



CEREC Network Operation Recommendations

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Sirona**

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1 Introduction

CEREC Primemill and all other CEREC equipment components are network based devices. Dentsply Sirona wants to enable all CEREC users to experience a smooth operation. Therefore the following information provides guidance to install CEREC Primemill and other devices in a dentist office and its network environment. The guide as well includes information for installing Hub.

Chapters 2 and 3 should be used to identify the right setup for the user.

Annex A to D provide a detailed overview for the network specifications of the devices as well as information how to analyse the network environment.

Annex E provides a detailed checklist for all network based devices and can be used by service technicians and/or IT professionals to define the right setup of network components and to check the settings for the components prior or within the install.

2 Modes of Operation

2.1 Scenario 1: Recommended typical Setup

The recommended setup for a CEREC Primemill, CEREC MC/MC X/XL and CEREC SpeedFire installation in combination with Primescan AC or Omnicam AC (or older CEREC Omnicam versions) is shown in the picture below. The manufacturing devices as well as the Hub use Ethernet based connections to a router. Ethernet ports at the point of operation in combination with a switch are required at the point of operation.

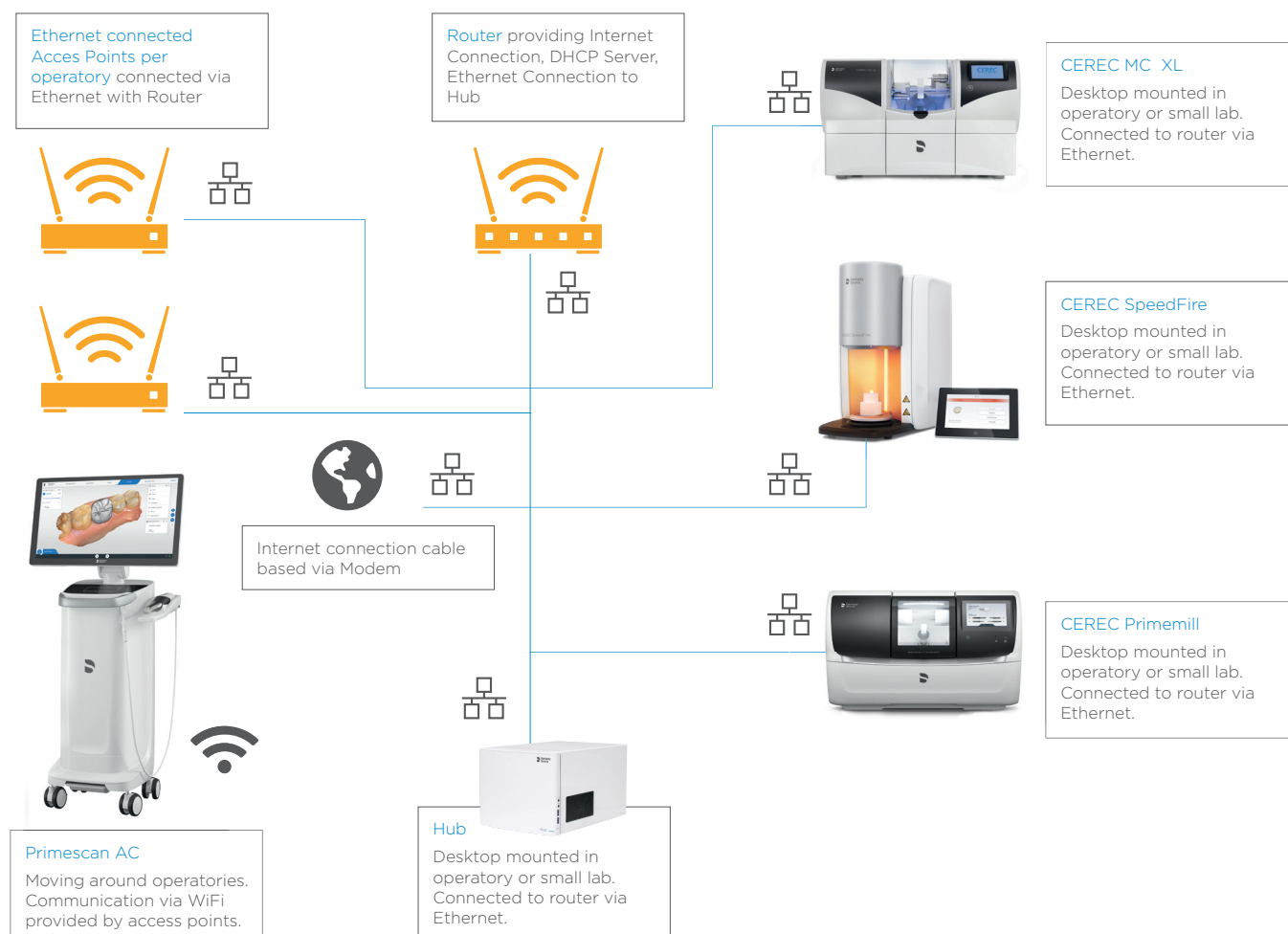
The Primescan AC / Omnicam AC is connected to the network via WiFi that is provided by single WiFi-Access points per operatory. Those are connected via Ethernet to the router using one SSID and act as a Mesh Network.

