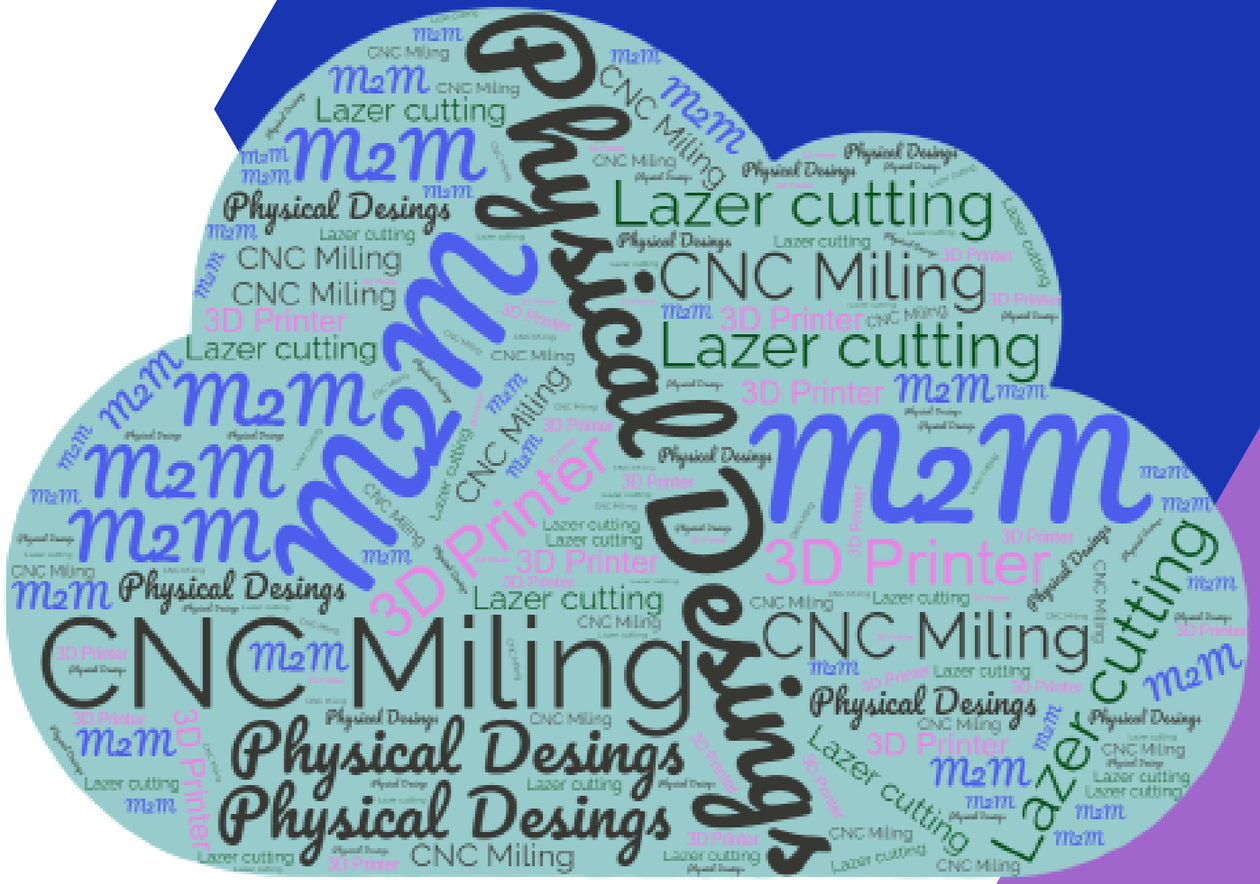
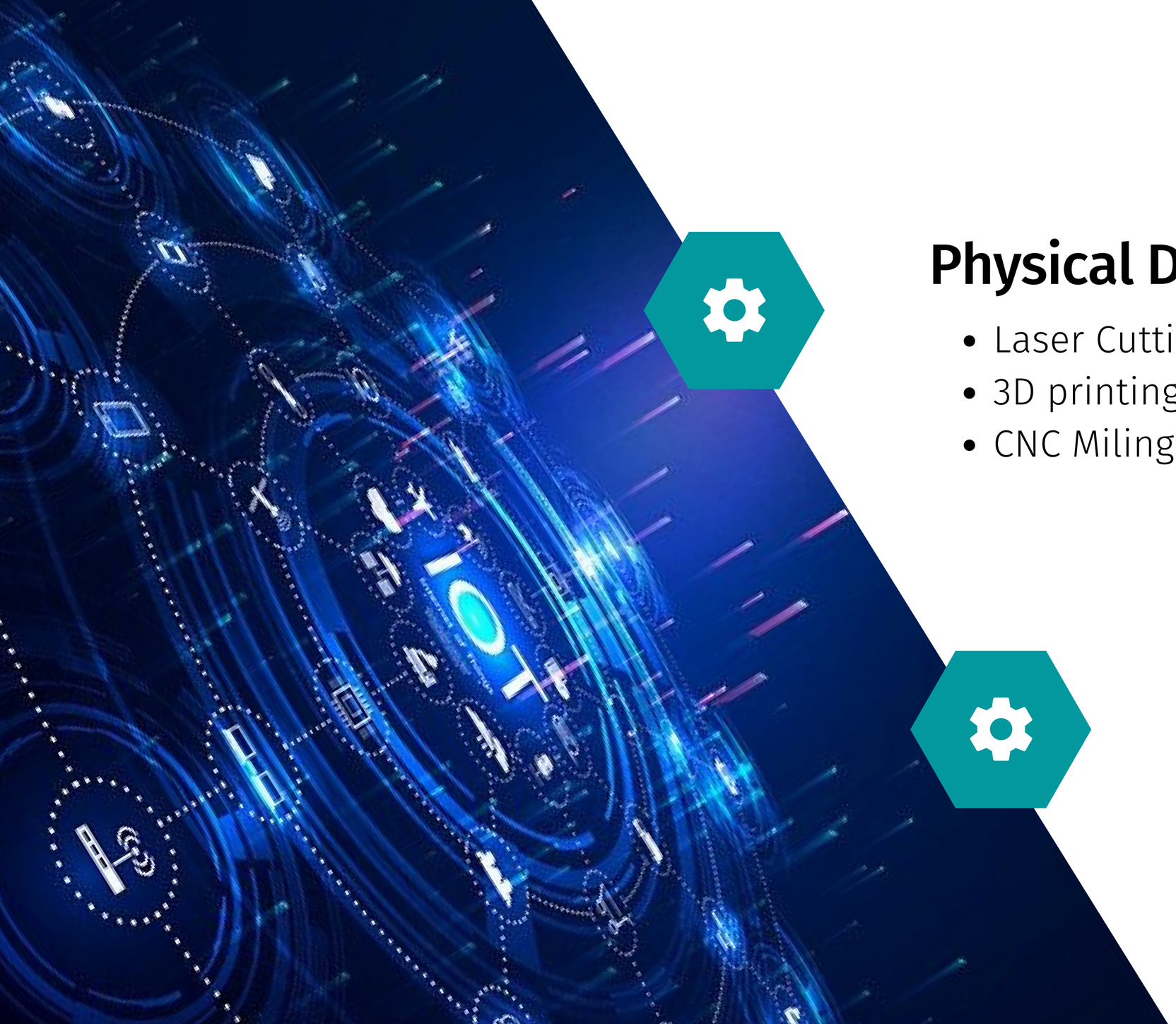
IOT

PHYSICAL DESIGN AND M2M

Presented by:
Abhay Lad
Neshi Bhakta
Sowmya Vanukuru
Preksha Shah





Physical Designs

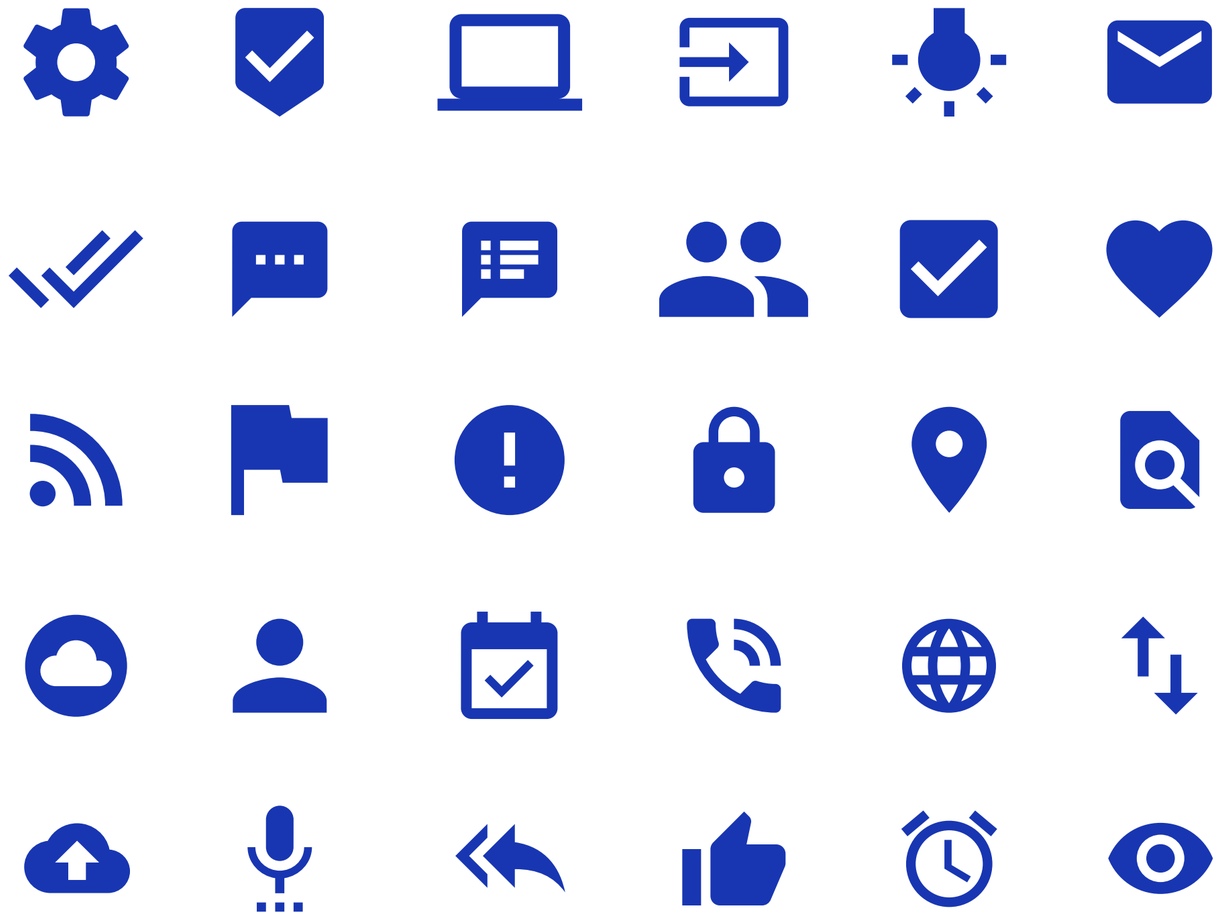
- Laser Cutting
- 3D printing
- CNC Miling

M2M

- Introduction to M2M
- Architecture of M2M
- M2M Technologies
- Differences and similarities

M2M

Introduction of M2M

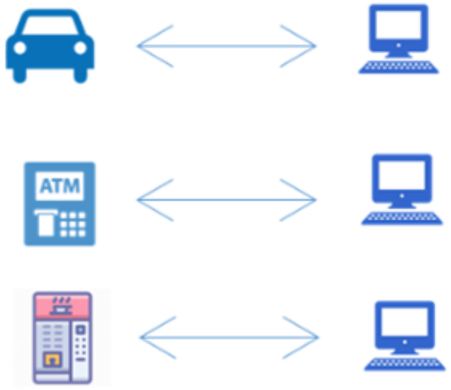


INTRODUCTION OF M2M

Machine-to-Machine refers to the direct communication or exchange of data between two or more machines using any communications channel.

