Nvidia Omniverse

A new way to create

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Imagine being able to create a model in a popular 3D modeling program like Maya, SideFX, or Blender, and then seeing a photorealistic ray-traced rendering of it in real-time. And then, changing some part of it, the materials, or a fin, and again it changed immediately. Would that be a fantastic productivity enhancement? Especially considering doing that, you must involve three or more programs and a couple of libraries.

Not too long ago, no one expected to be able to do such a thing. Instead creators spent too much time being an unwilling IT grunt. Then in 2015, Pixar released its universal scene description specification, **USD**, as an open source solution. Many in the media and entertainment community quickly embraced it. Support has continued and by 2019 it had accumulated increased support among software vendors including Autodesk, Foundry, SideFX, and more (like Maxon).

Nvidia saw the potential for USD in M&E, AEC, and beyond. As a result, the company established a dedicated team to expand on USD creating tools, plug-ins, and applications. The result is Omniverse which has become an ongoing universal interoperability platform designed for collaboration and simulation. It is a stage designed as an interface for any 3D application to enable rich interactive experiences. Content creators can now work as their imagination and creativity take them. They will not lose the thread by being a slave to the machine. Now the machine works for and with them.

Traditionally, edits made in one program would be exported and then imported into another one often losing information in each translation making it difficult to bring changes back upstream.

But now, using Omniverse edits made in one program get reflected at once in all associated programs. This is the long-sought dream of consolidating the production pipeline to a single viewing and editing environment. The result will be unimaginable improvements in productivity, accuracy, and collaboration. It will also free designers to create as they can think.

1.1 The Nucleus

At the center of it all is the Omniverse **Nucleus**. The Nucleus server offers a collection of essential services, managing updates to the scenes efficiently by only transmitting what changes, leveraging a key feature of USD. Those services enable various client applications, renderers, and microservices to share and modify virtual world representations in real-time.

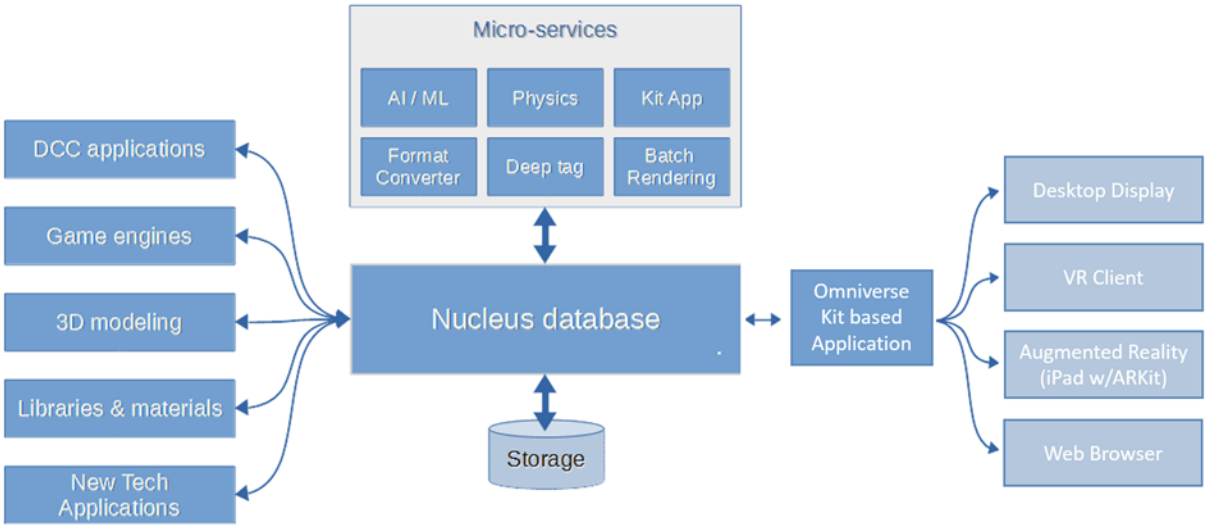

Figure 1: Changes in one app show up in others via the Nucleus server using USD

Nucleus operates under a publish/subscribe model. Subject to access controls, Omniverse clients can publish modifications of digital assets to the Nucleus Database. If someone else made an edit, the user could subscribe to the changes. Digital assets can include geometry, lights, materials, textures, and other data that describe virtual worlds and their evolution through time.