Note: PowerLan/Powerline Communication (PLC) connections are not recommended!

Note: For CEREC Primemill the CEREC Radio modules should not be used.

Note: A list of recommended devices for this setup please find attached in Chapter 3.

Note: A list of required/recommended bandwidth for smooth operation please find attached in Annex C.



2.2 Wifi Connected Mill and Furnace

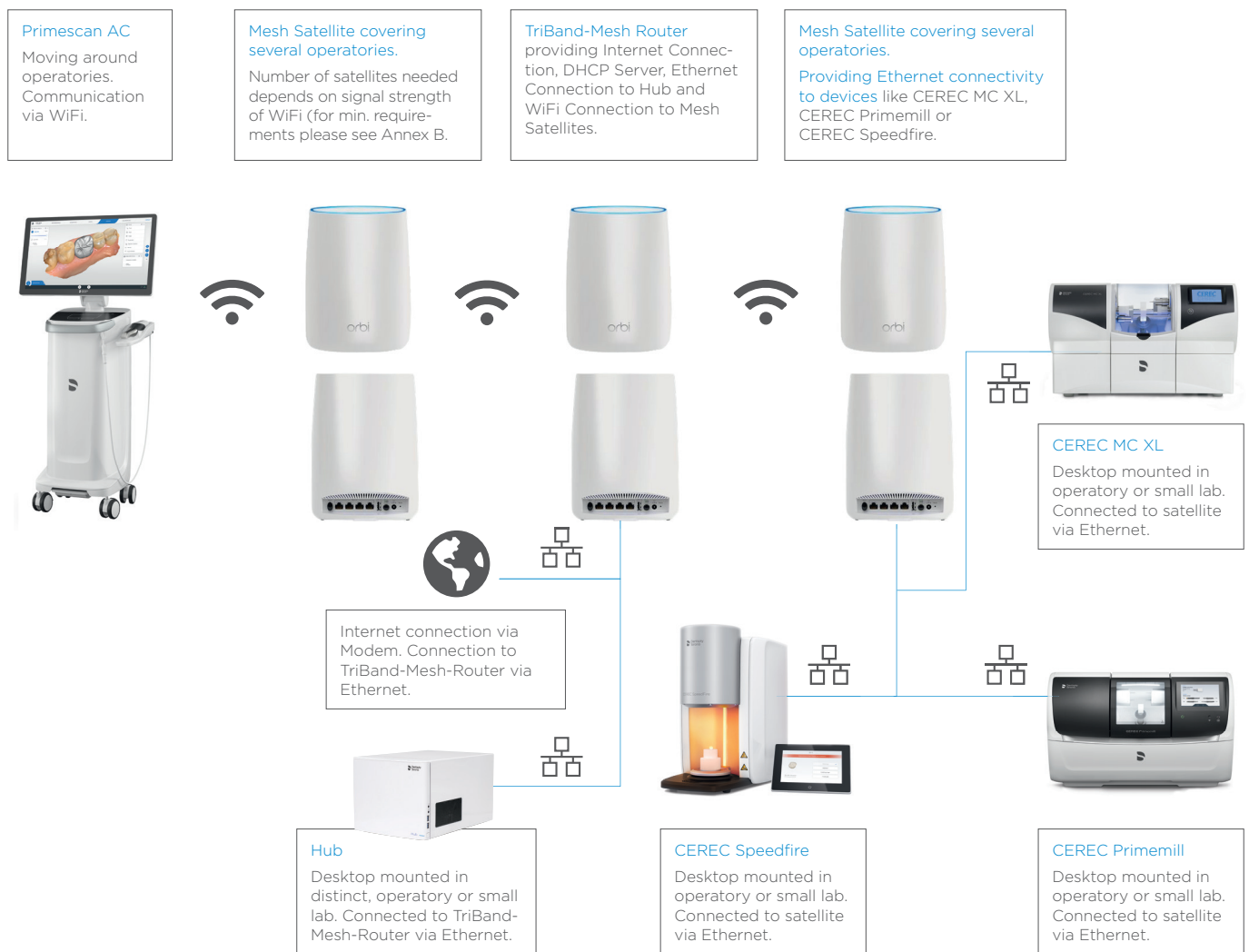
In case the given infrastructure does not provide Ethernet cabling and sockets at the point of operation of the manufacturing devices, it is recommended to setup a TriBand-Mesh Network with satellites that provide ethernet ports (manufacturers of such systems are e.g. Netgear (Orbi System) or TP-Link).

