when using the GridION X5 is as below:

Figure 1: Default data analysis workflow of the GridION device

Specifications

The GridION X5 is designed around a simple user interface on top of cutting-edge custom electronics providing real-time analysis solutions:

Component	Specification
Operating System	- Ubuntu 16.04 running off Intel CPU - Customers are advised to keep up to date with all software and security patches

Storage	-	4 TB internal SSD
Memory	-	64 GB RAM
Size and weight	-	H220 x W 365x D 370 mm
	-	11 kg
Environmental ranges	-	-5° C to +40° C

Site Requirements

Installing the GridION X5 in your institution is similar to installing any new computer. Requirements for the device are as follows:

Component	Requirements

1x RJ45 Port	- IP address via either DHCP service OR statically assigned
	- TCP running on port 80 HTTP and port 443 HTTPS
	- Requires Perimeter firewall permissions:
	    o To access AWS eu-west-1 IP ranges listed at https://ip-ranges.amazonaws.com/ip-ranges.json for telemetry feedback and EPI2ME analysis
	    o To 178.79.175.200, 96.126.99.215, and 106.187.40.102 for software updates

2x Power supply	- 1x for GridION, C13 cable included with device o Maximum power draw from GridION of 600W - 1x for monitor power
1x Monitor	- Compatible with HDMI/DisplayPort connections for GridION interaction
1x Keyboard	- Compatible with USB connection for GridION interaction
1x Mouse	- Compatible with USB connection for GridION interaction

Networking explanations

The two requirements for firewall permissions are:

1. Access to the AWS eu-west-1 region for telemetry feedback and use of the EPI2ME platform through port 443
2. Access to the Linode-hosted IP addresses 178.79.175.200, 96.126.99.215 and 106.187.40.102 for software distribution

Telemetry

Telemetry information is collected by MinKNOW sequencing runs as per the Terms and Conditions to allow monitoring of experiment performance and provide support in troubleshooting cases. Some of this information is obtained from free-form text entry fields, therefore no personally identifiable information should be included. No sequence data is collected.

The EPI2ME platform from [Metrichor](#) is hosted within AWS and provides cloud-based analysis solutions for multiple applications. Use of this platform entails users uploading sequence data in .fast5 or .fastq format from the EPI2ME Agent, which is then processed through defined pipelines within the EPI2ME Portal. Downloads from EPI2ME are either in Data+Telemetry or Telemetry form. Telemetry information is used to populate reports within the EPI2ME portal.

Software updates

Depending on your geographical region, only one of 178.79.175.200, 96.126.99.215 or 106.187.40.102 will be used for provision of updates to device software. Updates are triggered as pull requests, therefore outbound-only access is required.

Included Software

Oxford Nanopore Technologies build and provide numerous software types involved in acquisition, orchestration and analysis:

- MinKNOW
- Albacore
- Guppy
- Dogfish
- EPI2ME (created by [Metrichor](#))

MinKNOW

MinKNOW carries out several core tasks:

- Data acquisition
- Real-time analysis and feedback
- Data streaming
- Device control, including run parameter selection
- Sample identification and tracking
- Ensuring chemistry is performing correctly

It utilizes an intuitive GUI and receives updates on a regular basis. This is the core software provided by Oxford Nanopore without which the sequencing devices cannot be run. Data from MinKNOW is

packaged into individual read .fast5 files (over 1 million of which can be generated by a single flow cell), which are a customized file format based upon the .hdf5 file type. These .fast5 files are then utilized by other down-stream software.
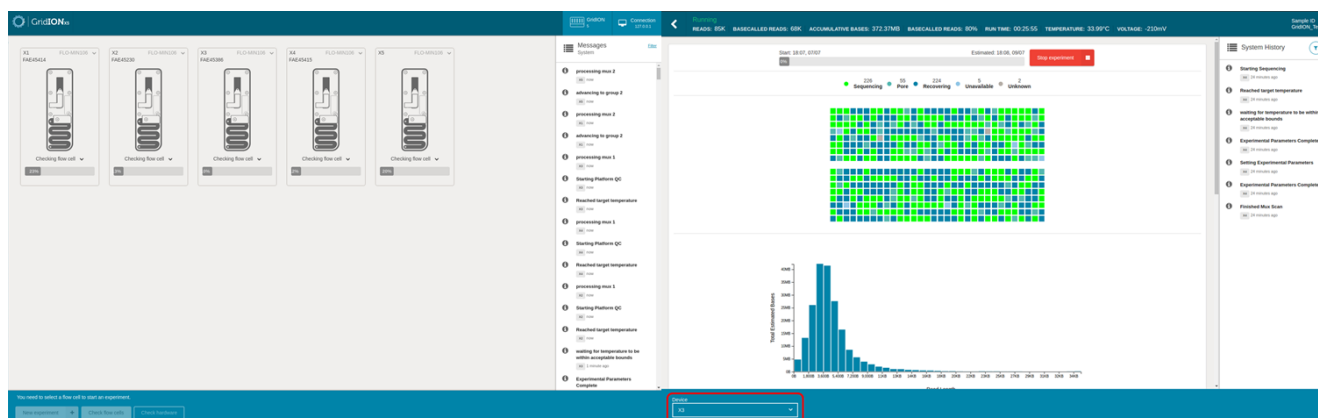

Figure 2: Example screen shots of the MinKNOW GUI. This permits selection and initiation of experiments, as well as providing real-time feedback on experiment progression

Albacore

Albacore is a production basecaller provided by Oxford Nanopore, and uses a command-line interface. It utilizes the latest in Recurrent Neural Network algorithms in order to interpret the signal data from the nanopore, and basecall the DNA or RNA passing through the pore. It implements stable features into Oxford Nanopore Technologies' software products, and is fully supported. It receives .fast5 files as an input, and is capable of producing:

- .fast5 files appended with basecalled information
- .fast5 files that have been processed, but basecall information present in a separate .fastq file

Guppy

Guppy is a production basecaller provided by Oxford Nanopore featuring the same core code as Albacore but optimized for running with basecall accelerators e.g. GPUs, FPGAs. Unlike Albacore, Guppy is not intended for direct interaction but instead makes use of Dogfish as a "broker" to divide processing of incoming .fast5 files across the available resource.

