Cloud-Based Visualization of 3D Product Data for Digital Twin Applications

Matt Heying
Vertex Software
Vice President of Product

GLOBAL PRODUCT DATA INTEROPERABILITY
SUMMIT
2021

Virtual Sessions

Presenters Bio

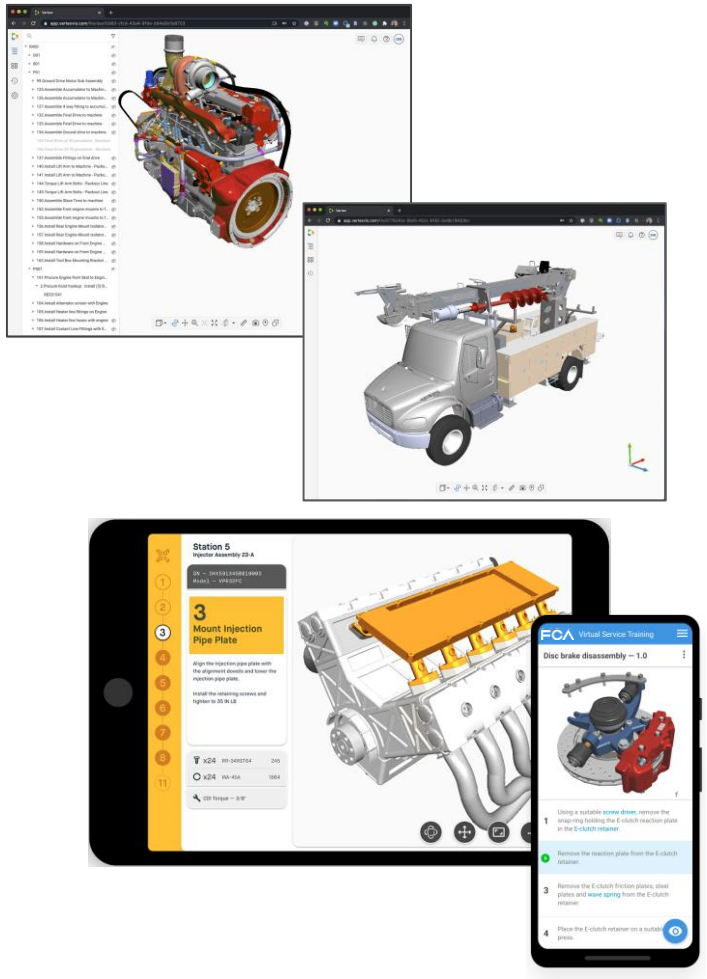
Matt Heying

Vice President of Product, Vertex Software

- BSME / MSME **Iowa State University**
- Grad Work (2003-2008) DARPA/ONR Grant on Machine Learning Models and 3D Visualization for Accelerated Insertion of Materials at Virtual Reality Applications Center (VRAC)
- **Workiva** (2008-2018) - VP of Product - built the first ever B2B Cloud SaaS on Google Cloud Platform
- **Vertex** (2018-Present) - Vertex VP of Product

Leveraging your 3D Product Data throughout your organization

- **Sales**: Shorten sales cycle through enhanced customer engagement
- **Manufacturing**: shop-floor MBD, increase factory yield and improve defect reporting and resolution
- **Service:** drive parts and service revenue, reduce customer downtime
- **Engineering**: Shorten design cycles by improving collaboration among engineering teams and suppliers
- **Customers**: customer experiences with interactive digital twins connected to live data sources



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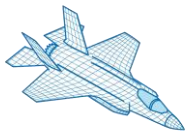
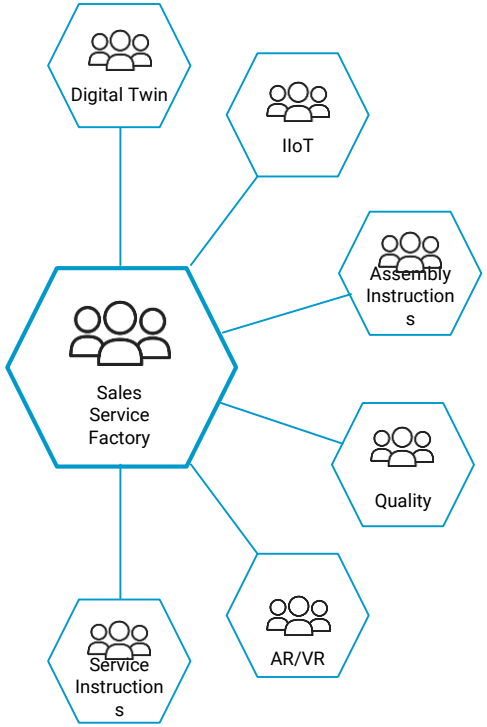


Engineering
CAD data

High quality

High fidelity

Source of truth



Leveraging your 3D Product Data throughout your organization

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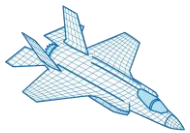


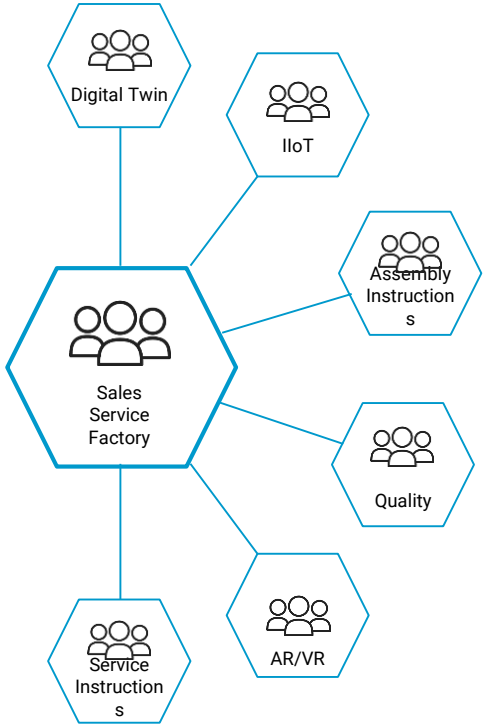
Engineering
CAD data

High quality

High fidelity

Source of truth

Expensive
Hardware



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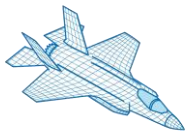


Engineering
CAD data

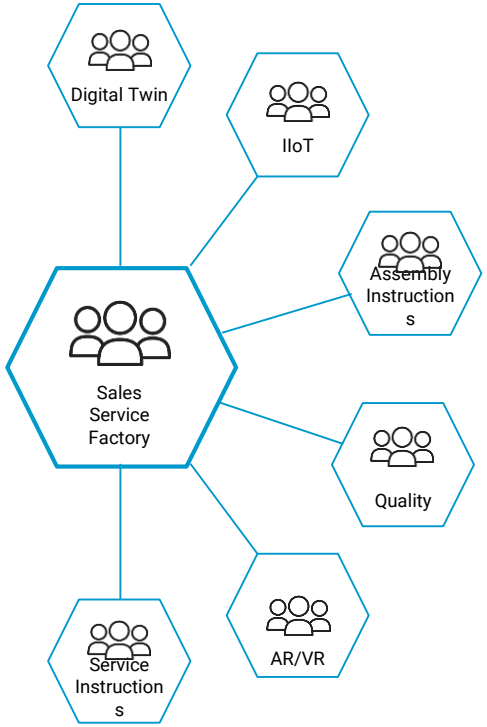
High quality

High fidelity

Source of truth

Expensive
Hardware

Installed
Software



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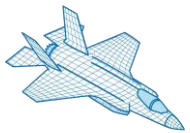