(OR)

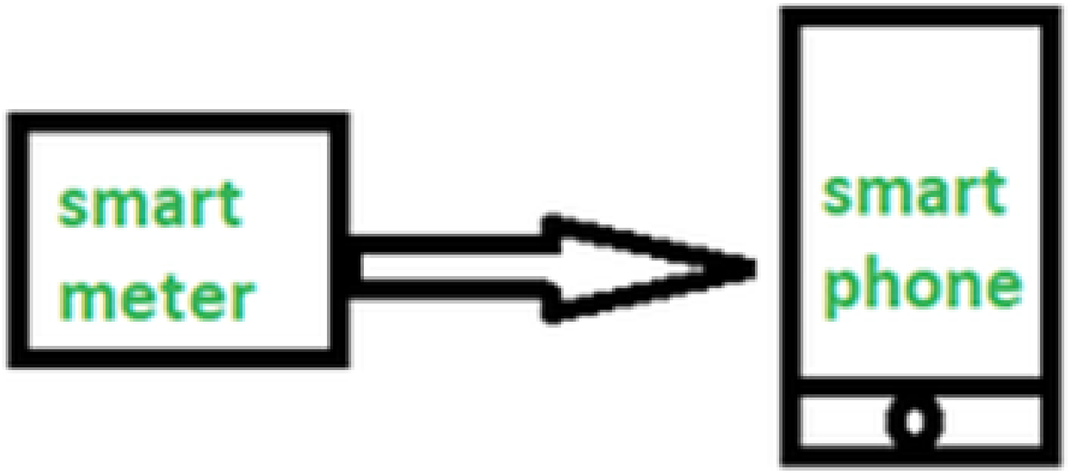
Machine-to-Machine refers to the networking of machines (or devices) for the purpose of remote monitoring and control and data exchange.



bluewireless

CONTINUE....

- Communication network can use either wired or wireless networks.
- M2M uses devices such as Sensor, RFID, meters, etc to capture an event like temperature that translates the captures event into meaningful information.
- To enable communication between remote M2M area networks, M2M gateways are used.



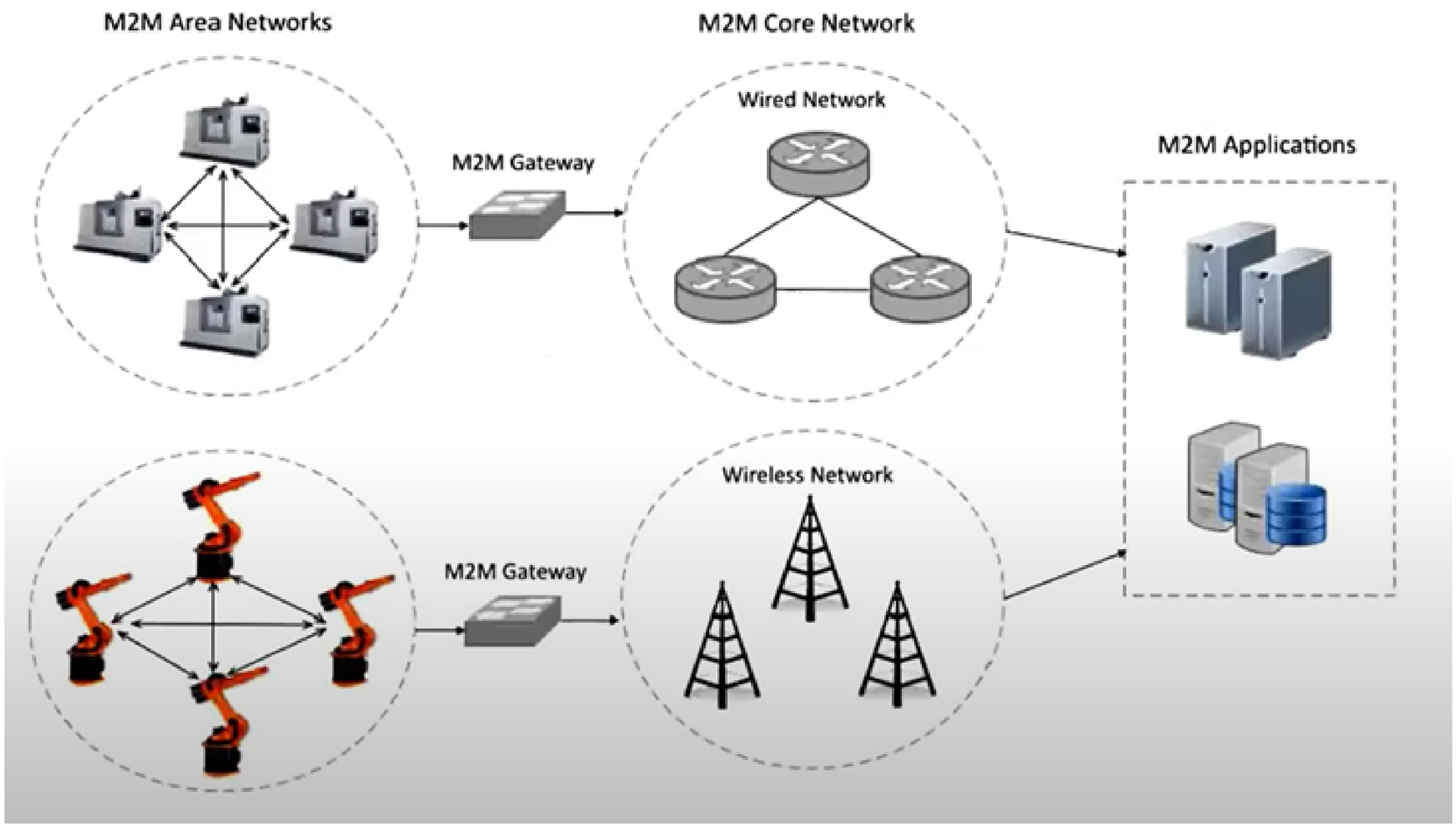
Connection type used i.e. the connection is a point to point

M2M ARCHITECTURE

M2M system architecture:

- M2M Area Network
- Communication network
- Application domains
- M2M gateways

The end-to-end architecture of M2M systems comprises of M2M area networks, communication networks and application domain.



M2M AREA NETWORK

- M2M area network consists of machines(or nodes) that have embedded hardware modules for sensing and communication.
- This is a local area network (LAN) or a Personal Area Network (PAN) and provides connectivity between M2M Devices and M2M Gateways.
- M2M nodes communicate within one network it cannot communicate with external network node.
- Typical networking technologies are IEEE 802.15.1 (Bluetooth), IEEE 802.15.4 (ZigBee), etc.

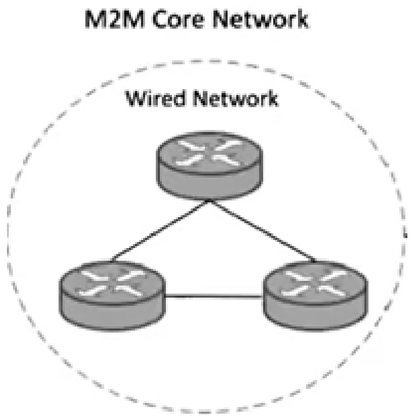
M2M GATEWAY

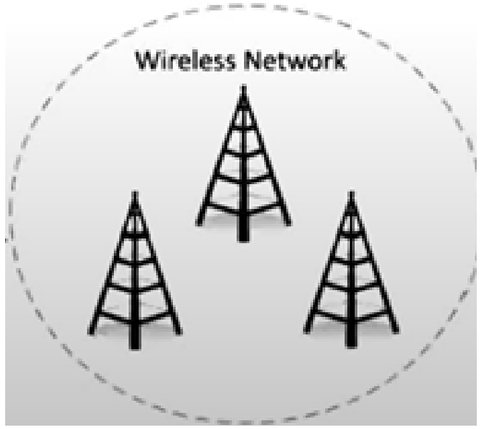
- The device that provides connectivity for M2M Devices in an M2M Area Network towards the Network Domain.

- The M2M Gateway contains M2M Applications and M2M Service Capabilities.

M2M CORE NETWORK/NETWORK DOMAIN

- The M2M core handles the data exchange between devices and applications.
- Communication network provides connectivity between M2M nodes and M2M applications.
- It uses wired or wireless networks such as LAN, WiMAX, Satellite communication, etc.

