



The Printer Working Group

3D Printing BOF

November 3, 2015

PWG F2F Meeting

Somewhere in the ether...

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BOF Agenda



- Scoping/use cases
- Review: 3D printing extensions for the Internet Printing Protocol (IPP)
- Next steps

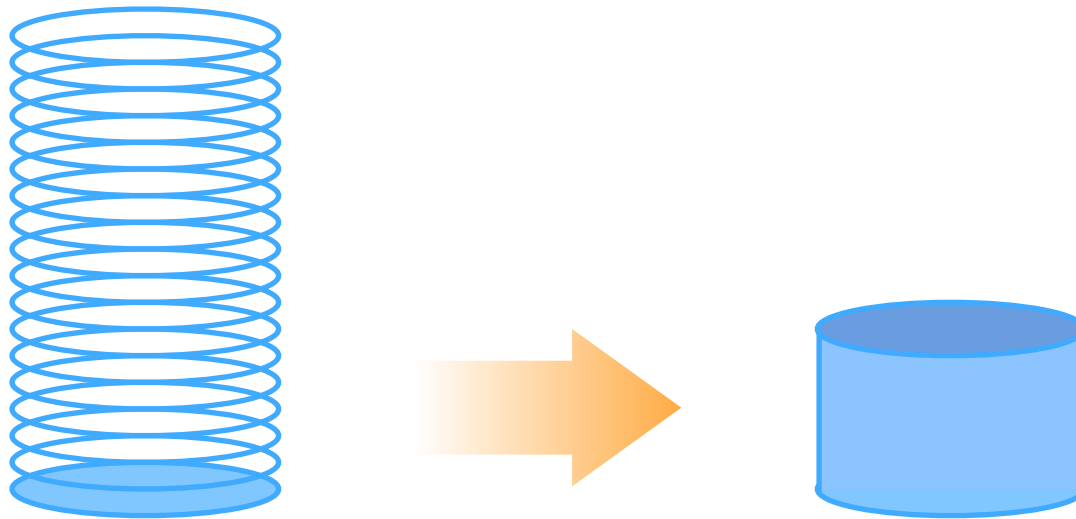


Background/Resources

- "3D Printing" is generally Additive Manufacturing (adding material to make a three dimensional object)
 - Subtractive Manufacturing (milling, grinding, etc.) is also applicable, and there are hybrid solutions that use both
- Useful web pages on 3D printing:
 - <http://3dprintingindustry.com/3d-printing-basics-free-beginners-guide/>
 - http://en.wikipedia.org/wiki/3D_printing
- Semantic Model:
 - <http://www.pwg.org/sm>
- Internet Printing Protocol (IPP):
 - <http://www.pwg.org/ipp>
- Past 3D Printing BOFs:
 - <http://www.pwg.org/bofs.html>

Additive Manufacturing

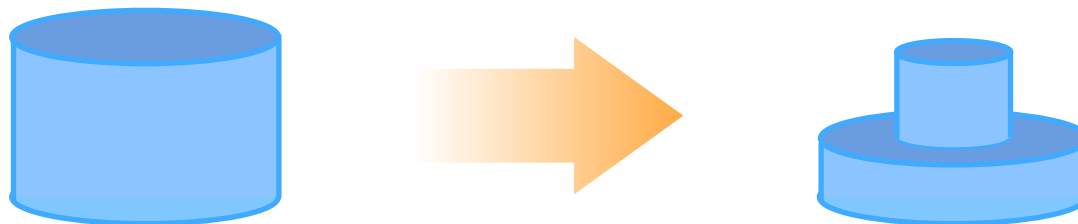
- In Additive Manufacturing, material is added to form three-dimensional objects, typically in deposited horizontal layers:



Subtractive Manufacturing



- In Subtractive Manufacturing, material is removed to form the final three-dimensional objects:





- From prior BOFs:
 - Stick with "personal manufacturing" class of products plus cloud solutions for now
 - Focus on higher-level document formats, since G-code can be too printer/material-specific and common SoC implementations have the memory and CPU needed to do slicing already
 - Still provide lower-level material/state information
 - Material information still needs to be specified in job ticket (at a minimum: outer "shell" materials, in-fill materials, and support materials)
 - Cloud-based solutions can take advantage of IPP Shared Infrastructure Extensions
 - Remote camera feeds can be supported by uploading snapshots - needs some prototyping to determine feasibility/performance constraints



IPP 3D Printing Extensions

- Current draft (white paper):
 - <http://ftp.pwg.org/pub/pwg/BOFs/3d-printing/wd-apple-ipp3d-20151029.pdf>
- Issues:
 - Concerns about the focus on high-level formats - current slicer software may require more memory than available with complex objects
 - Need to create new printer-state-reasons keywords for additional device states/conditions
 - Discuss ways to represent the amount of material that will be/has been used (next slide)

- How to represent material usage in Job Ticket and Job Receipt?
 - Common units are grams, millimeters, and milliliters
 - Maybe use separate member attributes of the "materials-col" attribute?
 - "material-length-mm (integer(0:MAX))": Length in millimeters
 - "material-mass-g (integer(0:MAX))": Mass in grams
 - "material-volume-ml (integer(0:MAX))": Volume in milliliters
 - "materials-col-actual (1setOf collection)" attribute for Job Receipt?

Next Steps



- What about recently formed IEEE workgroup on 3D printing?
- Continue with 3D Printing BOFs, or do we feel that we are ready to charter work on a spec?
- Are there other people, companies, or organizations that we should invite to participate?