Engineering
CAD data

High quality

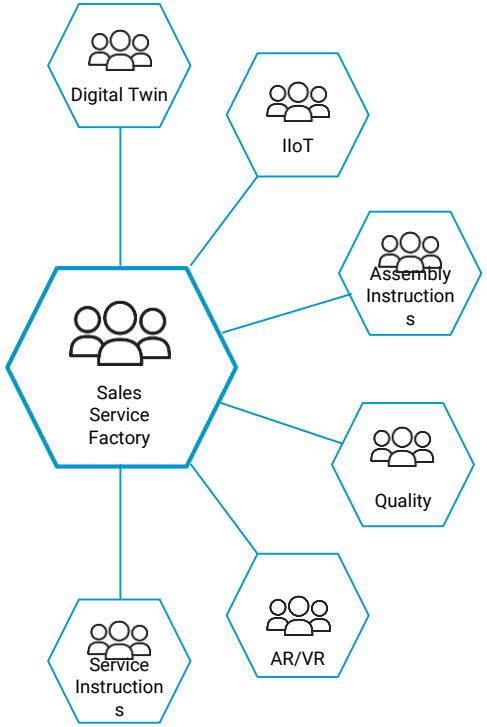
High fidelity

Source of truth

Expensive
Hardware

Installed
Software

Complex User
Experience



Leveraging your 3D Product Data throughout your organization

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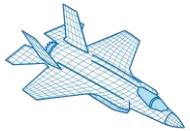


Engineering
CAD data

High quality

High fidelity

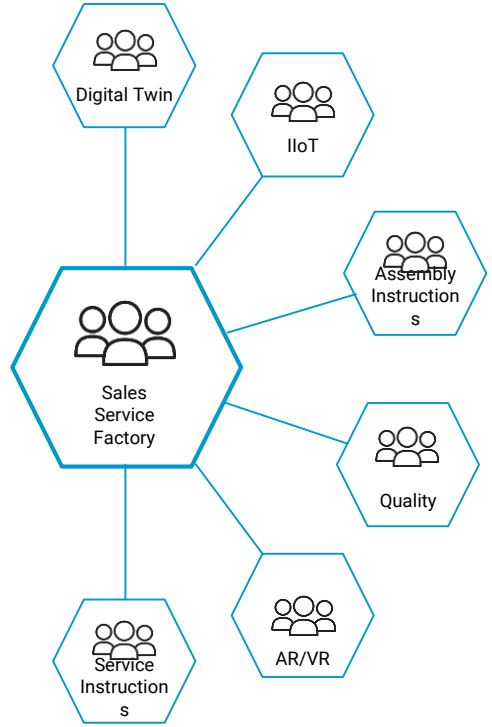
Source of truth

Expensive
Hardware

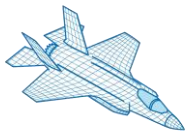
Installed
Software

Complex User
Experience

Very Large
IP Sensitive
Files



Conventional Method: Client-side Rendering

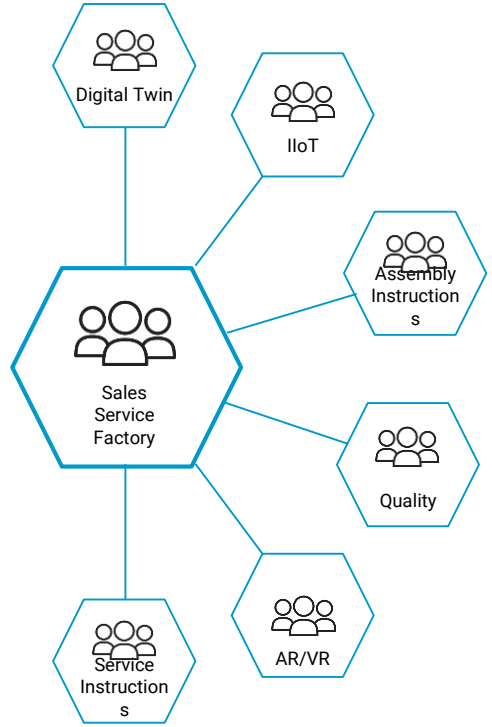


Engineering
CAD data

High quality

High fidelity

Source of truth



Conventional Method: Client-side Rendering

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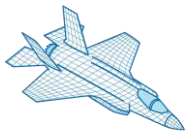