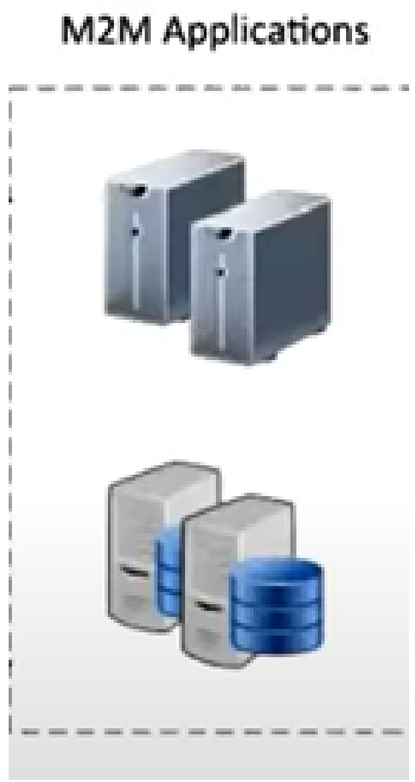


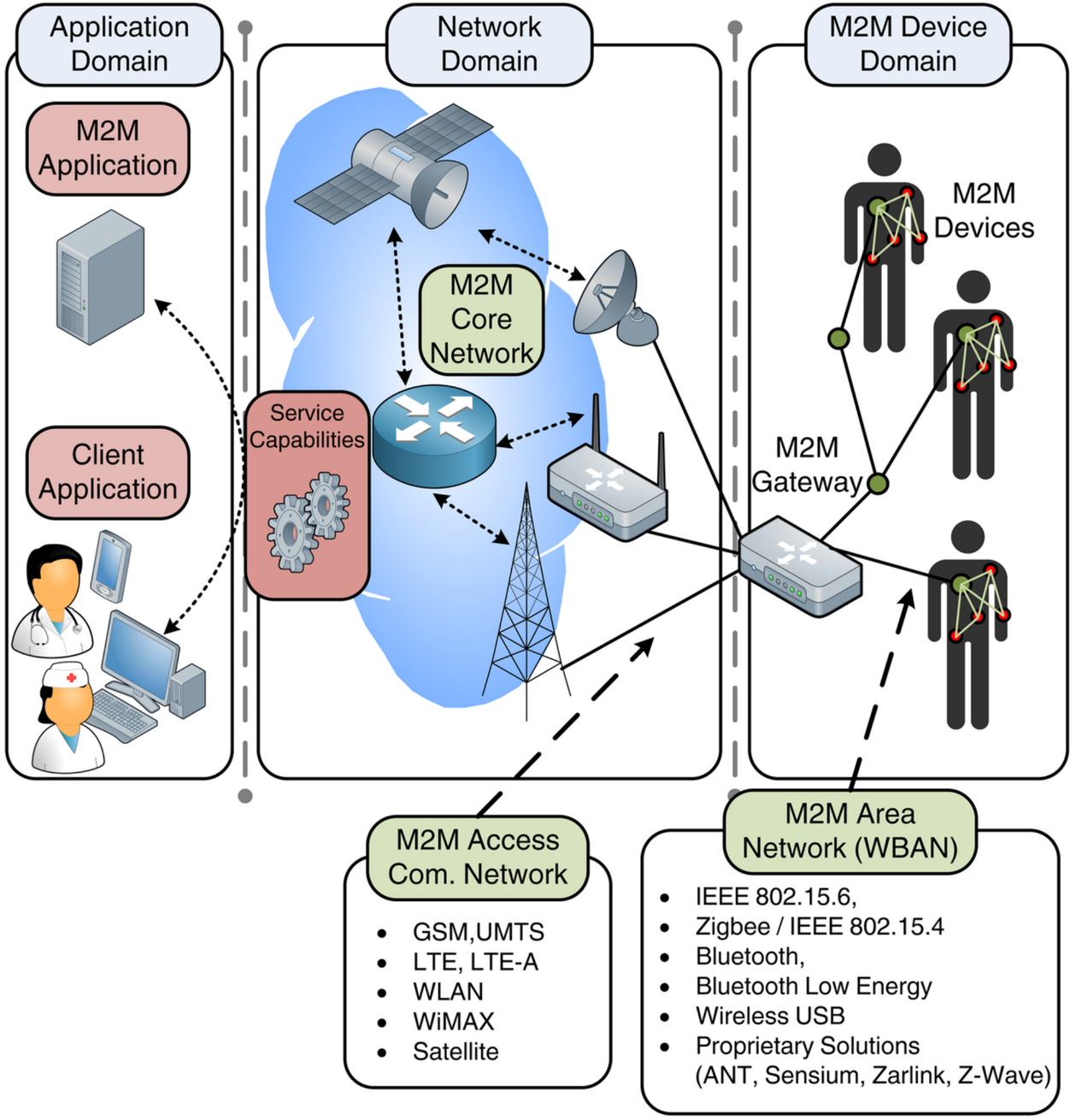


M2M APPLICATION/APPLICATION DOMAIN

- It contains the middleware layer where data goes through various application services and is used by the specific business processing engines.

- Applications may either target at end user or other application providers.




Application Domain
Network Domain
M2M Device Domain
M2M Application
Client Application
Service Capabilities
M2M Core Network
M2M Devices
M2M Gateway
M2M Access Com. Network
GSM,UMTS
LTE, LTE-A
WLAN
WiMAX
Satellite
M2M Area Network (WBAN)
IEEE 802.15.6,
Zigbee / IEEE 802.15.4
Bluetooth,
Bluetooth Low Energy
Wireless USB
Proprietary Solutions
(ANT, Sensium, Zarlink, Z-Wave)

APPLICATIONS OF M2M TECHOLOGY

- Utility Companies
- Traffic Control
- Telemedicine
- Inventory Management
- Banking

DIFFERENCE BETWEEN M2M & IOT

M2M

- Machine to machine communication and completly hardware based
- It is a point to point communication and uses non IP protocol
- It is less scalable.

IOT

- Machine to machine, machine to sensors or humans to machine and software based
- It uses IP networks and protocols as the communication is multipoint.
- It is more scalable.

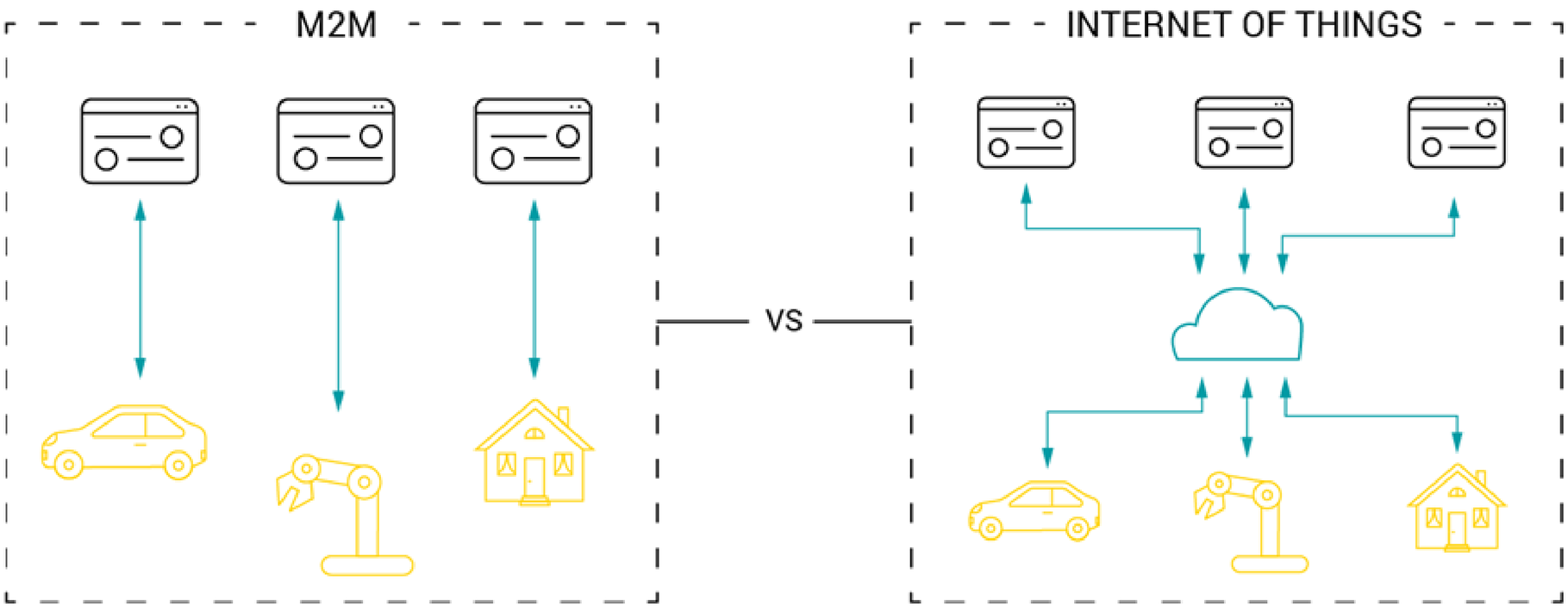
DIFFERENCE BETWEEN M2M & IOT

M2M

- This device don't rely on Internet.
- Data can be stored locally.
- Limited number of devices can be connected at a time.

IOT

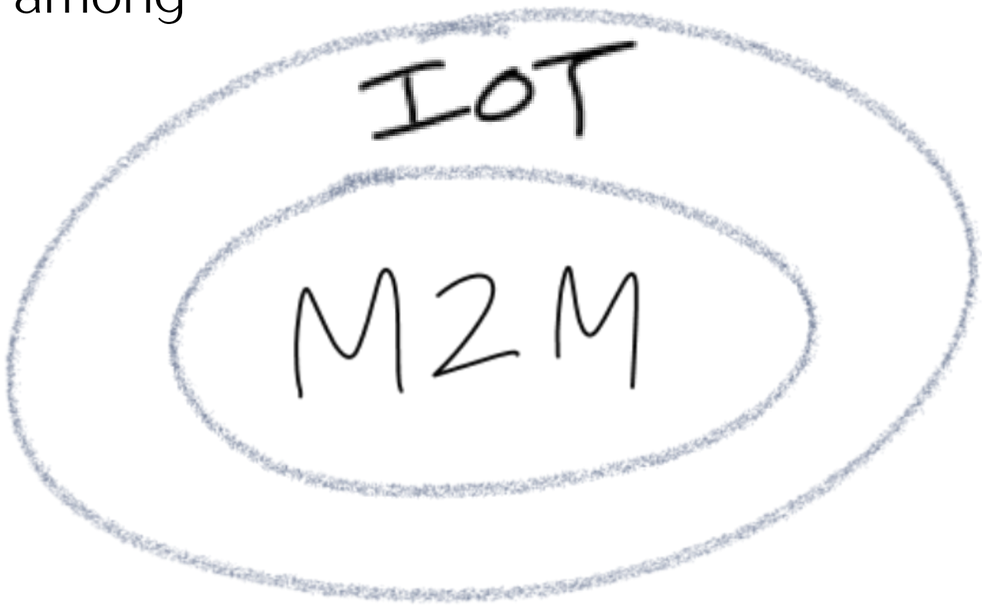
- Devices required internet connections.
- Data can be stored locally and also in cloud.
- More number of deveices can be connected at a time.


M2M
VS
INTERNET OF THINGS

SIMILARITIES BETWEEN M2M & IOT

M2M and IOT applications incorporate the ability to use wireless communication, and simulate an active human-to-machine model.