1.2 Omniverse Kit

Inside **Omniverse Kit** applications is another hierarchy of functions and capabilities for developers.

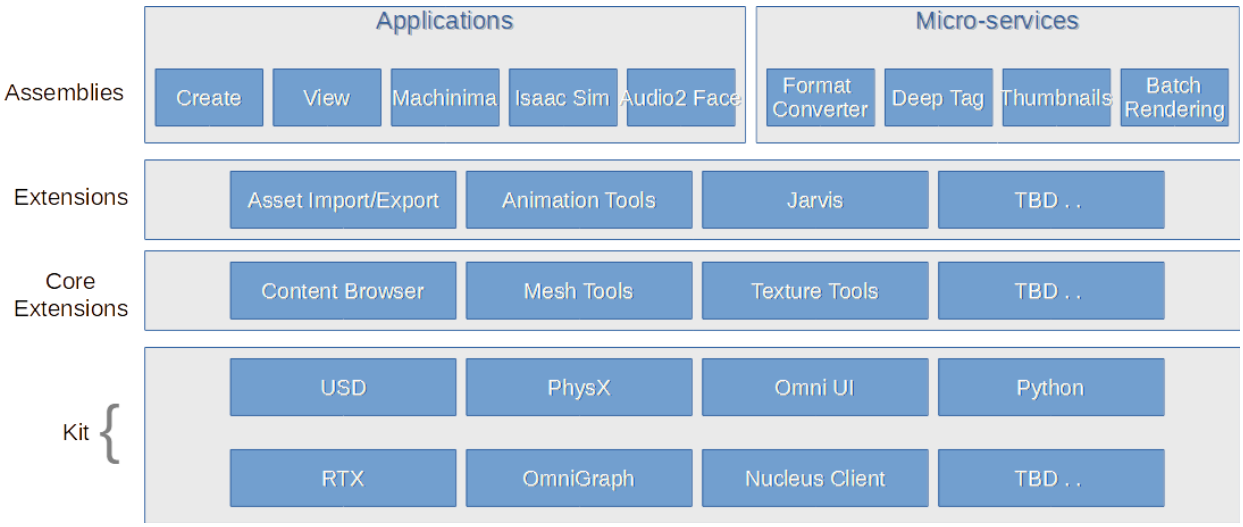

Figure 2: Omniverse Kit includes tools for developing extensions, assemblies, and links to other applications

Omniverse is an evolving platform. It will become more powerful with increased development from Nvidia, partners, and end-users' input.

Omniverse has many points of entry for developers and users. It supports extensions, plug-ins, and direct USD connections and uses Python bindings.

Omniverse Applications like Create, View, Audio2Face and others are built from extensions. Particles and physics come from Nvidia's PhysX standard. Users can also use other physics engines. Materials libraries use Nvidia's MDL programming language to define materials. Omniverse also supports other libraries as well including AI technologies like Audio2Face for AI-driven facial animation, Jarvis for conversational AI, DeepTag for searching through 3D assets, and Kaolin for deep learning researchers.

1.3 Omniverse Workflows

One can examine Omniverse from different points of view. As an organizational block diagram (shown above, or as a flow, shown below.