Engineering
CAD data

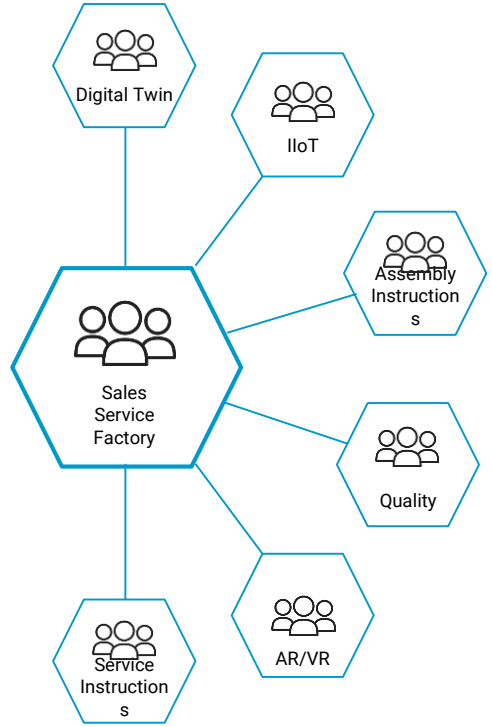
Native CAD File

Export

High quality

High fidelity

Source of truth



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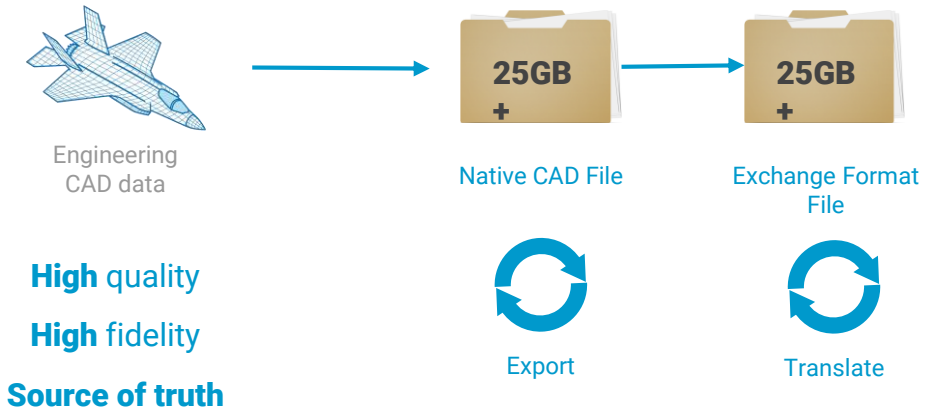
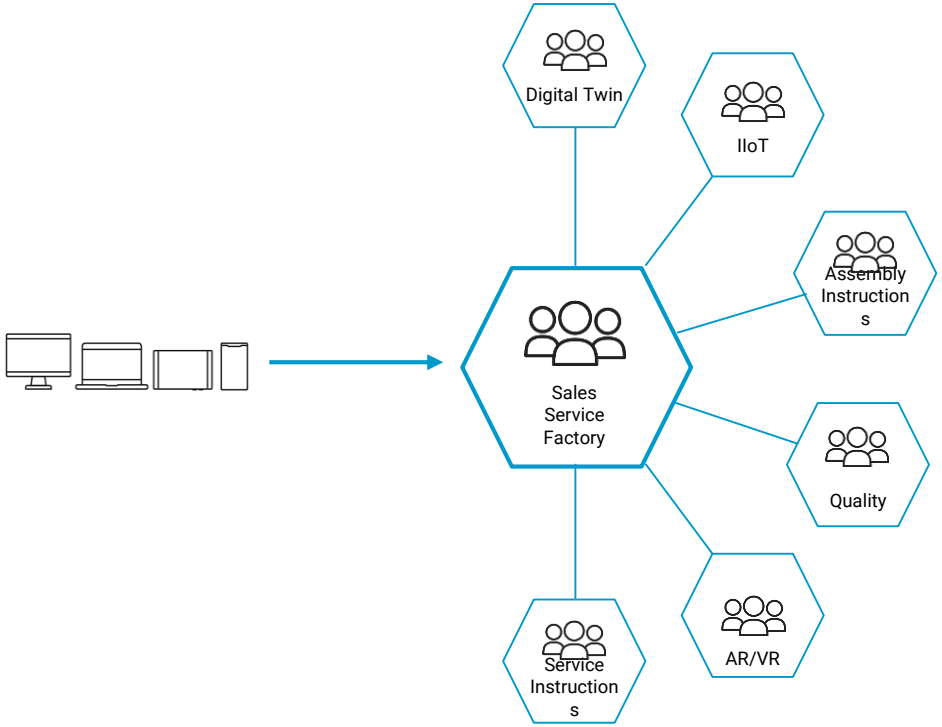


High quality

High fidelity

Source of truth



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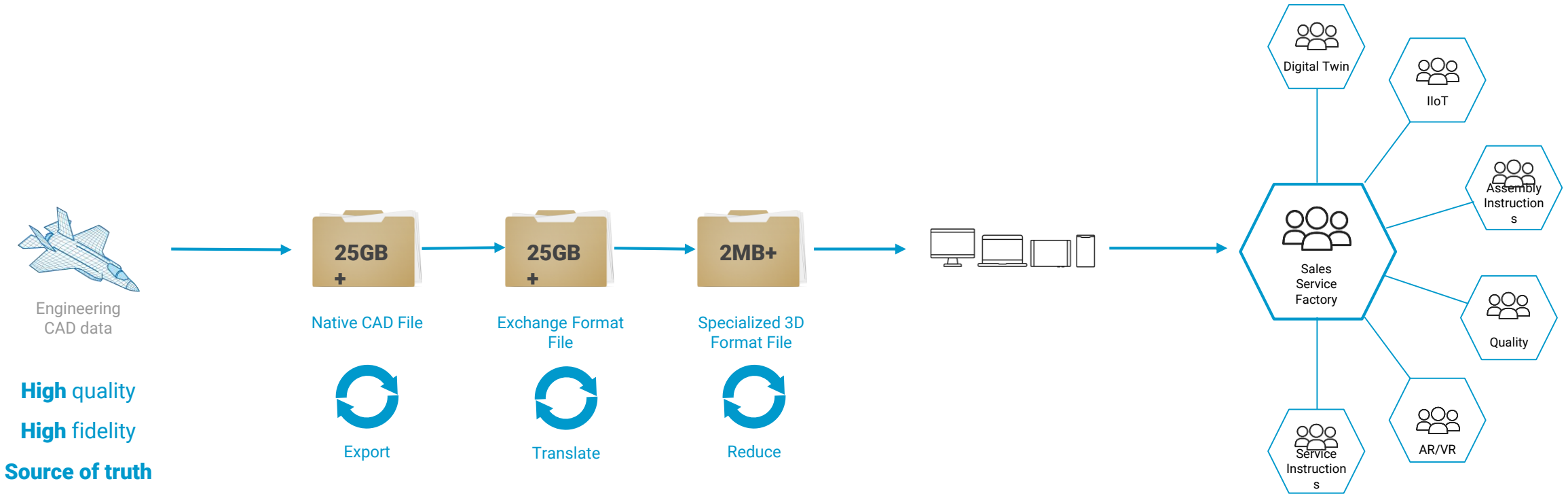