Those systems enable a strong WiFi within the whole office. A central Mesh Router acts as a master device and satellites are placed close to the point of operation of CEREC Primemill (or other manufacturing devices and Hub). The manufacturing devices are connected to the satellites via Ethernet cabling.

The Primescan AC / Omnicam AC is connected via WiFi into the network that is provided by the Wifi-Mesh Router and the Mesh Satellites. They should be setup using one SSID.

Note: The List of recommended devices please find attached in chapter 3.

Note: A list of recommended/minimum bandwidth please find attached in Annex C.



3 List of Recommended Devices

Dentsply Sirona wants to empower its users to enjoy the smoothest way of operation of devices. Therefore certain requirements have to be met by the network components.

The list below provides an overview of components that basically fulfill the distinct specifications (see Annex A).

The devices marked with (*1) have been tested in dentist environments during the CEREC Primemill testing phase. The devices marked with (*2) have completed a 30-day testing with Hub.

Note: *In most cases the standard settings of the components will allow a plug'n'play installation of Dentsply Sirona equipment. As all offices and clinics are not setup equally, we encourage all users to review the connectivity plans with IT professionals and/or create an alternative installation plan based on the technical specifications and office needs.*

3.1 List of recommended devices for Scenario 1

3.1.1 List of Routers

- Fritzbox 7490 (*1, *2)
- Netgear Nighthawk AX3000 (*2)
- Asus RT-AC3200 (*2)
- Asus ROG Rapture GT-AC 5300 (*2)
- AX3000 (*2)
- Cisco RV130W (*2)
- D-Link Exo AC 2600 (*2)
- DrayTek Vigor 2925 ac (*2)
- Fortinet Fortigate FWF 60E (*2)
- Lancom 1781VA(*2)
- Linksys EA9500 (*2)
- Linksys WRT 1200 AC (*2)

3.1.2 List of Access Points

- Unifi Ubiquiti AP (*1)
- Netgear ProSafe Wireless N Access Point (*1)

3.2 List of recommended devices for Scenario 2

3.2.1 List of Mesh Network Systems

- Orbi RBK 53 Mesh WiFi System (*1)
- Orbi RBK 43 Mesh WiFi System (*1)
- TP-Link Deco M9 Plus Mesh WiFi System – Ubiquiti Amplifi

