The Makerspace IT Environment
Version 2.0

As schools embrace more makerspace and educational technologies such as 3D printers, laser cutters, robotics and coding, local IT services should be involved in the implementation process. The functions of some makerspace equipment may be affected by IT policies which are designed to protect the local area network (LAN) from inappropriate use, but which may hamper or limit the operation of the equipment.

1st Maker Space is here to assist IT professionals to assess and, if appropriate, accommodate this equipment for the benefit of teachers and students.

Overview

The trend in advanced manufacturing is to digital means of design & production. This means that increasingly, modern tools of manufacturing are enabled using digital technologies like microcontrollers, software and are integrated with Computer Aided Design (CAD.) You'll find these advanced tools in nearly every makerspace today. Most require connections to a local Mac or PC to operate but some are managed through web-apps and are compatible with Chromebooks. USB, Ethernet, WiFi and Bluetooth connections are common.

The modern school-based makerspace should have adequate Internet access for these new tools. It is important that the tools are connected on the same network 'subnet' as the PCs/Macs/Chromebooks used by the teachers and students using the tools.

Some vendors require users to register on their web portal to get access to design software and other resources. These credentials are simply for identification on their web site and allows the vendor's app to control the tool remotely – so communication between the school's network and vendor's web portal must be enabled. No other access to a school's network is required and local credentials/resources are never compromised.

Tools that are permitted to access the school's LAN for the purpose of uploading design files, controlling the machine, and streaming video from an integrated camera can also automatically update their firmware which improves reliability, performance and security.

WAN/LAN Internet Access Details

Internet access in a makerspace is almost always a priority. Access to students' work product/design files and/or an LMS where teachers place resources/assignments used to complete makerspace projects is typically no different than in any classroom.

A makerspace may have dedicated design workstations that are configured to provide access to CAD, coding or other software which may need to be installed locally. Some of that software may require updates from time to time. Others make use of design libraries, images, graphics, or templates that are hosted on equipment vendors' websites.

Completely web-based design programs such as TinkerCAD and OnShape are very useful, require only basic hardware to operate (including Chromebooks) and free to use for educators and students.

There are probably hundreds of thousands of online makerspace learning resources. YouTube is just as, if not more, valuable to makers as any other learner. Internet access is almost always important.

Device Connectivity

Some devices require Internet access to operate. Generally, these devices are managed using a hosted service that authenticates/identifies a device and communicates with it via a web portal.

Glowforge Laser Cutters/Engravers
For example, the Glowforge Laser Printer requires a user to create an account on their website and login to their service to upload/download design files and control their laser printer.

During setup, the printer is configured via a temporary WAP service hosted by the printer that allows connection from a PC/Mac/Chromebook for the purpose of configuring the credentials for the school's wireless network. After that process is completed, the printer reboots and joins the school's wireless network. Thereafter, the user logs into the Glowforge app hosted on the Glowforge website. Communication with the printer is 'brokered' by their web service.

The teachers and students' devices must be configured for Internet access on the same subnet (or VLAN) as the Glowforge to operate. Access to the Glowforge from the brokered connection must be permitted through the school's firewall.

Flashforge 3D Printers
Flashforge 3D printers support access/control over the Internet using a website named Polar3D. The printer is configured to access the local network using a touchscreen to enter a WEP Key. Thereafter, the Polar3D site brokers a connection to the printer based on the PIN code assigned to the printer at setup and email address the user registered on the Polar3D site.

Using the Polar3D site anyone with valid login credentials may view the video stream originating from the camera mounted in the printer. Print jobs may be stored on-line, uploaded from the design workstation or directly from TinkerCAD, sliced, started/stopped and shared from the Polar3D web app.

Flashforge printers also support direct/local wireless and wired (via an integrated Ethernet connection) or USB ports on some models. Some schools, which don't support any Internet connectivity, may use a USB A-B cable plugged directly into the printer from a PC/Mac. Chromebooks are unsuitable because they are not compatible with the FlashPrint software. Teachers/students may use the FlashPrint software installed on a PC/Mac and save the GCODE file onto a flash drive which they insert into the available USB port on the printer.

To operate on a LAN the printer must be able to acquire an IP address on the same subnet as the teacher/student devices so the FlashPrint utility can connect to the printer. Static assignment of IP address information is also possible.

Dremel 3D Printers and Laser Cutters/Engravers operate in a similar fashion to FlashForge 3D printers configured for wireless access (since Dremel systems don't have NICs.) They require entry of the WEP key on the control panel and then acquire an IP address via DHCP which is displayed on the control panel. The user then accesses the printer/laser cutter using a browser. No persistent Internet connection is required.

For Chromebooks, the AstroPrint.com web app service may be useful to produce GCODE files for FlashForge and Creality (Ender 3 Series) 3D printers.

G. Weike Laser Cutters
1st Maker Space imports laser cutters from China manufactured by the G. Weike company. These machines pair nicely with software produced in the US by a company named Lightburn. Lightburn is compatible with Macs and PCs (but not Chromebooks.)

Lightburn connects to the laser via a USB cable. No Internet or LAN connectivity is required

Tello Drones

Tello drones have a Wireless Access Point (WAP) built-in to allow them to be controlled by wireless devices like smart phones and tablets (controllers.) When connected to the drone, the control device will be disconnected from the local network and Internet.

A controller can only be connected to one drone at a time. If there are multiple drones, each controller chooses the wireless networking in the normal way that it would if it was joining the local network. Drones are identified by their serial number. There is no password to 'join' the drone hosted network.

USB Connected Devices

We sell a variety of microcontroller-based products that connect via a local USB cable to download programs, receive data, or offer HID functionality. These may be operated by Macs, PCs or Chromebooks.

IoT, Arduino and other Coding platforms

There are many other devices used in a makerspace that may fall under the purview of the IT department. The most common would require WiFi – such as IoT platforms like ESP8266/ESP32 and Adafruit's Feather S2 and S3 microcontroller-based products. Here, a dedicated/private subnet serving DHCP, with or without access to the Internet, would suffice to allow maximum productivity.

The Arduino Integrated Development Environment (IDE) is very common. This is a program that is downloaded on a Mac or PC – or a website which offers similar functionality – that is used to develop a C++ like program which is compiled and then downloaded to the microcontroller over a USB cable.

Bluetooth connectivity is required for some 'floor' robots like Make Wonder's Dash & Dot products and RoboLink's CoDrones which are programmable drones that 1st Maker Space sells & supports. Both connect to devices locally over Bluetooth or BLE and use a web app to develop Blockly/Javascript or Python programs.

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