High quality

High fidelity

Source of truth

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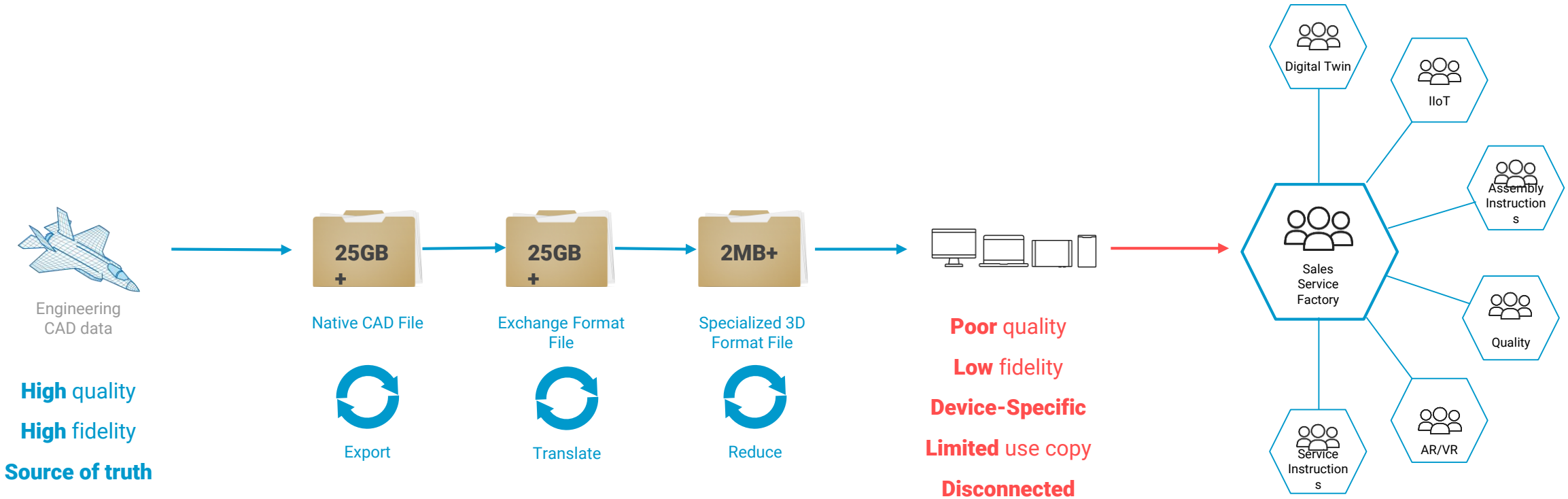
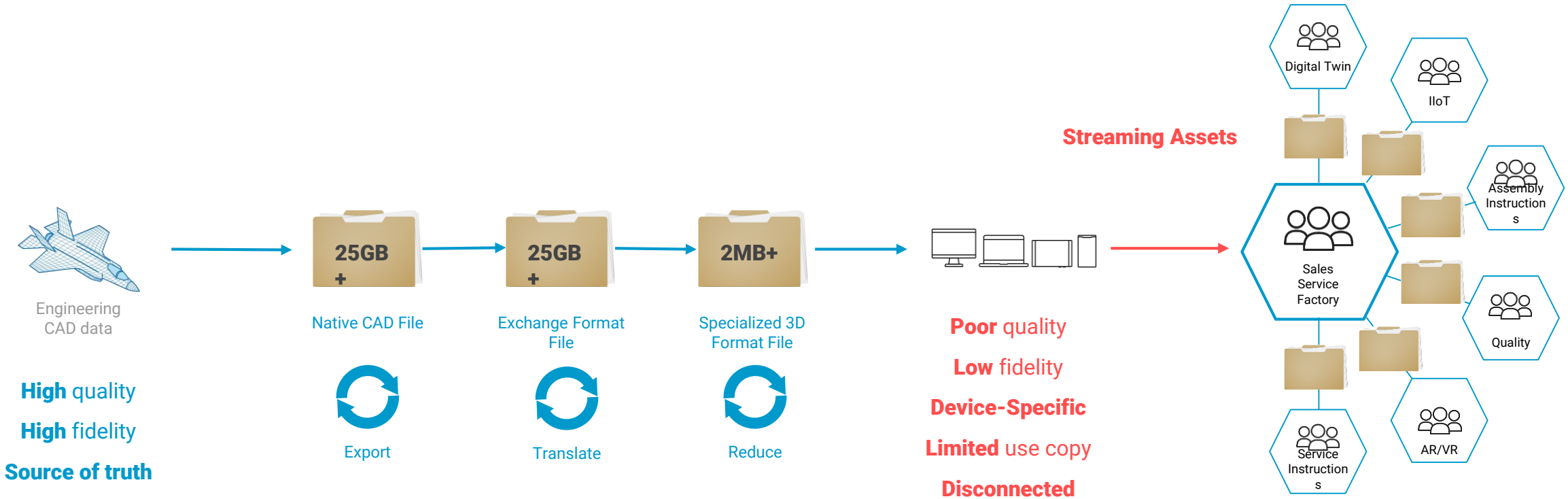
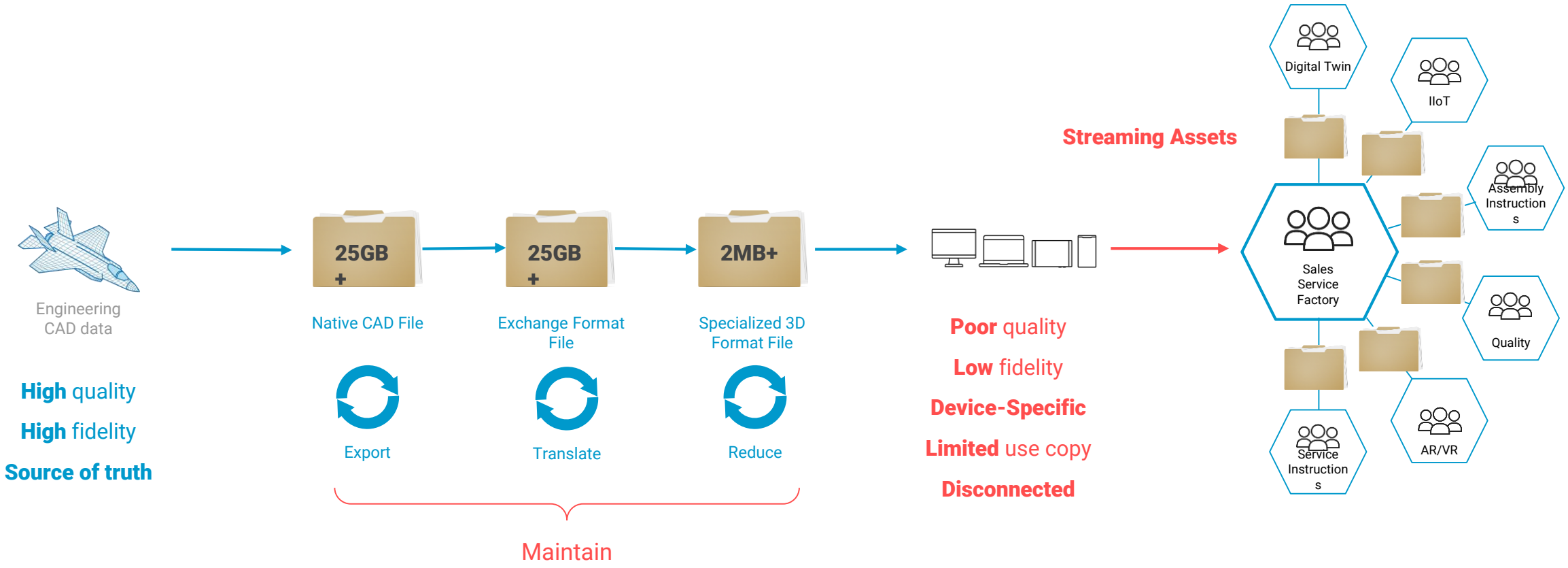


Conventional Method: Client-side Rendering



Conventional Method: Client-side Rendering



Conventional Method: Client-side Rendering

Client-side Rendering:

- Stream Assets (geometry) to device
- File-based
- Levels of Detail Management
- Render on device with OpenGL / Vulkan / WebGL etc
- Performance Implications (device hardware, load time etc)
- Security Implications (how sensitive are your triangles?)