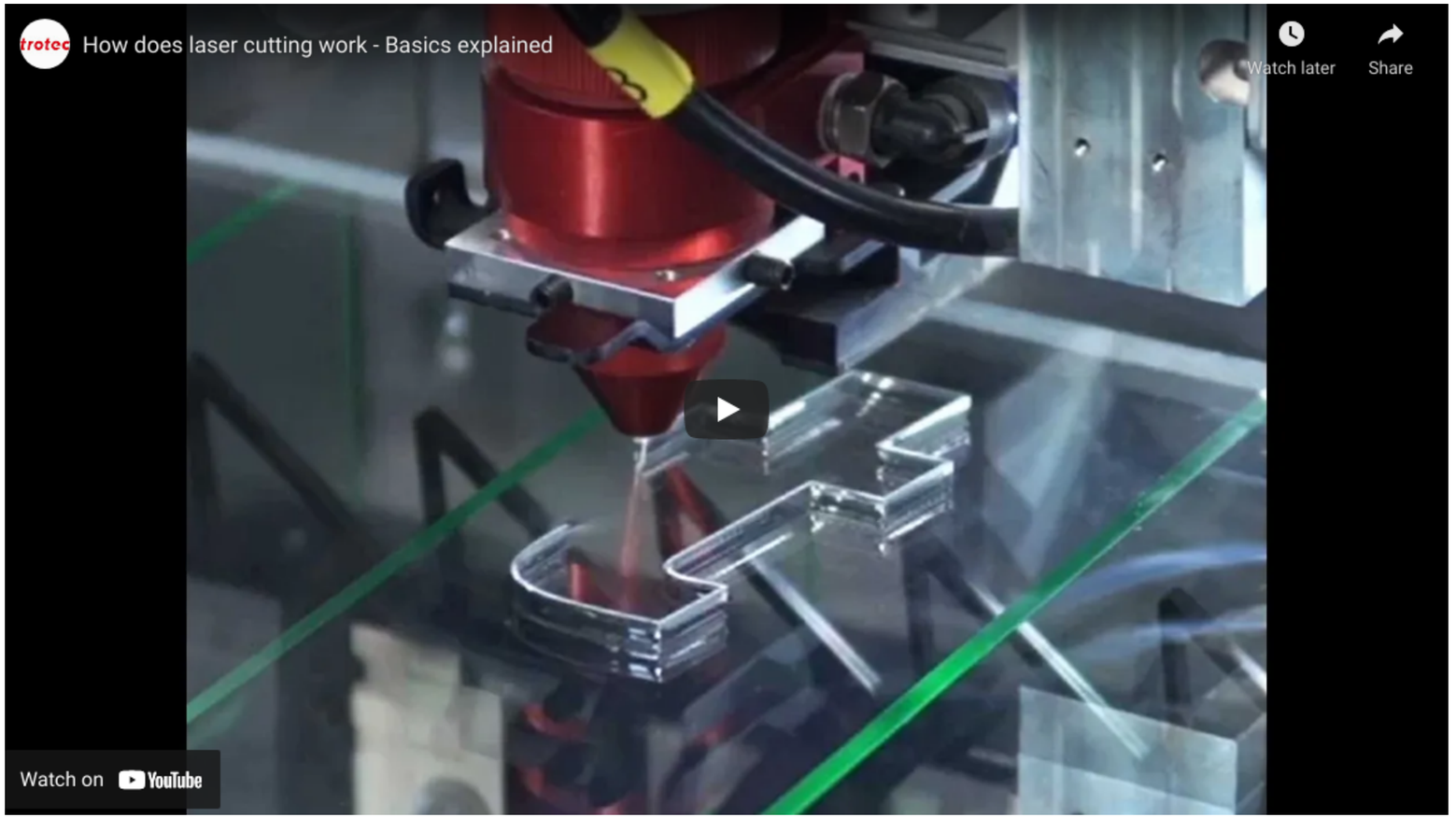
The core similarity is that both provide remote access to machine data and both exchange information among machines without human intervention.



Laser Cutting

For many shapes, breaking it into a sequence of two-dimensional planes is easier than designing in three dimensions, greater range of materials which can be cut, and faster speed make the laser cutter a versatile piece of kit.

Laser Cutting



- Most of the laser cutter is given over to the bed; this is a flat area that holds the material to be cut.
- The bed contains a two-axis mechanism with mirrors and a lens to direct the laser beam to the correct location and focus it onto the material being cut.
- It is similar to a flatbed plotter but one that burns things rather than drawing on them.
- The computer controls the two-axis positioning mechanism and the power of the laser beam.
- This means that not only can the machine easily cut all manner of intricate patterns, but it can also lower the power of the laser so that it doesn't cut all the way through.
- At a sufficiently low power, this feature enables you to etch additional detail into the surface of the piece.
- You can also etch things at different power levels to achieve different depths of etching, but whilst the levels will be visibly different, it isn't precise enough to choose a set fraction of a millimetre depth.

Choosing a laser cutter

- The size of the bed: This is the place where the sheet of material sits while it’s being cut, so a larger bed can cut larger items. You don’t need to think just about the biggest item you might create; a larger bed allows you to buy material in bigger sheets (which is more cost effective), and if you move to small-scale production, it would let you cut multiple units in one pass.

- The power of the laser: More powerful lasers can cut through thicker material.

- For example, the laser cutter at our workplace has a 40W laser, which can cut up to 10mm-thick acrylic. Moving a few models up in the same range, to one with a 60W laser, would allow us to cut 25mmthick acrylic.

Laser cutting (continue)

- Depending on what you're trying to create, you can cut all sorts of different materials in a laser cutter.
- Whilst felt, leather, and other fabrics are easy to cut.
- Card and, particularly, corrugated cardboard are good for quick tests and prototyping, but MDF, plywood, and acrylic (also commonly known by the brand name Perspex) are the most common choices.
- For example, laserable rubber can be used to create ink stamps, and laminate acrylic provides a thin surface in one colour, laminated with a thicker layer in a contrasting colour so that you can etch through the thin layer for crisp, high-contrast detailing and text.

Laser cutting (continue)

- The lower-powered models don’t cut through the metal; and worse, as the shiny surface of many metals does an excellent job of reflecting the laser beam, you run a real risk of damaging the machine.

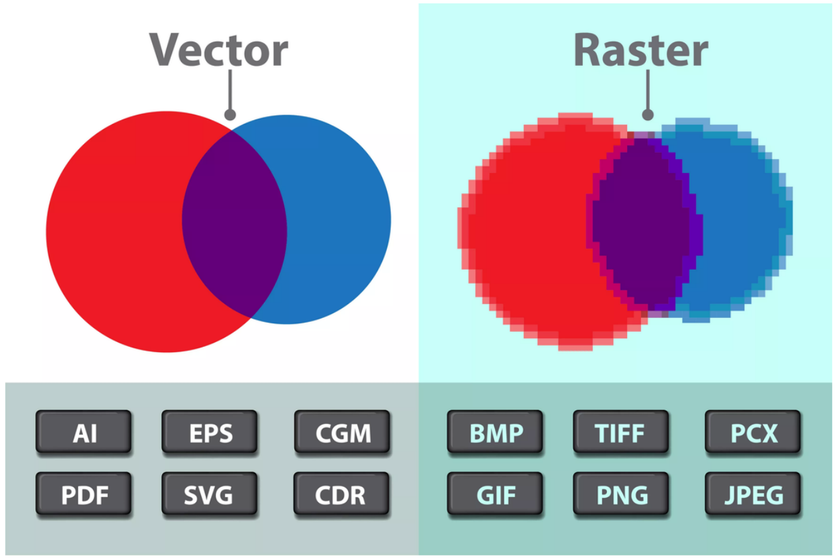
- The laser cutters can be used to etch metals, though, if you’ve carefully prepared the reflective surface beforehand with a ceramic coating compound, such as CerMark.

- Once coated, either from a spray-can or as tape, the laser will fuse the compound with the underlying metal to leave a permanent dark mark.

- Ponoko (http://www.ponoko.com), let you upload designs that they cut and then post back to you.

Laser cutting: Software

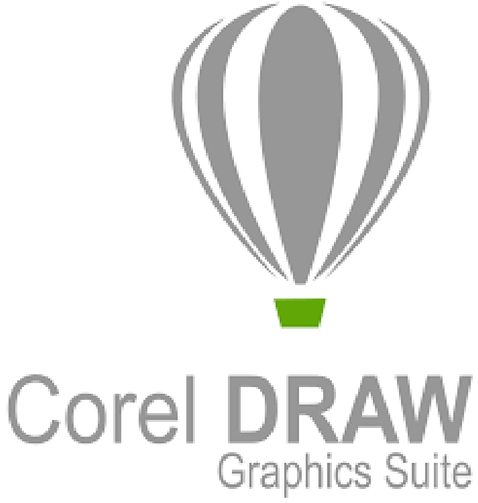
- Vector formats capture the drawing as a series of lines and curves, which translate much better into instructions for moving the laser cutter.
- There's also no loss in fidelity as you resize the image. With a bitmap, as you might have seen if you've ever tried blowing up one small part of a digital photo, the details become jagged as you zoom in closely, whereas the vector format knows that it's still a single line and can redraw it with more detail.



Laser cutting: Software (continue)

- CorelDRAW is a common choice for driving the laser cutters themselves, and you can use it to generate the designs too.

- Other popular options are Adobe Illustrator, as many designers already have a copy installed and are familiar with driving it, and Inkscape, largely because it's an open source alternative and therefore freely available.



Laser cutting: Software (continue)

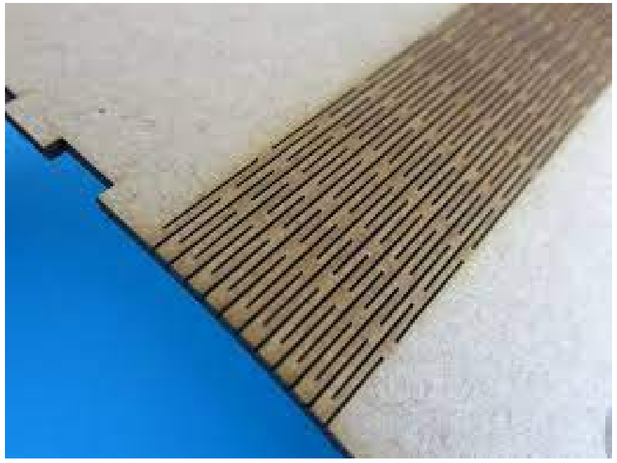
- When creating your design, you use the stroke (or outline) of the shapes and lines rather than the filled area to define where the laser will cut and etch.
- The kerf, the width of the cut made by the laser, is about 0.2mm but isn't something you need to include in the design.
- A thinner stroke width is better, as it will stop the laser cutter from misinterpreting it as two cuts when you need only one.

Laser cutting: Hinges and Joints - Lattice (or Living) Hinges

- If you’re looking to introduce some curves into your design, one of these hinge patterns, reminiscent of the lattice pastry on top of a fruit pie, will do the trick.

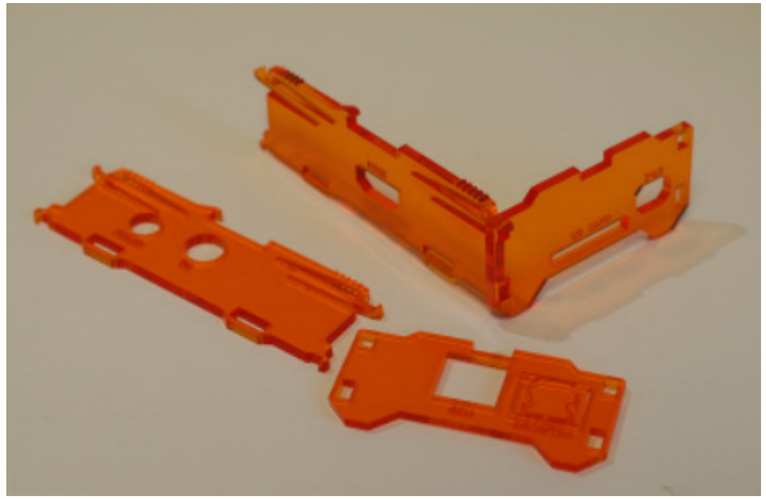
- A series of closely laid-out cuts, perpendicular to the direction of the curve, allows the material to be bent after it has been cut.

- Varying the number of cuts and their separation affects the resulting flexibility of the hinge.