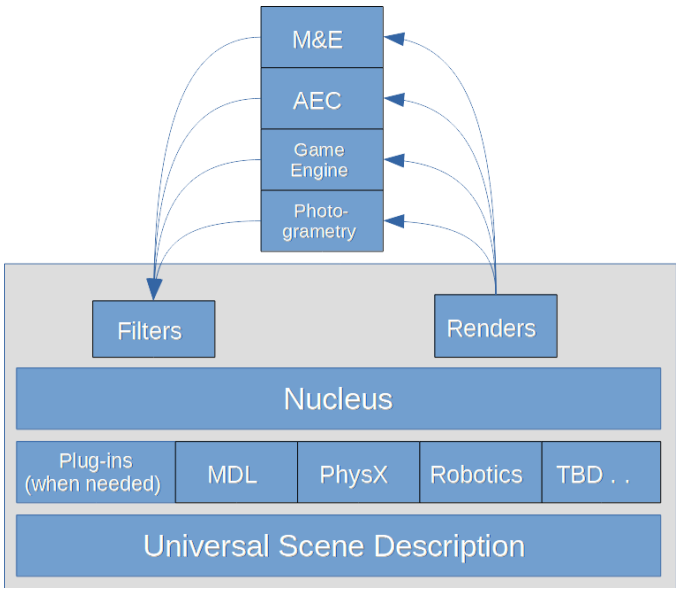

Figure 3: Omniverse flow diagram

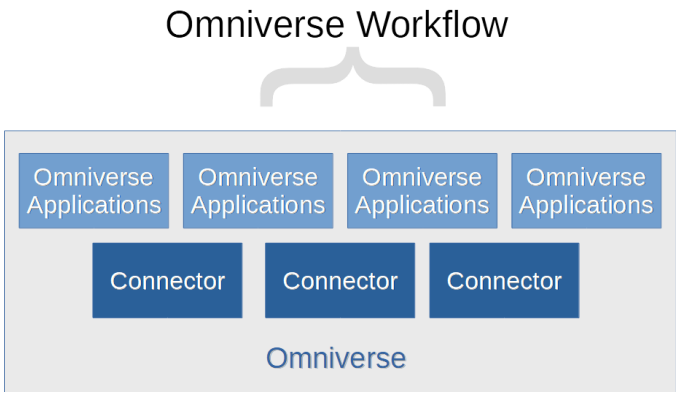

Figure 4: Connectors are used to link applications to the Omniverse

End users can bring their existing applications to the Omniverse by using a Connector, which is a plug-in for 3rd party products. Most popular M&E and AEC products already have Connectors, and more are coming for Manufacturing. A complete list is maintained at nvidia.com/omniverse.

Within the Omniverse environment is a **launcher**. Customers use it to download, update and configure their own Omniverse ecosystem to fit their specific workflow.

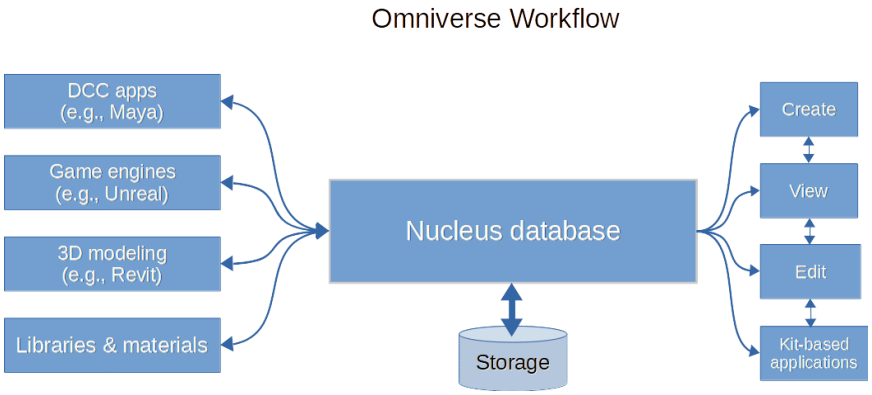

Figure 5: Example workflow featuring third-party and Omniverse apps

The magic is in the interoperability Omniverse brings to content creators. Creators can work together using common content such models, animation, renders, audio and pull in other supporting or augmenting applications. They can make edits and have those edits ripple through every application connected at once.

1.4 Simulation

The Omniverse platform includes the latest PhysX 5.0 with **Finite Element Model (FEM)** which is an industry-standard simulation technique for deformable bodies. It is used extensively in the automotive and manufacturing industries to accurately simulate the structural strength of both rigid and soft assemblies. As Omniverse serves as the platform for Isaac Sim (Robotics) and Drive Sim (autonomous vehicles), Nvidia is imbuing it with its latest physics and simulation technologies including Flow and Blast. Being able to recreate environments with enough fidelity to train robots and autonomous vehicles really pushes a digital twin to the limits in terms of polygon count, rendering fidelity (lighting, shadows) and simulation accuracy which is why Omniverse was built from the ground up for scalability over large amounts of GPUs unlike most game engines.

1.5 Omniverse collapse the pipeline

The content creation pipeline has been a linear collection of specialized applications from various vendors requiring multiple people to process them in a stepwise operation. Omniverse collapses the linear pipeline into a homogenized sea of heterogeneous applications and gives the creator instant access to all of them in concert. That access becomes a communications network that allows all applications to communicate with each under the creator's or the team's direction. And the communications happen instantaneously.

