The Printer Working Group

3D Printing BOF

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PWG F2F Meeting

Toronto, ON

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Purpose of this BOF

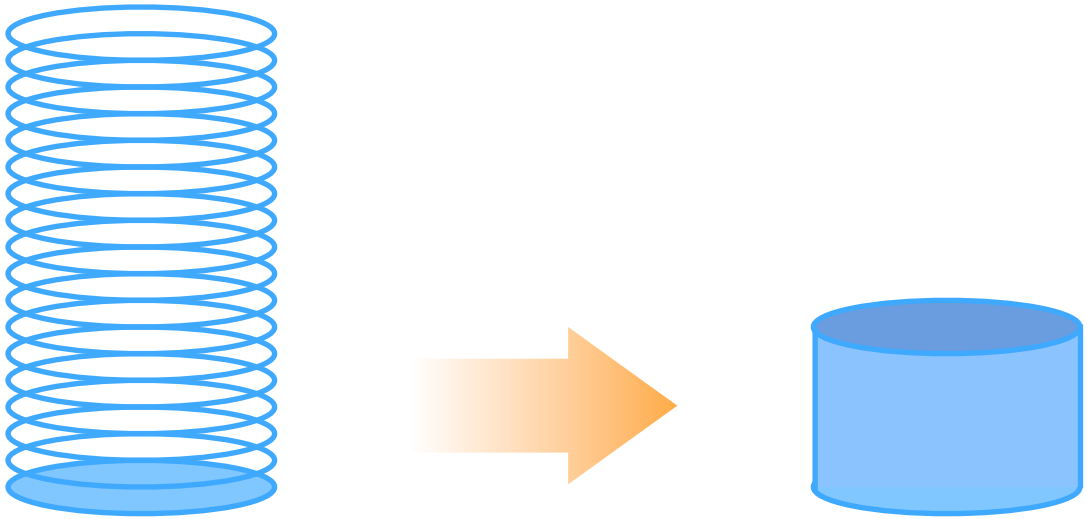
- Provide a brief overview of 3D Printing
- Discuss whether the PWG Semantic Model is applicable to 3D Printing
  - If so, what kinds of changes would be required to support 3D Printing?
- Discuss whether the PWG should continue to hold 3D Printing BOFs
  - If so, what additional vendors, organizations, and/or individuals should be invited to participate?

Introduction

- 3D Printing is a marketing term/name typically used for Additive Manufacturing (AM) such as Fused Deposition Modeling (FDM)
- Can also include traditional Subtractive Manufacturing (SM) techniques such as CNC milling where material is removed instead of added
- Some products are a hybrid - paper-based 3D printers laminate sheets ....
- Useful web pages:
  - http://3dprintingindustry.com/3d-printing-basics-free-beginners-guide/
  - http://en.wikipedia.org/wiki/3D_printing

Introduction

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



Introduction

- 3D printing often uses a single source material to produce a finished object, for example “blue PLA filament”.
- 3D printing often uses “rafts” and other support structures to maintain the shape of objects while they are printed.
  - These supports are removed after printing, either manually (break them off by hand) or with finishing hardware.
- Printing can be very slow, although speeds continue to improve with every new generation of products.
- Common printer faults such as running out of the source material can cause ruined objects.

Introduction

- End User software is mainly designed for experts and dedicated "makers" (inventors/enthusiasts).
  - 3D object files (STL, etc.) do not specify units of measure, making sizing/scaling problematic.
  - Objects often need to be "water tight" (no holes) to work with layering software.
  - Rafts and other support structures can affect the usable build volume.
  - End Users need a expert understanding of the capabilities and limitations of the printer and software being used.
- Networked 3D printers typically provide little or no feedback to the client device - most errors are only reported on the 3D printer.
  - So End Users need to monitor the 3D printer console closely for issues to prevent a ruined object.

Introduction

- Common file formats used for 3D printing:
  - Input 3D object formats: 3DMF, Collada, DXF, OBJ, STL, VRML97, X3D
  - Layer definition/instruction formats: AMF, G-code
- Network protocols used for 3D printing:
  - Tegh: RESTful web service API
  - S3G: Makerbot network protocol
  - Various vendor-specific solutions
- Standards groups for 3D printing:
  - ASTM International Committee F42
    - http://www.astm.org/COMMITTEE/F42.htm
  - ISO TC261
    - http://www.iso.org/iso/standards_development/technical_committees/other_bodies/iso_technical_committee.htm?commid=629086

Is the Semantic Model Applicable to 3D Printing?

- Device/service model?
- Job model?

What Can the PWG Offer for 3D Printing?

- Semantic Model extensions
  - Job Ticket elements
  - Service Capability/Description/Status elements and values
  - Services and Operations
  - Device Capability/Description/Status/Subunit elements and values
- Registration of MIME media types for standard file formats
- Network protocol bindings: IPP, SOAP, RESTful API/ RPC?
- Common security model

Should the PWG Continue the 3D Printing BOFs?

- When to hold them?
- Where to hold them?
- Who to invite?
- What are the topics?
- What is the scope of the discussions?
- Do we foresee formation of a new workgroup or adoption of new chartered work?
  - If so, who will do the work?
  - Volunteers?