Laser cutting: Hinges and Joints - Integrated Elastic Clips

- This jointing technique is used in situations similar to a through mortiseand-tenon joint, when joining two sheets of material at 90 degrees.
- The tenon (tongue) is replaced with two hooks which protrude above and to the side of the mortise, thus holding the mortise sheet tight to the tenon sheet without any need for glue or additional fixings.
- To provide the required flexibility in the tenon to fit it through the mortise during assembly, additional, deeper cuts are made into the tenon side, as can be seen in the following image



3D Printing

Additive manufacturing, or 3D printing as it's often called, is fast becoming one of the most popular forms in rapid prototyping.

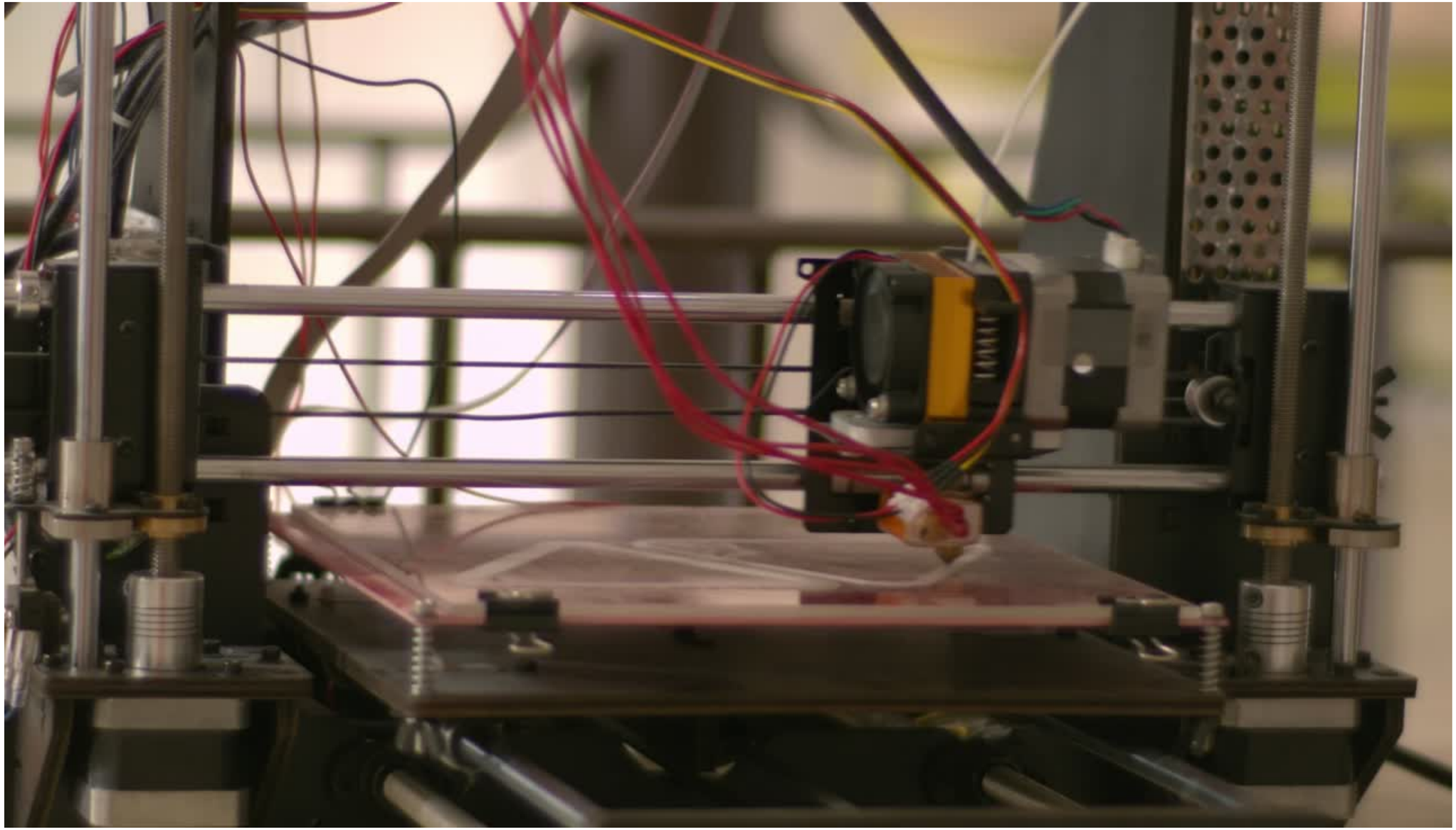
3D Printing

- The term additive manufacturing is used because all the various processes which can be used to produce the output start with nothing and add material to build up the resulting model.

- This is in contrast to subtractive manufacturing techniques such as laser cutting and CNC milling, where you start with more material and cut away the parts you don’t need.

- Various processes are used for building up the physical model, which affect what materials that printer can use, among other things. However, all of them take a three-dimensional computer model as the input.

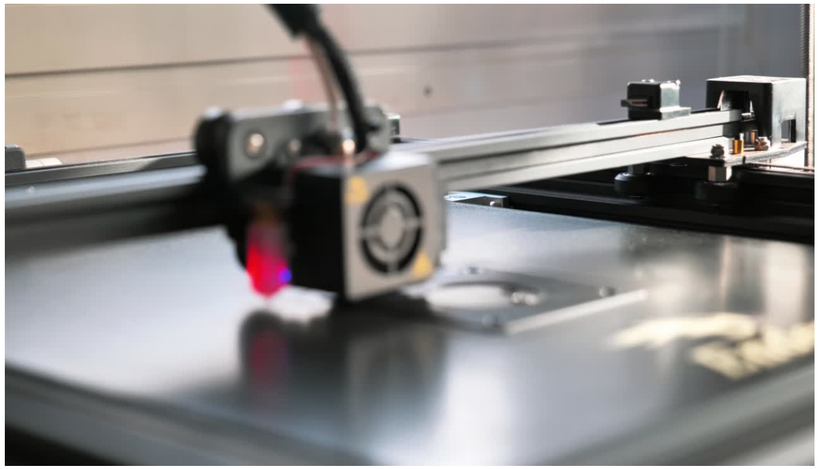
- The software slices the computer model into many layers, each a fraction of a millimetre thick, and the physical version is built up layer by layer.



3D Printing (continue)

- Another common trick with 3D printing is to print pieces which include moving parts: it is possible to print all the parts at the same time and print them ready-assembled.

- This effect is achieved with the use of what is called “support material”. In some processes, such as the powder-based methods, this is a side effect of the printing technique; while the print is in progress, the raw powder takes up the space for what will become the air-gap.

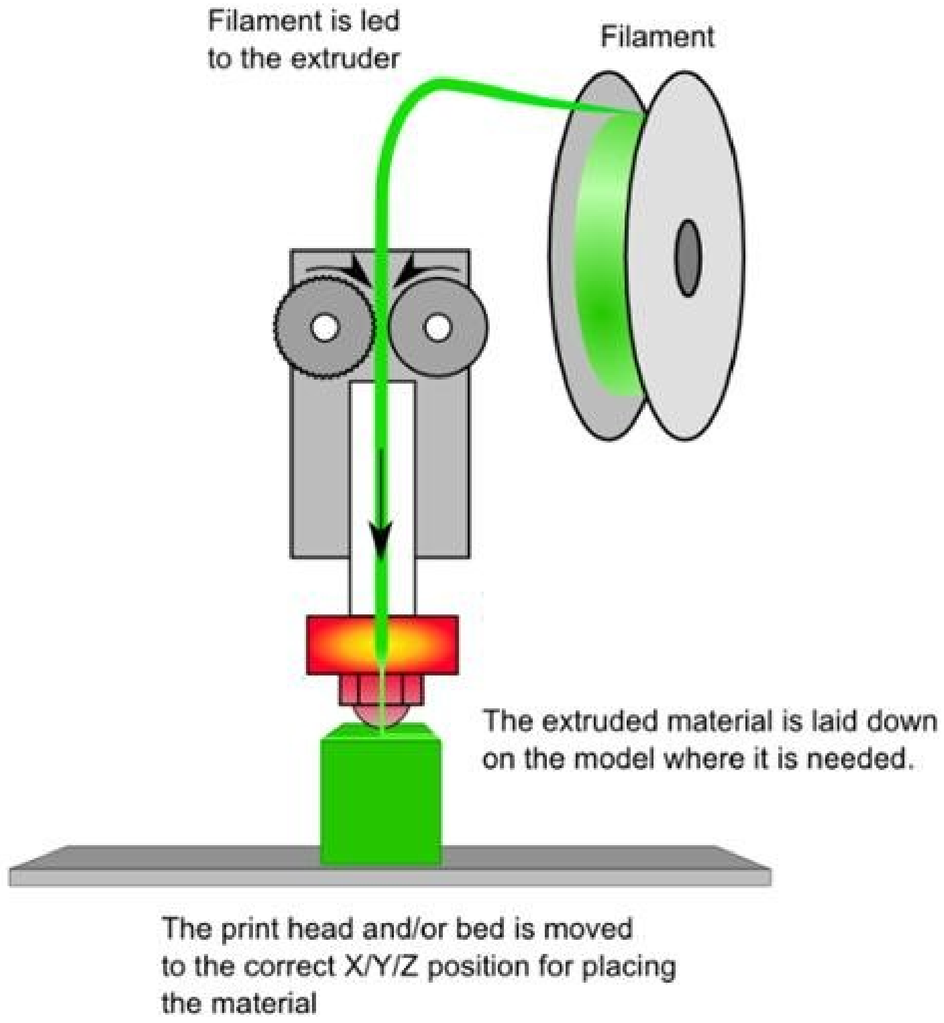


3D Printing: Types

- Fused filament fabrication (FFF): Also known as fused deposition modeling (FDM), this is the type of 3D printer you're most likely to see at a maker event. The RepRap and MakerBot designs both use this technique, as does the Stratasys at the industrial level.

- It works by extruding a fine filament of material (usually plastic) from a heated nozzle. The nozzle can be moved horizontally and vertically by the controlling computer, as can the flow of filament through the nozzle.

3D Printing: Types



3D Printing: Types

- Laser sintering: This process is sometimes called selective laser sintering (SLS), electron beam melting (EBM), or direct metal laser sintering (DMLS).

- It is used in more industrial machines but can print any material which comes in powdered form and which can be melted by a laser.

- It provides a finer finish than FDM, but the models are just as robust, and they're even stronger when the printing medium is metal. This technique is used to print aluminium or titanium, although it can just as easily print nylon.