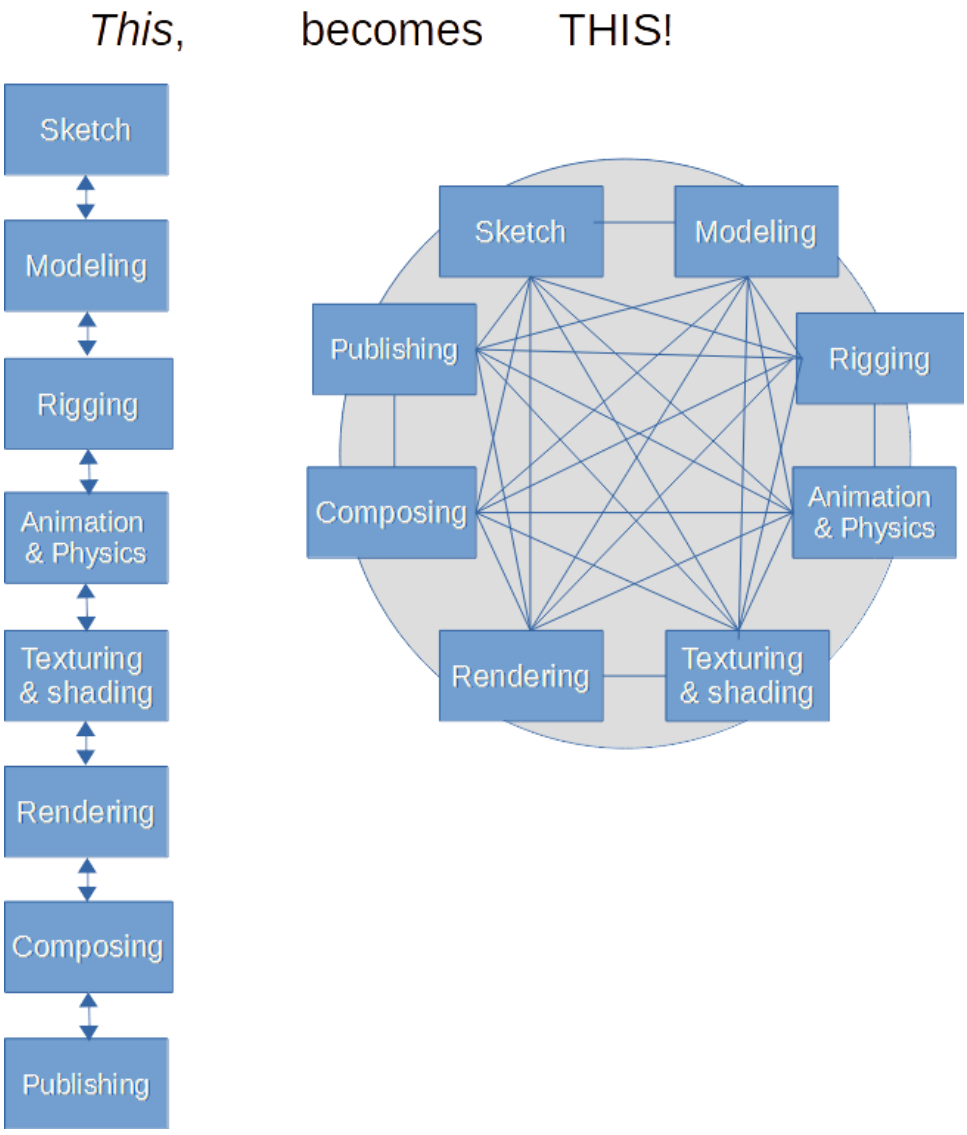

Figure 6: The before and after of content creation using Omniverse

Omniverse is a live system and will evolve. Nvidia and/or users can add new applications either via USD or via Connector plug-ins. New workflows will get generated, and templates for them developed. And new libraries, macros, and algorithms will continue to appear and get added. Creators will not have to give up any of their favorite applications to get the benefits of the Omniverse. They won't have to learn any new applications or skills. Productivity and creativity will reach new heights, and we'll look back upon pre-2020 and wonder how did ever get anything done?