Dogfish

Dogfish is a service running on the GridION X5 that permits accelerated basecalling with Guppy, accessible through a command-line interface. It monitors for .fast5 files from MinKNOW then passes them into Guppy in a fashion that allows for utilization of the integrated basecalling accelerator.

EPI2ME

EPI2ME^{TM} is an onwards data-analysis platform created by Oxford Nanopore's subsidiary company Metrichor. It provides users with real-time analysis such as species identification, alignment workflows

and other bioinformatics solutions. It is currently provided as a cloud-based analysis platform which is initiated through the local EPI2ME Agent.
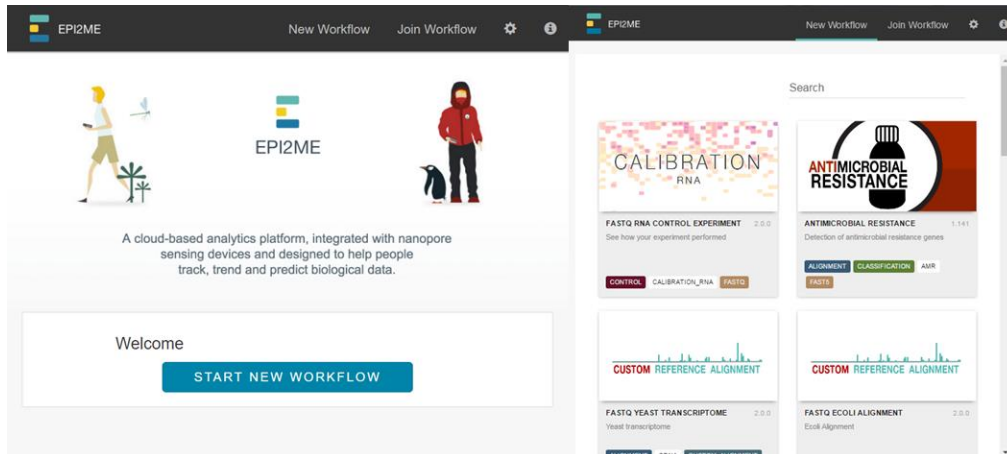

Figure 3: The EPI2ME Agent. Installed on the device, this allows selection and initiation of workflows within the EPI2ME portal.

Users will be able to review basic experimental statistics as well as use prepared workflows such as real-time taxonomic identification, reference alignment and many more.
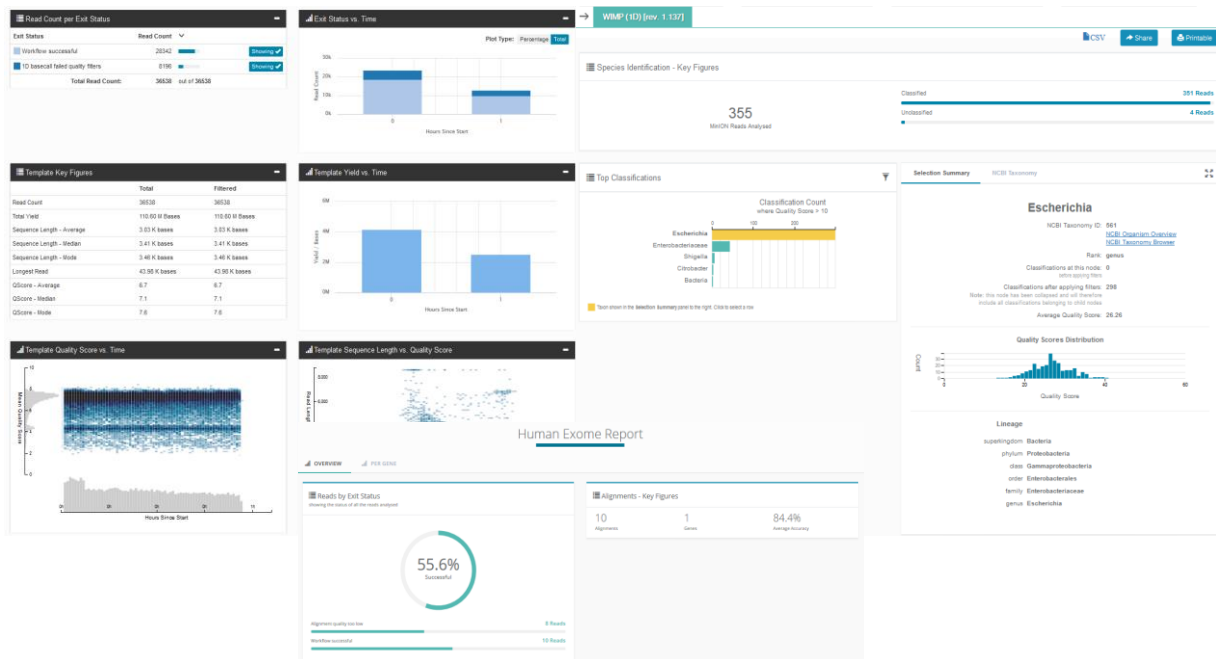

Figure 4: Example reports and plots from the EPI2ME portal.

Change log

Date	Version	Changes made
Dec 17	v0	Initial version