Cloud Native Method: Server-side Rendering (GPU-based)

Server-side Rendering:

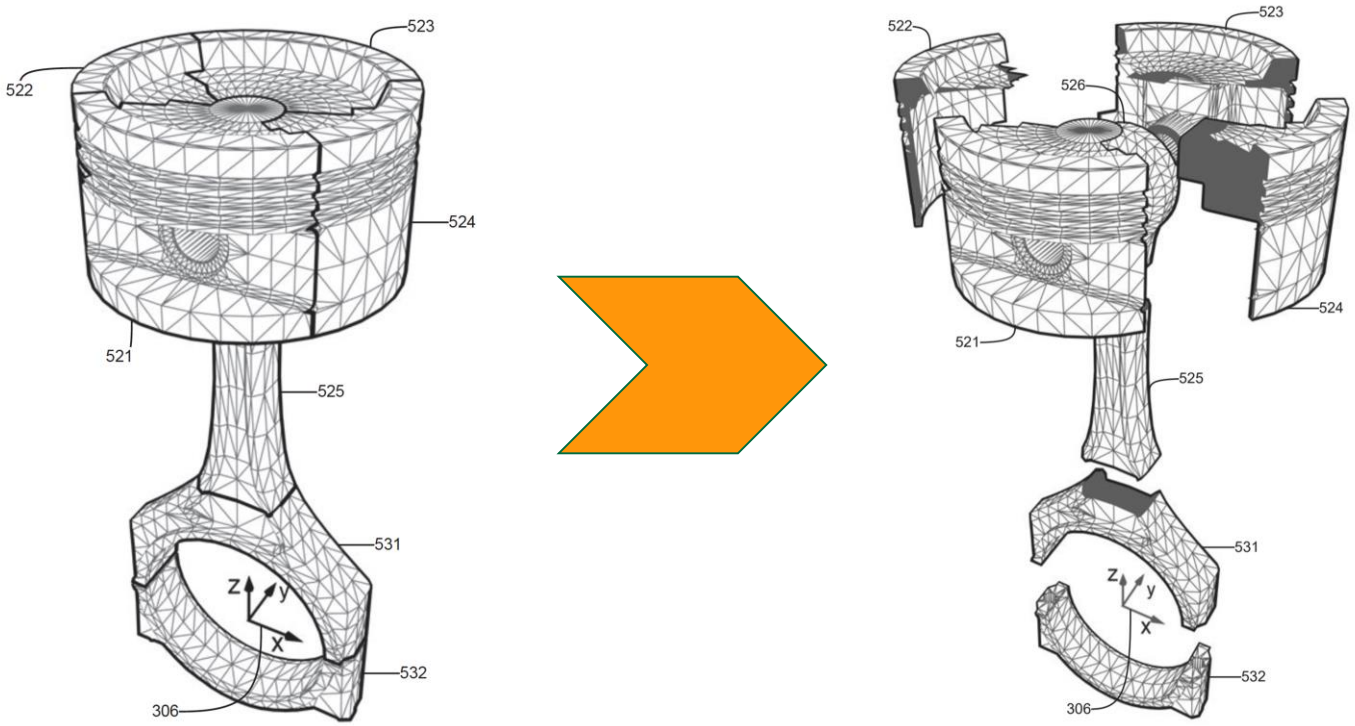
- Get a beefy GPU box
- Stream pixels to device
- Render on server with OpenGL / Vulkan / WebGL etc
- Cost Implications (GPUs, servers etc)
- Security Implications (how sensitive are your pixels?)
- Scalability (number of concurrent users)

Cloud Native Method: Server-side Rendering (CPU-based)

Sharding

Subdivide geometry & scenes into spatially compact shards

Enhances scalability, IP security, and enables wide-scale parallelism

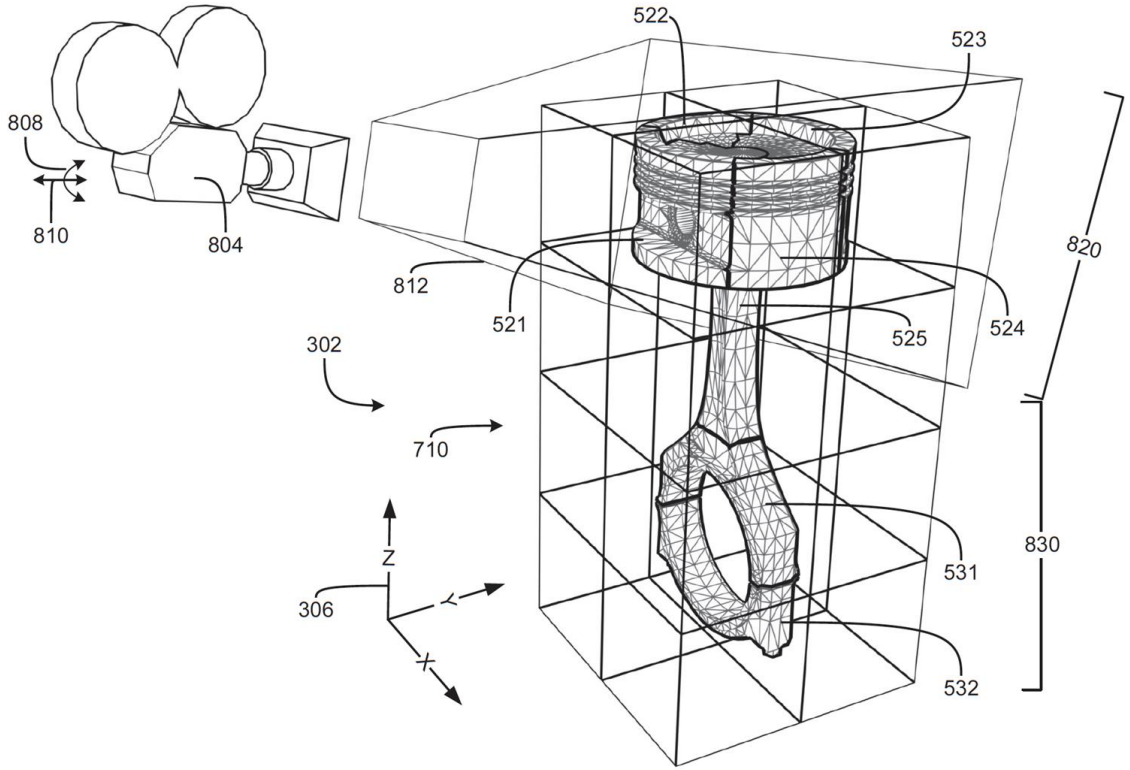


Cloud Native Method: Server-side Rendering (CPU-based)

Spatial Culling

View frustum, screen-size & occlusion culling

Enhances scalability & frame latency



Cloud Native Method: Server-side Rendering (CPU-based)

Distributed Rendering

Work is load-balanced across many workers and combined to produce final composite image.