4 Annex A: Requirements for WiFi and Ethernet Connectivity of AC- and Manufacturing Systems

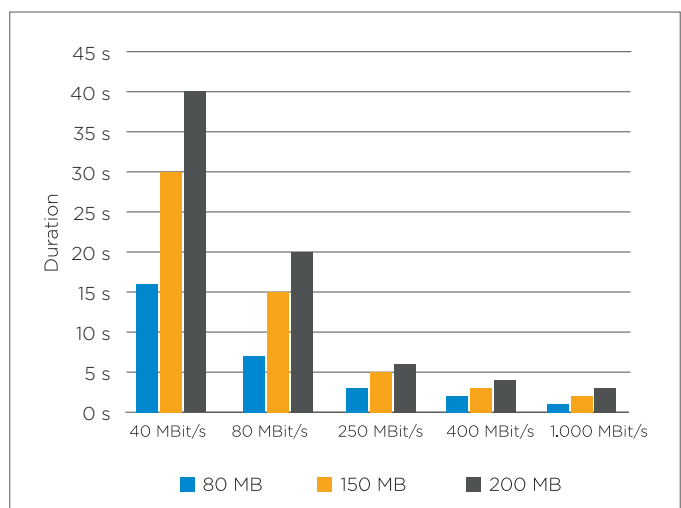
To ensure smooth operation of the network components the network load has to be managed by the network components.

4.1 Typical Network loads

Typical network loads are shown in Table 1.

Task	Network Load
Saving CEREC Omnicam Case to Hub (Crown Design, Quadrant- Scanning)	Approx. 80 MB
Saving CEREC Omnicam Case to DS Hub (Crown Design, Upper-, Lower Full-Arch)	Approx. 140 MB
Saving CEREC Omnicam Case to Hub (Crown and Bridge Design, Upper-, Lower Full-Arch)	Approx. 200 MB
Saving CEREC Primescan Case to Hub (Crown and Bridge Design, Upper-, Lower Full-Arch)	Approx 150 MB
Download Firmware Update to CEREC Primemill	Approx. 60 MB
Download new operating System to CEREC Primemill	Approx. 250 MB

The duration to execute the different tasks depends on the bandwidth of the network. Examples for duration times are shown in Table 2 in relation to the provided network bandwidth/transfer rate.



Transfer Duration Through Network

4.2 Network Bandwidth requirements

The table below shows the requirements the network has to fulfill via Ethernet or WiFi **at the point of operation** – e.g. at the dental chair for the Acquisition Center. Tools to measure those are listed in Annex C.

Level of Network	Bandwidth
Not recommended	< 50 Mbit/s
Acceptable	>50 Mbit/s <100 Mbit/s
Excellent	>100 Mbit/s

4.3 List of Hardware Standards

The following list provides an overview of standards that are recommended for the different networks components and should be ensured upfront the installation of CEREC Primemill or other equipment.

Type of Device	Recommended Standard
WiFi Frequency	Dual Channel 2.4Ghz and 5 Ghz
WiFi Standard	802.11ac or better
Ethernet Cable	CAT5e or better
Router	DHCP / IPV4 / IPV6
WiFi SSID	Mesh setup recommended with a single SSID

5 Annex B: Individual Settings to be checked in case of Trouble-Shooting

The following network settings should be checked by an IT professional in case of any trouble within the installation of a network based component of the CEREC System.