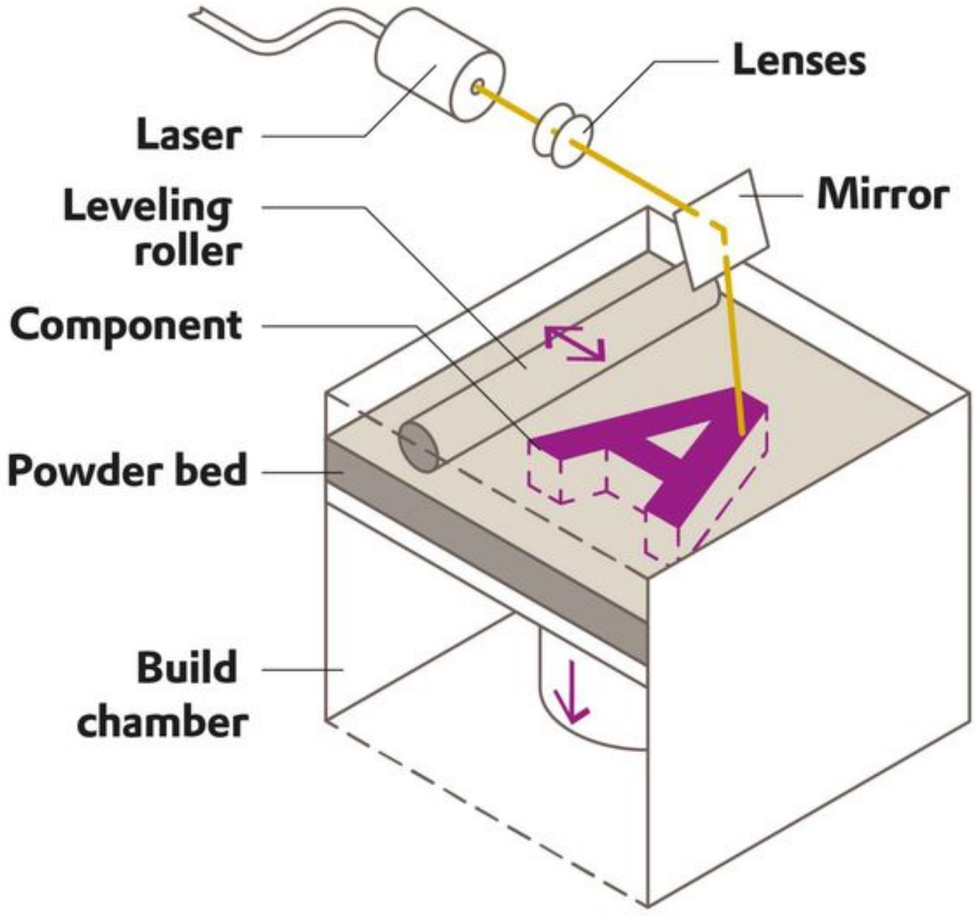
3D Printing: Types

- Powder bed: Like laser sintering, the powder-bed printers start with a raw material in a powder form, but rather than fusing it together with a laser, the binder is more like a glue which is dispensed by a print head similar to one in an inkjet printer.

- The Z Corp. machines use this technique and use a print medium similar in texture to plaster.

- After the printing process, the models are quite brittle and so need post processing where they are sprayed with a hardening solution.

- The great advantage of these printers is that when the binder is being applied, it can be mixed with some pigment; therefore, full-colour prints in different colours can be produced in one pass.

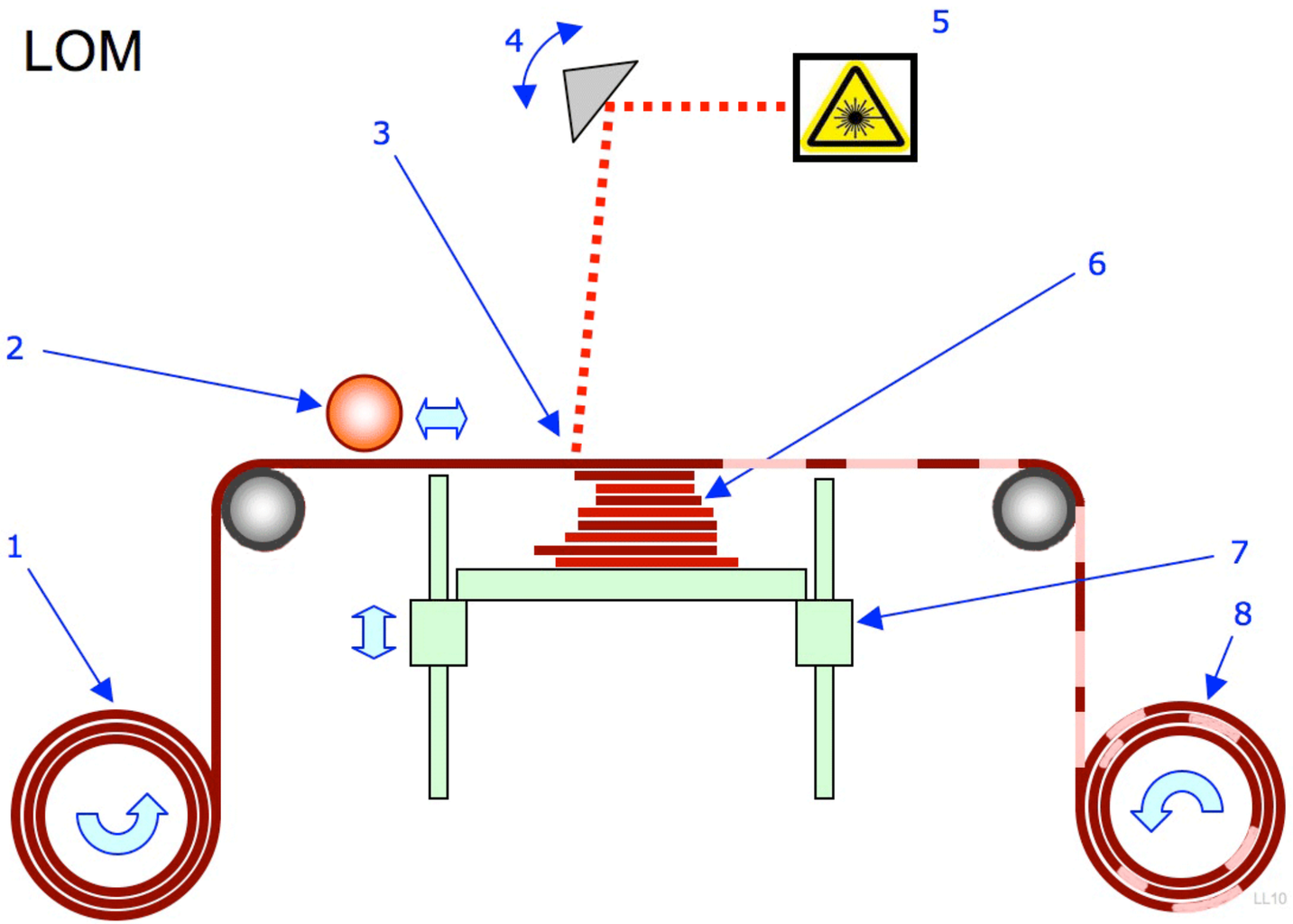

Lenses
Laser
Mirror
Leveling roller
Component
Powder bed
Build chamber

3D Printing: Types

- Laminated object manufacturing (LOM): This is another method which can produce full-colour prints.

- LOM uses traditional paper printing as part of the process. Because it builds up the model by laminating many individual sheets of paper together, it can print whatever colours are required onto each layer before cutting them to shape and gluing them into place.

- The Mcor IRIS is an example of this sort of printer


LOM
1
2
3
4
5
6
7
8
LL10

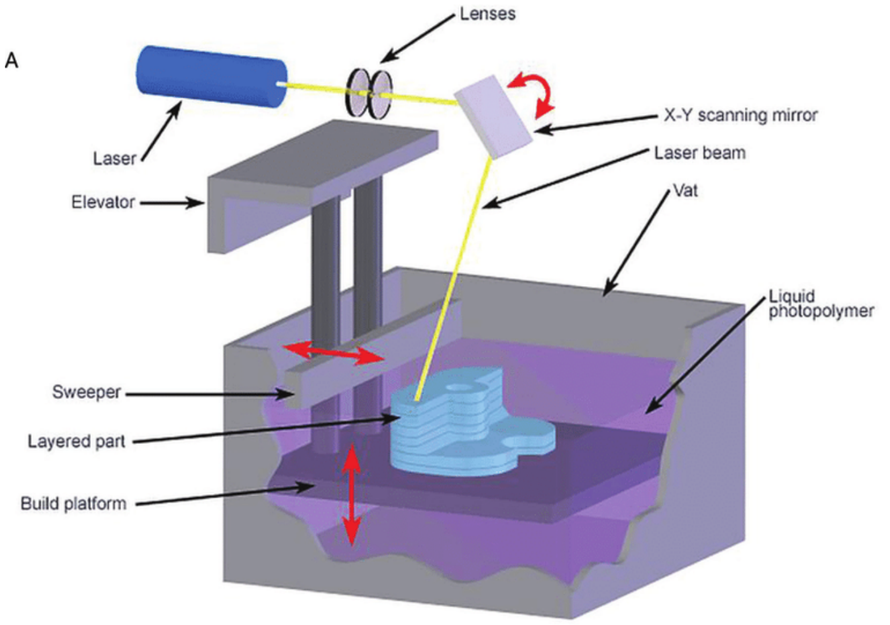
3D Printing: Types

- Stereolithography and digital light processing: Stereolithography is possibly the oldest 3D printing technique and has a lot in common with digital light processing, which is enjoying a huge surge in popularity and experimentation at the time of this writing.

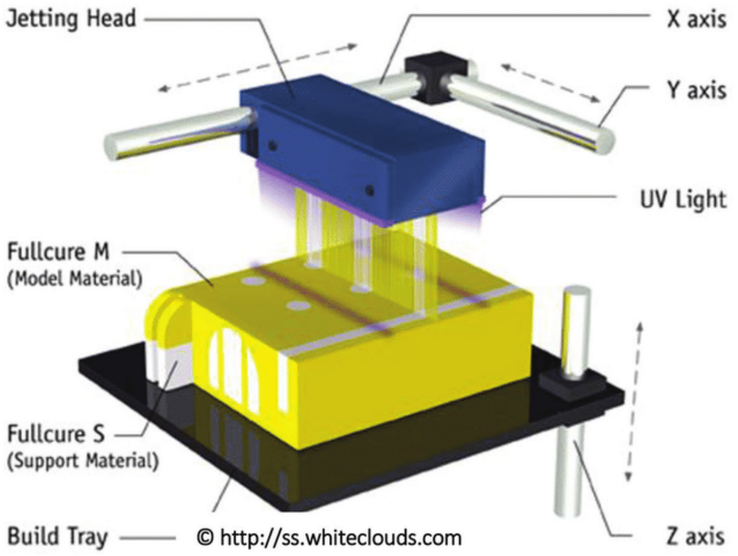
- Both approaches build their models from a vat of liquid polymer resin which is cured by exposure to ultraviolet light.
-
- Stereolithography uses a UV laser to trace the pattern for each layer, whereas digital light processing uses a DLP projector to cure an entire layer at a time.

- Whilst these approaches are limited to printing with resin, the resultant models are produced to a fine resolution. The combination of this with the relatively low cost of DLP projectors makes this a fertile area for development of more affordable high-resolution printers.