Enables wide-scale parallelism and fault-tolerance

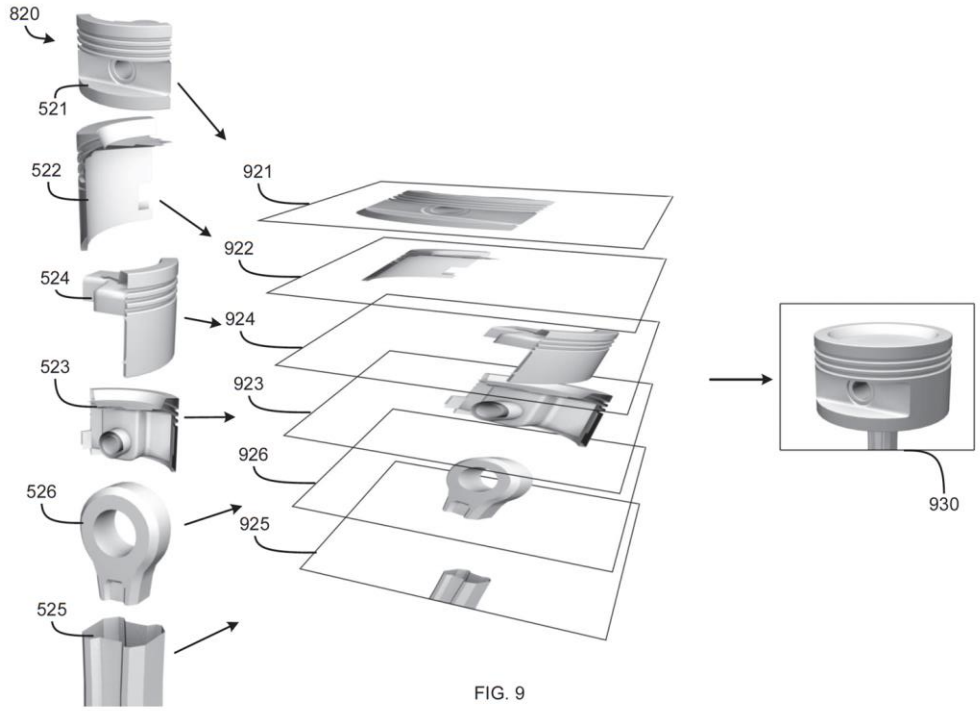
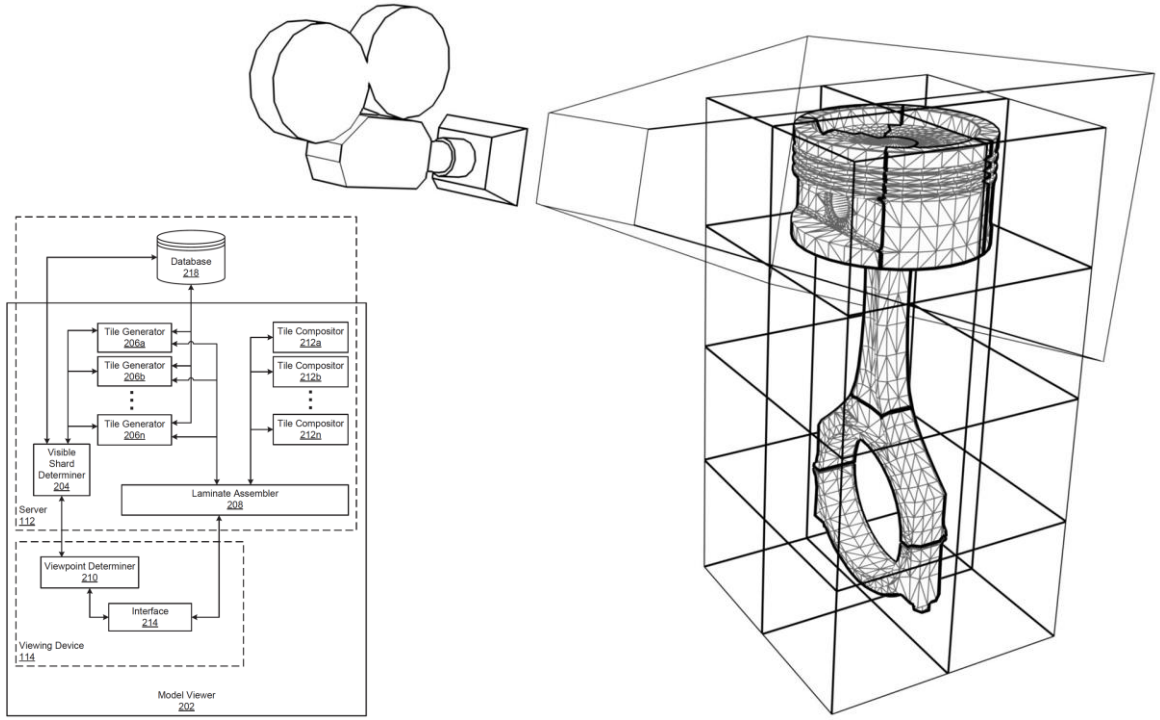


FIG. 9

Cloud Native Method: Server-side Rendering (CPU-based)

- Unbounded scalability:
  - Concurrent users
  - Scene complexity
- Massively parallel
- Low latency
- Highly secure
  - SOC II compliant
  - Sensitive 3D data
- Fault-tolerance
- Ultra-low cost
  - CPU vs GPU
  - Adaptive load management



US Patent No. 10,950,044:

Methods and apparatus to facilitate 3D object visualization and manipulation across multiple devices

Issue Date: March 16, 2021

Cloud Native Method: Server-side Rendering (CPU-based)

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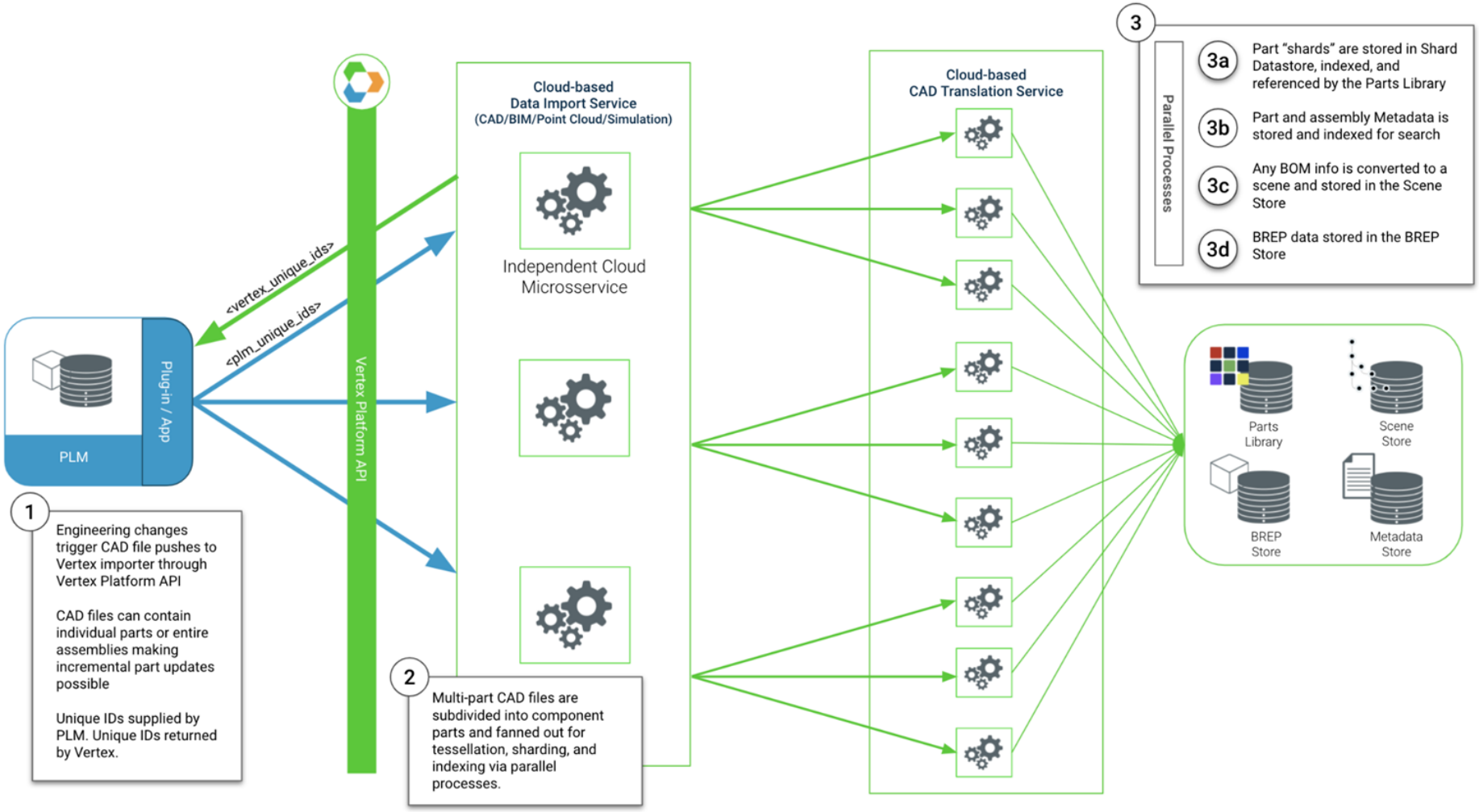