5.1 Settings for CEREC Primemill

5.1.1 Unblocked mDNS Multicast Address

- IPv4: 224.0.0.251
- IPv6: ff02::fb

5.1.2 Open Ports:

- 5353 / udp
- 28930 / tcp
- 50926 / tcp

5.2 Settings for Hub

5.2.1 Until Hub 2.1.0 / CEREC 5.1

5.2.1.1 Unblocked Multicast Address

- IPv4: 239.0.0.222

5.2.1.2 Open Ports:

- 2222

5.2.2 Later versions:

5.2.2.1.1 Unblocked mDNS Multicast Address

- IPv4: 224.0.0.251
- IPv6: ff02::fb

5.2.2.1.2 Open Ports:

- 5353

5.2.2.1.3 DHCP Server

- required for PnP

5.3 Special Requirements for CEREC MC, MC X, MC XL, inLab MC XL, inLab Mc X5 and SpeedFire

5.3.1 IPv4

- used

5.3.2 Open Ports:

- 28930

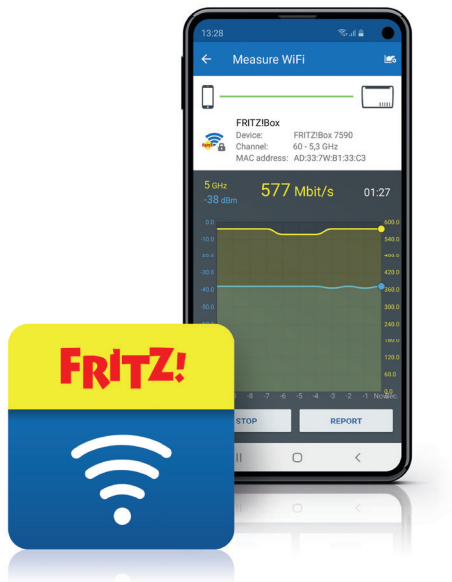
6 Annex C: Tools to identify Bandwidth at Point of Operation

For the measurement of the bandwidth at the point of operation different tools can be used. The availability of those depend on the App stores in the individual market. Please contact your local IT professional for further information.

6.1 Examples for Measurement of WiFi Bandwidth at Point of Operation

6.1.1 Fritz! WLAN App or Similar

The Fritz! WLAN App is available for either Android or iPhone and measures exactly the bandwidth of an WiFi Network at the point of Operation



6.2 Windows 10 Tools

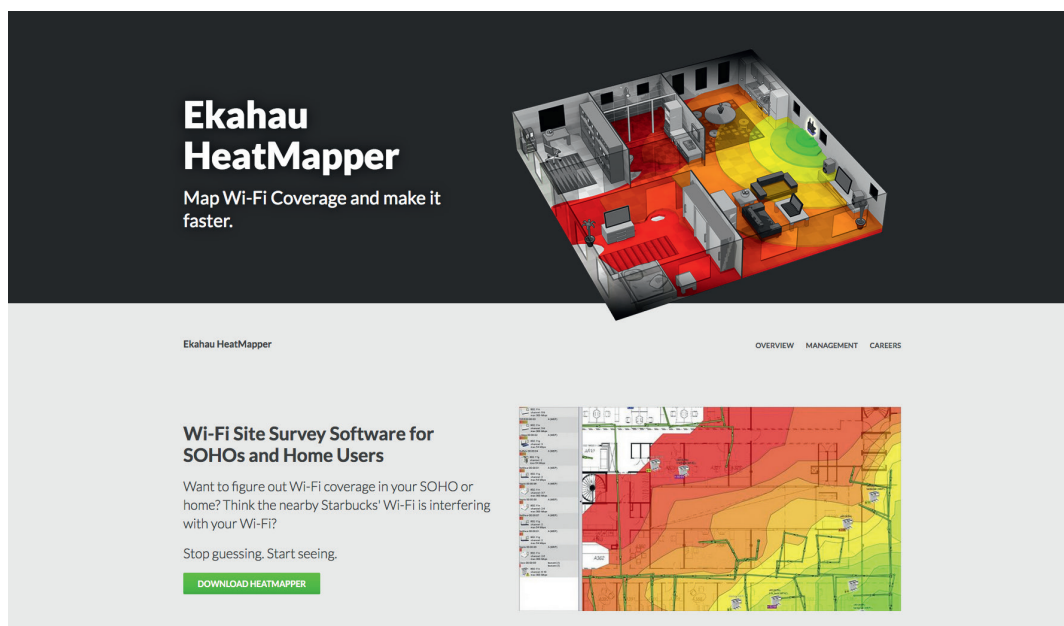
In Windows 10 the network and internet settings can be checked by the following steps:

1. Click the Start icon (or press the Start button on the keyboard), and then tap or click Settings.
2. Click “Network & Internet”.
3. Click “View network properties”
4. Check individual status of WiFi or Ethernet connection.

6.3 Professional Tools

There are even more professional tools available that e.g. can create heat maps for a complete office. An example is shown in the picture below. Please contact your individual IT professional for further information.