A



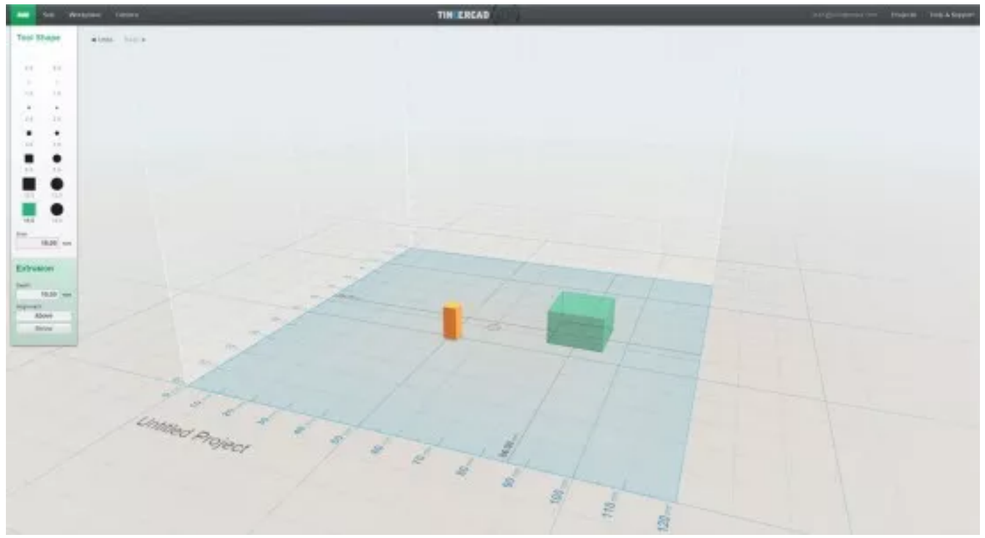
B



3D Printing: Websites

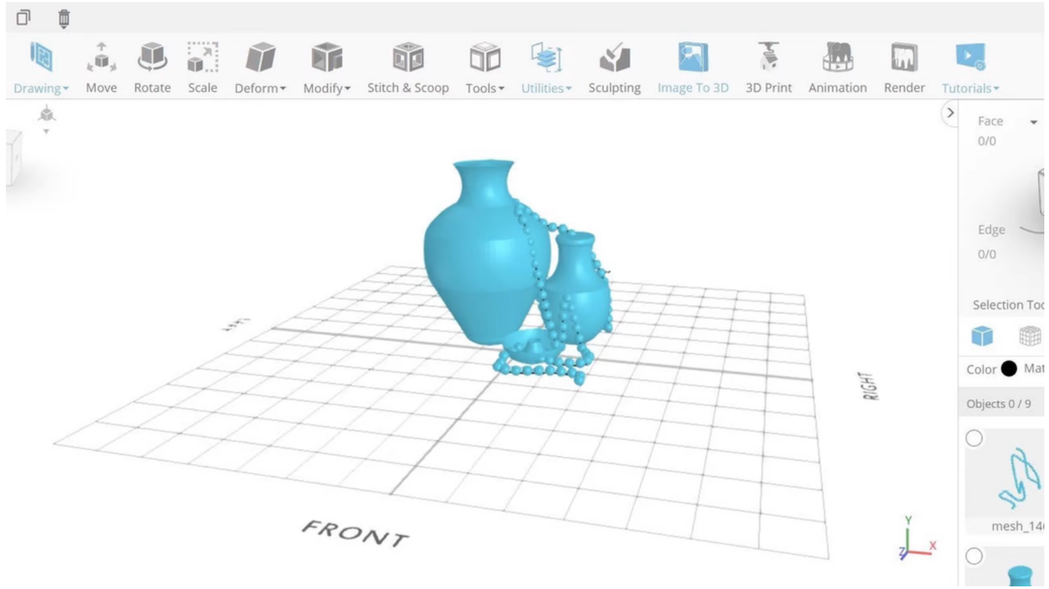
- Shapeways (http://www.shapeways.com/),
- i.materialise(http://i.materialise.com/), and
- Ponoko (https://www.ponoko.com/)

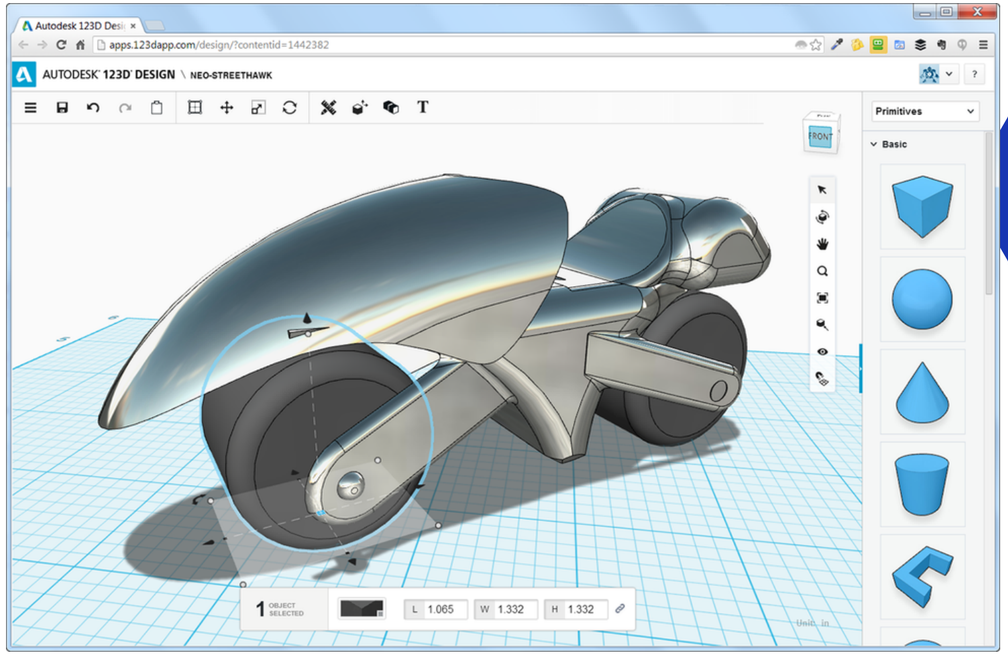
You upload your design online, choose how you want it printed, and a few days later receive it in the post.



3D Printing: Websites

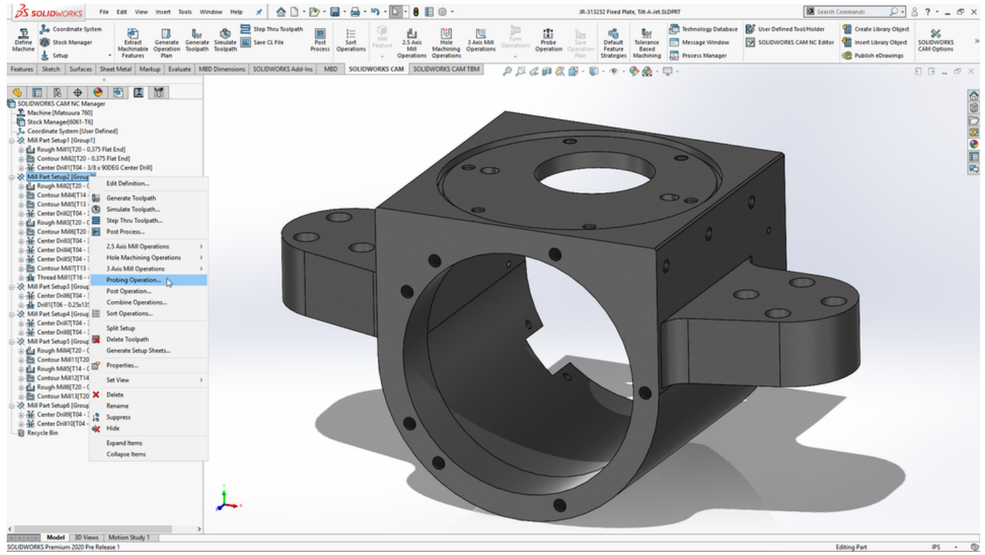
- Tinkercad (http://tinkercad.com) and Autodesk's 123D Design Online (http://www.123dapp.com/design) are two options which just run in your web browser.

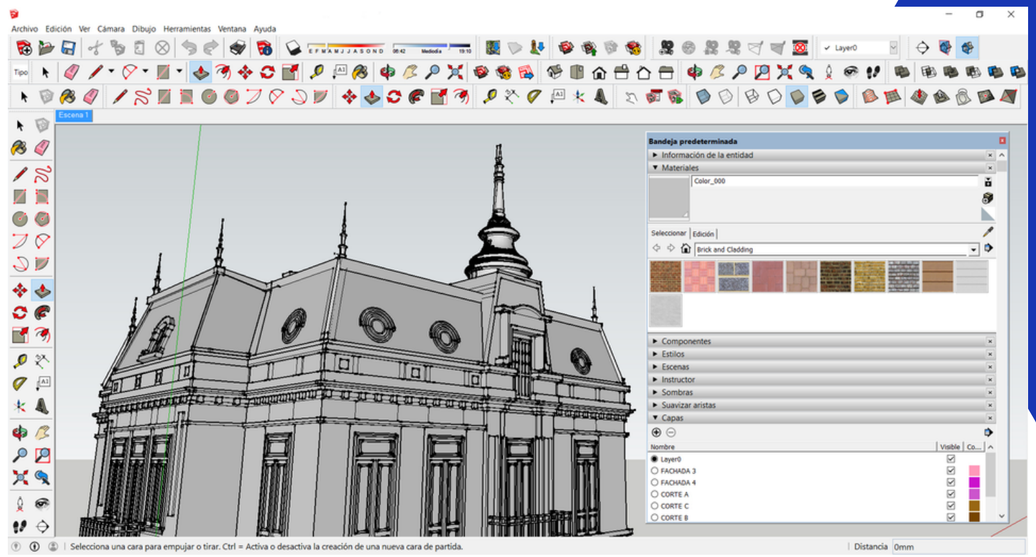




3D Printing: Softwares

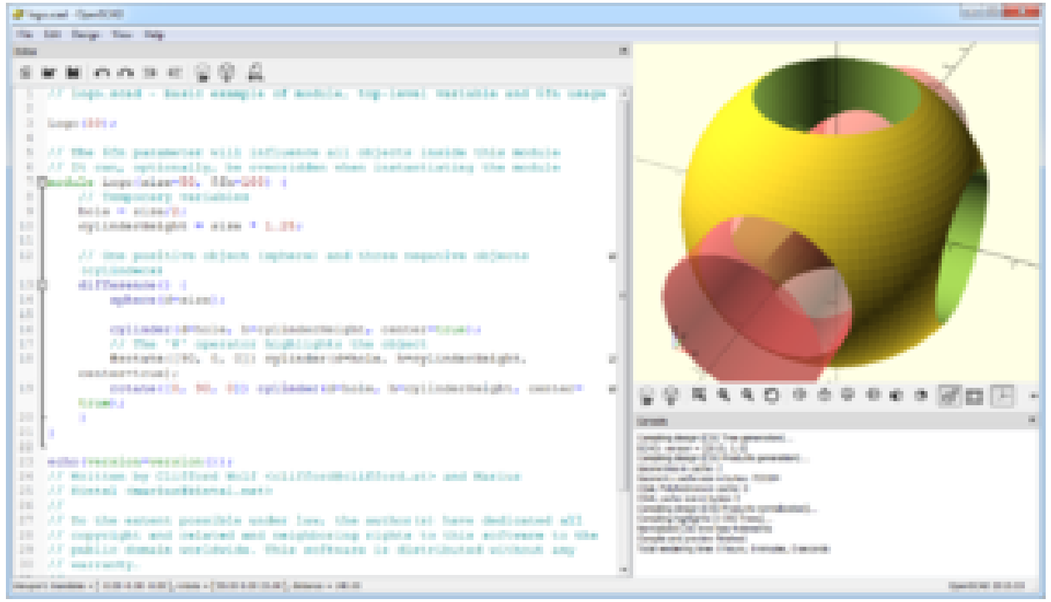
- SolidWorks (http://www.solidworks.com) and Rhino (http://www.rhino3d.com) are the industry-standard commercial offerings, and SketchUp (http://www.sketchup.com), which was owned by Google for a while but in 2012 was sold to Trimble, is popular with hobbyists





3D Printing: Softwares - open source

- In the open source camp, the main contenders are OpenSCAD (http://www.openscad.org) , which has a rather unorthodox scripting workflow, and FreeCAD (http://free-cad.sourceforge.net). You also can use Blender (http://www.blender.org), but it has a steep learning curve and is better suited to 3D animation than computer-aided design.