Cloud Native Method: Server-side Rendering (CPU-based)

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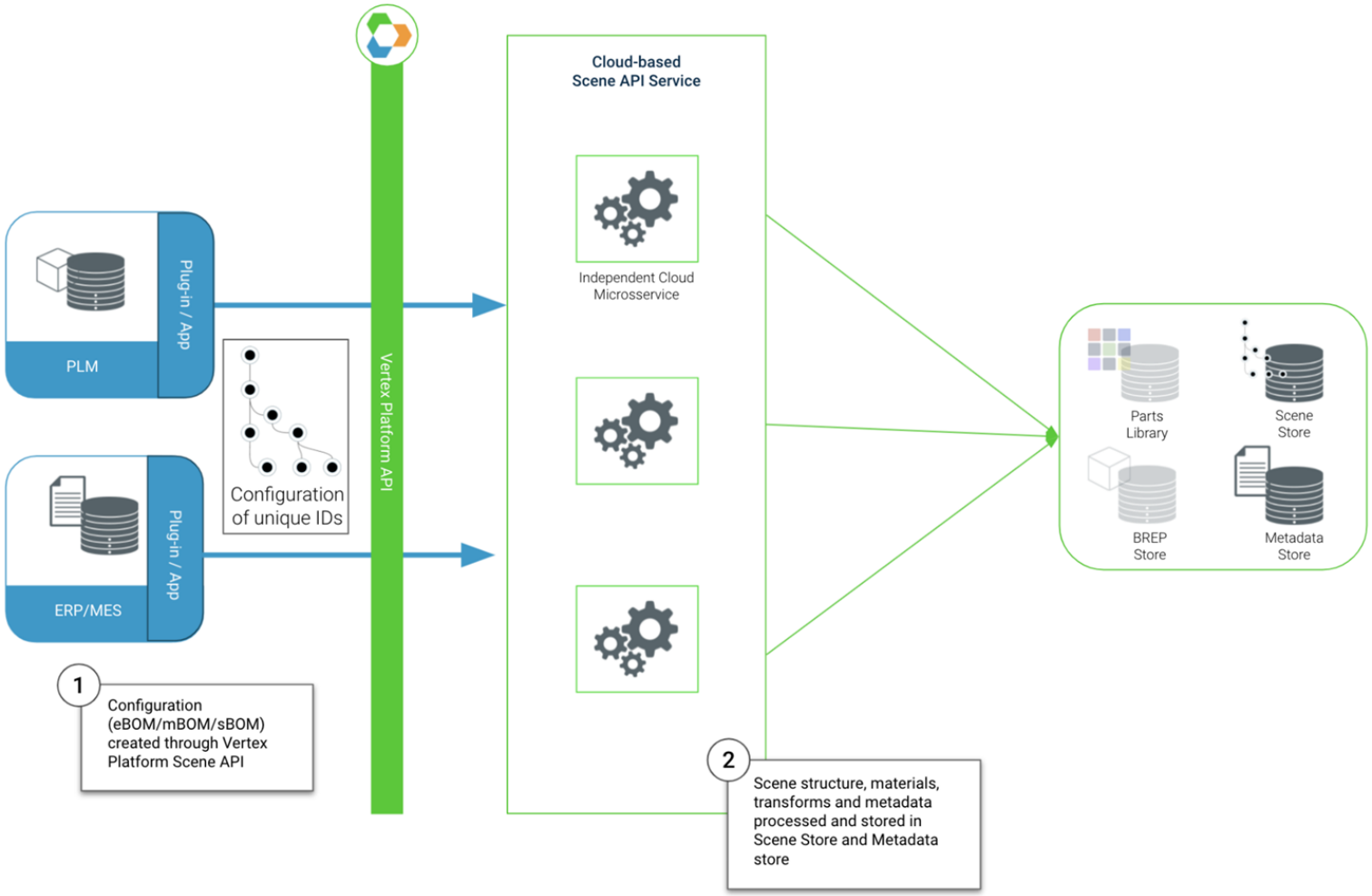

Cloud Native Method: Server-side Rendering (CPU-based)

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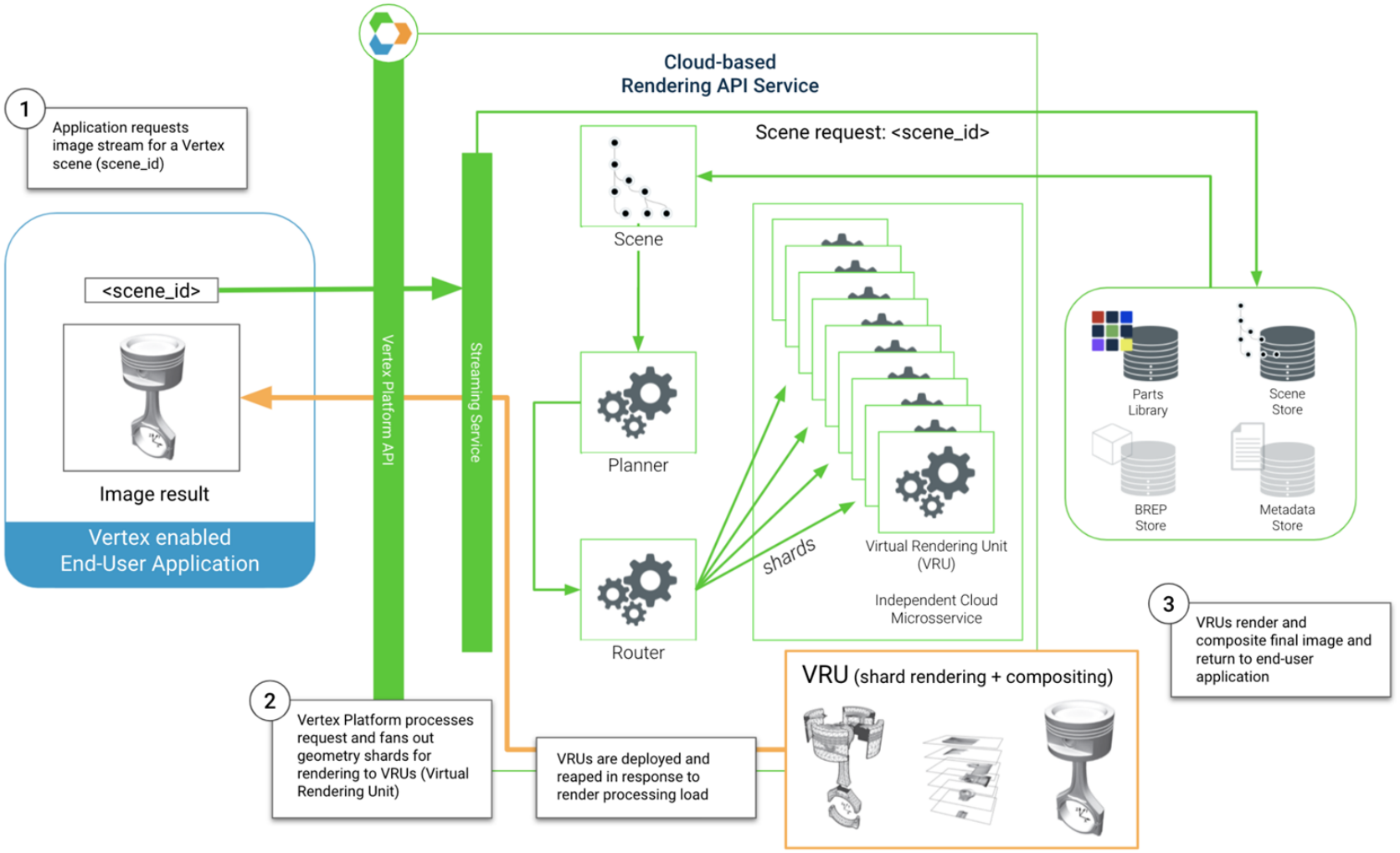
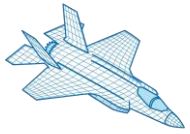