<https://www.ekahau.com/de/products/heatmapper/overview/>



The screenshot displays the Ekahau HeatMapper website. The top section features the product name "Ekahau HeatMapper" in white text on a dark background, with the tagline "Map Wi-Fi Coverage and make it faster." To the right is a 3D isometric view of an office floor plan with color-coded areas representing signal strength. Below this, a navigation bar includes "Ekahau HeatMapper" and "OVERVIEW MANAGEMENT CAREERS". The main content area has the heading "Wi-Fi Site Survey Software for SOHOs and Home Users" and a paragraph: "Want to figure out Wi-Fi coverage in your SOHO or home? Think the nearby Starbucks' Wi-Fi is interfering with your Wi-Fi? Stop guessing. Start seeing." A green button labeled "DOWNLOAD HEATMAPPER" is positioned below the text. To the right of the text is a 2D heat map of a floor plan, with colors ranging from red (high signal) to green (low signal).

7 Annex D: Detailed description of network based CEREC System Components

The following information should be used by and handed over to IT professionals to understand the requirements for the smooth operation of CEREC System components.

7.1 Network Characteristics Manufacturing Units: CEREC Primemill, CEREC MC Family and CEREC SpeedFire

Device	CEREC Primemill	CEREC MC, MC X, MC XL	CEREC SpeedFire
Ethernet Connector	100BASE-T (100 Mbit/s)	10BASE-T (10 Mbit/s)	100BASE-T (100 Mbit/s)
Operating System	Linux with TCP/IP Stack	PXROS	Linux with TCP/IP Stack
Network Setup (ex factory, can be changed manually)			
IPV4	DHCP / AutoIP	Static: 192.168.230.0xx	Static: 192.168.230.0xx
IPV6	SLAAC	n.a.	n.a.
Port	28930, 50926 (only Webserver)	28930	28930
mDNS	5353/udp	n.a.	n.a.
Subnet Mask		255.255.255.0	255.255.255.0
Internal Buffer	50 Packages (approx. 1 min)	12 Packages (approx. 20 sec)	> 100 Jobs
Max. required data transfer rate per Process	350 kBit/s	350 kBit/s	
Average required data transfer rate per Process	200 kBit/s	200 kBit/s	

7.2 Network Characteristics Acquisition Units: Omnicam & Primescan

PC Hardware Version	3.2.1, 3.2.2 (AC 1.0 OC) 3.4.1, 3.4.2, 3.4.3 (AF/AI)	1.1.2 (AC 2.0 OC) 1.7.2 (AC 2.0 PS) 3.2.2, 4.2.1 (AC 1.0 OC) 5.2.1 (Windows 10 Upgrade PC AC 1.0) 4.4.1 (AF/AI)	1.1.1 (AC 2.0 OC) 1.7.1 (AC 2.0 PS)
WLAN Card	TP-Link TL-WDN4800	TP-Link Archer T6E	TP-Link Archer T9E
Supported Standards	-	IEEE802.11ac	IEEE802.11ac
	IEEE802.11a	IEEE802.11a	IEEE802.11a
	IEEE802.11n	IEEE802.11n	IEEE802.11n
	IEEE802.11g	IEEE802.11g	IEEE802.11g
	IEEE802.11b	IEEE802.11b	IEEE802.11b
Frequencies	5 GHz	5 GHz	5 GHz
	2.4 GHz	2.4 GHz	2.4 GHz
Signal Rates	5 GHz	5 GHz	5 GHz
	11n: up to 450 Mbit/s (dynamic)	11ac: up to 867 Mbit/s (dynamic)	11ac: up to 1300 Mbit/s (dynamic)
	11a: Bis zu 54 Mbit/s (dynamic)	11a: up to 54 Mbit/s (dynamic)	11a: up to 54 Mbit/s (dynamic)
	2.4 GHz	2.4 GHz	2.4 GHz
	11n: up to 450 Mbit/s (dynamic)	11n: up to 400 Mbit/s (dynamic)	11n: up to 600 Mbit/s (dynamic)
	11g: up to 54 Mbit/s (dynamic)	11g: up to 54 Mbit/s (dynamic)	11g: up to 54 Mbit/s (dynamic)
	11b: up to 11 Mbit/s (dynamic)	11b: up to 11 Mbit/s (dynamic)	11b: up to 11 Mbit/s (dynamic)
Transmission Power	Max. 20 dBm	Max. 23 dBm	Max. 20 dBm
Supported Modes	Ad-Hoc	Ad-Hoc	Ad-Hoc
	infrastructure	infrastructure	infrastructure
Supported Protection	WPA-PSK/WPA2-PSK	WPA-PSK/WPA2-PSK	WPA-PSK/WPA2-PSK
	802.1x	802.1x	802.1x
	WEP w/ 64 and 128 Bit	WEP w/ 64 and 128 Bit	WEP w/ 64 and 128 Bit
Modulation Method	DBPSK, DQPSK, CCK, OFDM, 16-QAM, 64-QAM	DBPSK, DQPSK, CCK, OFDM, 16-QAM, 64-QAM, 256-QAM	DBPSK, DQPSK, CCK, OFDM, 16-QAM, 64-QAM
Certification	CE, FCC, RoHS	CE, FCC, RoHS	CE, FCC, RoHS