3D Printing: Softwares - Algorithm

- Skeinforge was the first slicing software used by the open source printers, but it has been largely overtaken by the newer and more user-friendly Slic3r.

- Both will let you tweak all manner of parameters to fine-tune your 3D prints, specifying options like the temperature to which the plastic should be heated, how densely to fill the solid objects, the speed at which the extruder head should move, etc

CNC Milling

Computer Numerically Controlled (CNC) milling is similar to 3D printing but is a subtractive manufacturing process rather than additive.

CNC Milling (continue)

- The CNC part just means that a computer controls the movement of the milling head, much like it does the extruder in an FDM 3D printer.

- However, rather than building up the desired model layer by layer from nothing, it starts with a block of material larger than the finished piece and cuts away the parts which aren’t needed—much like a sculptor chips away at a block of stone to reveal the statue, except that milling uses a rotating cutting bit (similar to an electric drill) rather than a chisel.

CNC Milling (continue)

CNC Milling (continue)

- CNC mills can work with a much greater range of materials than 3D printers can.

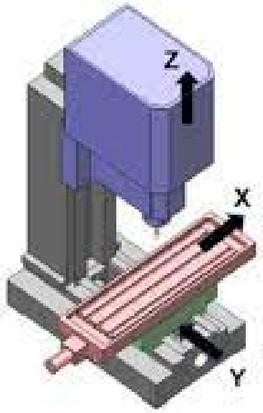
- You still need an industrialscale machine to work with hardened steel, but wax, wood, plastic, aluminium, and even mild steel can be readily milled with even desktop mills.

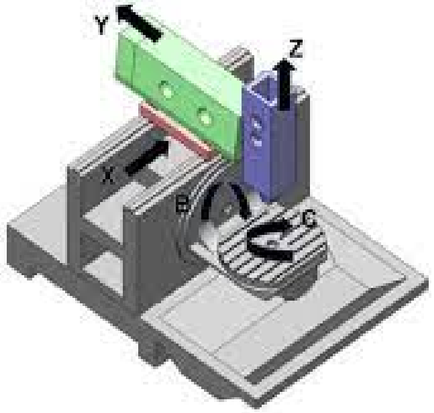
CNC Milling Axes:

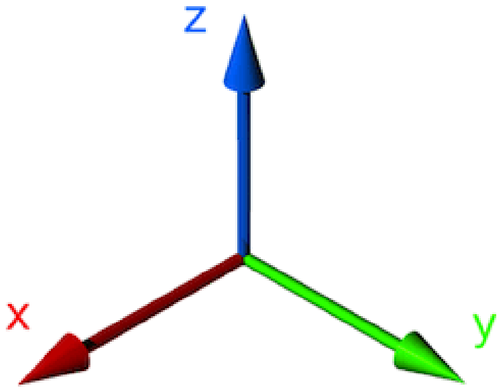
Beyond size and accuracy, the other main attribute that varies among CNC mills is the number of axes of movement they have:

- 2.5 axis: Whilst this type has three axes of movement—X, Y, and Z—it can move only any two at one time.

- 3 axis: Like the 2.5-axis machine, this machine has a bed which can move in the X and Y axes, and a milling head that can move in the Z. However, it can move all three at the same time (if the machining instructions call for it).







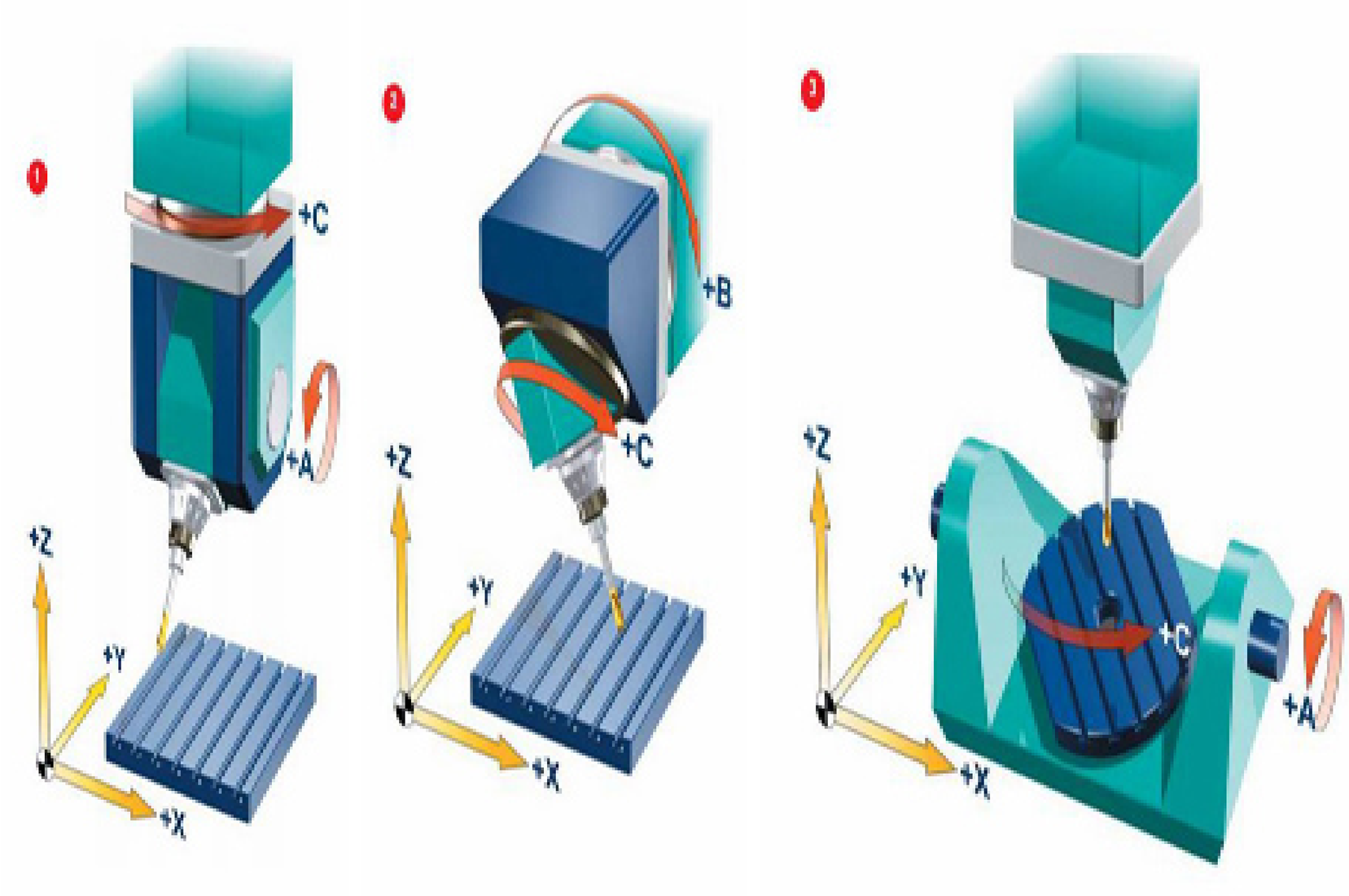
CNC Milling Axes:

- 4 axis: This machine adds a rotary axis to the 3-axis mill to allow the piece being milled to be rotated around an extra axis, usually the X (this is known as the A axis). An indexed axis just allows the piece to be rotated to set points to allow a further milling pass to then be made, for example, to flip it over to mill the underside; and a fully controllable rotating axis allows the rotation to happen as part of the cutting instructions.

- 5 axis: This machine adds a second rotary axis—normally around the Y—which is known as the B axis.

- 6 axis: A third rotary axis—known as the C axis if it rotates around Z—completes the range of movement in this machine.

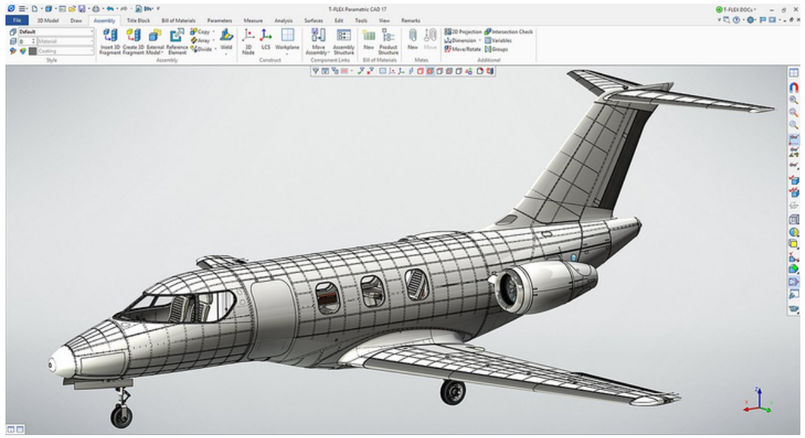
CNC Milling Axes:

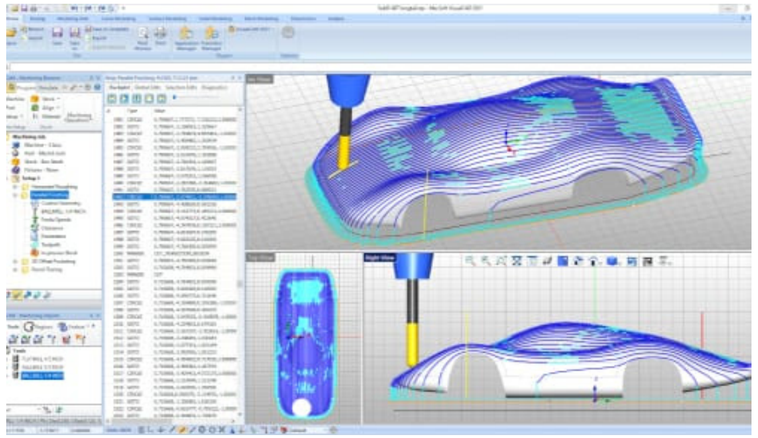


CNC Milling: Software

As with 3D printing, the software you use for CNC milling is split into two types:

- CAD (Computer-Aided Design) software lets you design the model.
- CAM (Computer-Aided Manufacture) software turns that into a suitable toolpath—a list of co-ordinates for the CNC machine to follow which will result in the model being revealed from the block of material.





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Thank you!