7.3 Network Characteristics: Hub

Feature	Configuration
Ethernet Connector	2x 1 Gigabit (1000 Mbit/s)
Operating System	Ubuntu Server 16.04
Network Setup (ex factory, can be manually changed)	
IPV4	DHCP
IPV6	n.a.
Port	11009 - 11021
mDNS	5353/udp
Subnet Mask	As by DHCP

8 ANNEX E. Checklist for CEREC Primemill Installation and other network based devices

Characteristic	Status	Recommendation
Type of Router	<input type="radio"/> IPV4 capable <input type="radio"/> IPV6 capable <input type="radio"/> DHCP possible	
IPV4 activated	<input type="radio"/> Yes <input type="radio"/> No	In case of “No” activate IPV4 in router settings
IPV6 activated	<input type="radio"/> Yes <input type="radio"/> No	In case of “No” activate IPV6 in router settings
DCHP activated	<input type="radio"/> Yes <input type="radio"/> No	In case of “No” activate DHCP
Ethernet socket at point of Operation (min. CAT5E)	<input type="radio"/> yes (free socket) <input type="radio"/> yes (but no free socket) <input type="radio"/> no	<ul style="list-style-type: none"> • In case of “Yes but no free socket” use switch. • In case of “no” install Mesh System
WiFi available	<input type="radio"/> Yes <input type="radio"/> No In case of YES Name of SSID:	In case of “no” select and install the right setup according to the requiriments
Wifi Standard 802.11ac or better	<input type="radio"/> Yes <input type="radio"/> NO	In Case of “No” choose components from the recommendation list
Bandwith of WiFi at Point of operation of AC (in Mbit)	Operator 1: Better as 100Mbit: <input type="radio"/> YES <input type="radio"/> No Operator 2: Better as 100Mbit: <input type="radio"/> YES <input type="radio"/> No Operator 3: Better as 100Mbit: <input type="radio"/> YES <input type="radio"/> No To be listed for all operatories.	In case of “No” create new Mesh-network, add Accesspoints or Satellites to your existing setup
Bandwith of Ethernet at Point of operation of Manufacturing devices or Hub (in Mbit) min better than 50 Mbit/s	<input type="radio"/> Yes <input type="radio"/> No	In case of “No” check withIT professional the overall network load and/or CAT Standard of Ethernet Cable
Open Ports	5353 <input type="radio"/> YES <input type="radio"/> No 5353 / udp <input type="radio"/> Yes <input type="radio"/> No 28930 / tcp <input type="radio"/> Yes <input type="radio"/> No 50926 / tcp <input type="radio"/> Yes <input type="radio"/> No 2222 <input type="radio"/> Yes <input type="radio"/> No	In case of “No” open applicable ports
Unblocked Multicast Address	IPv4: 224.0.0.251 <input type="radio"/> Yes <input type="radio"/> No IPv6: ff02::fb <input type="radio"/> Yes <input type="radio"/> No IPv4: 239.0.0.222 <input type="radio"/> Yes <input type="radio"/> No	In case of “No” unblock applicable Multicast Adresses

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Procedural Solutions

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