Cloud Native Method: Server-side Rendering (CPU-based)

High quality

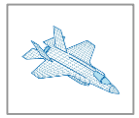
High fidelity

Source of truth



Engineering

Vertex 3D Platform



Streaming Images
(30 fps)

High fidelity

Any Device

Any User

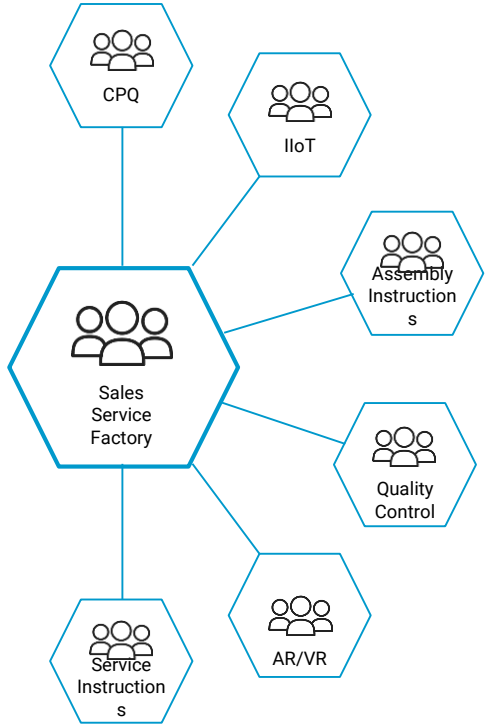
Any Size Model

Connected to PLM

Secure

Device-independent

Digital Twin



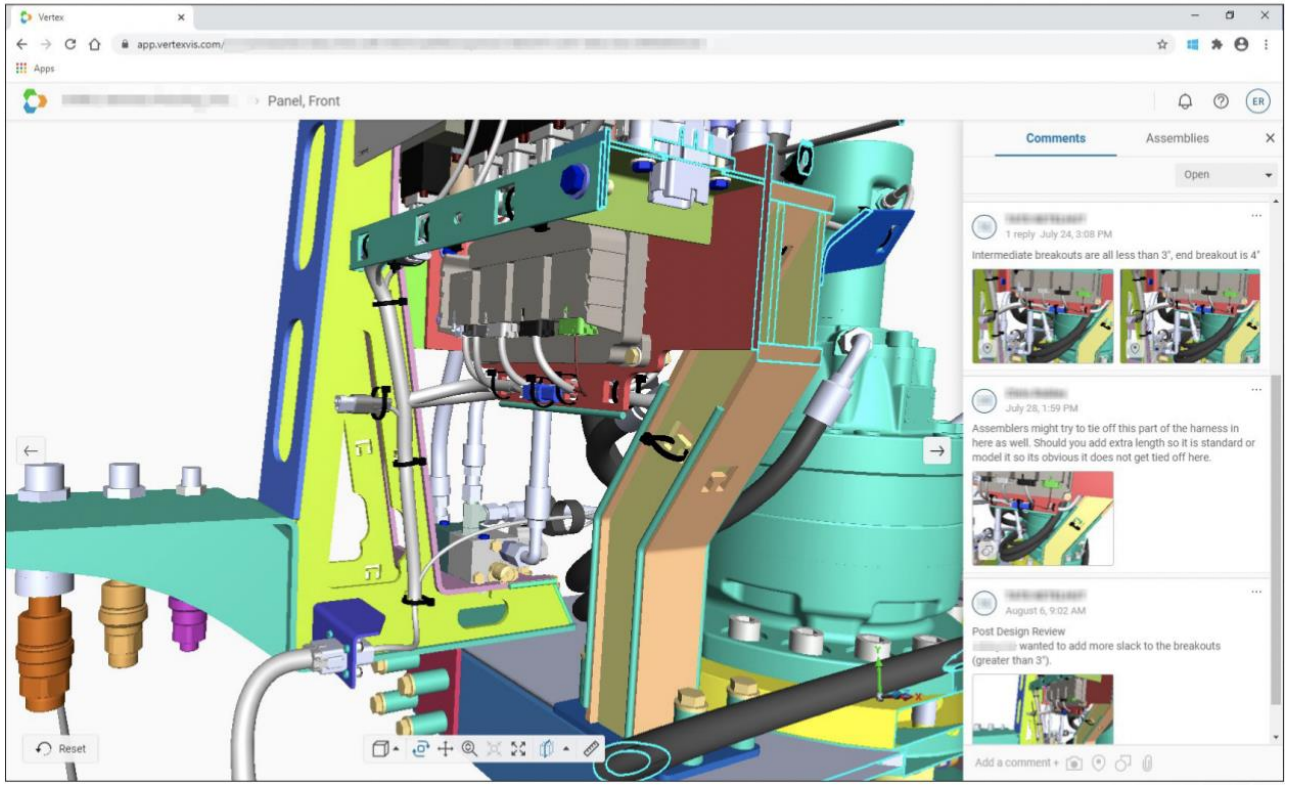
Cloud Native Method: Server-side Rendering (CPU-based)

Commercial Aviation model:

- File Size 1.3 GB compressed
- Model stats: 140K parts, 220M triangles
- Initial translation: ~4 minutes
- Load times: < 10 seconds

Load testing:

- 1,500 users = 210M parts, 330B triangles
- 3 hours with randomized camera views
- 15 frames per second per user



Digital Twin - Manufacturing - Electronic Work Instructions

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Challenge

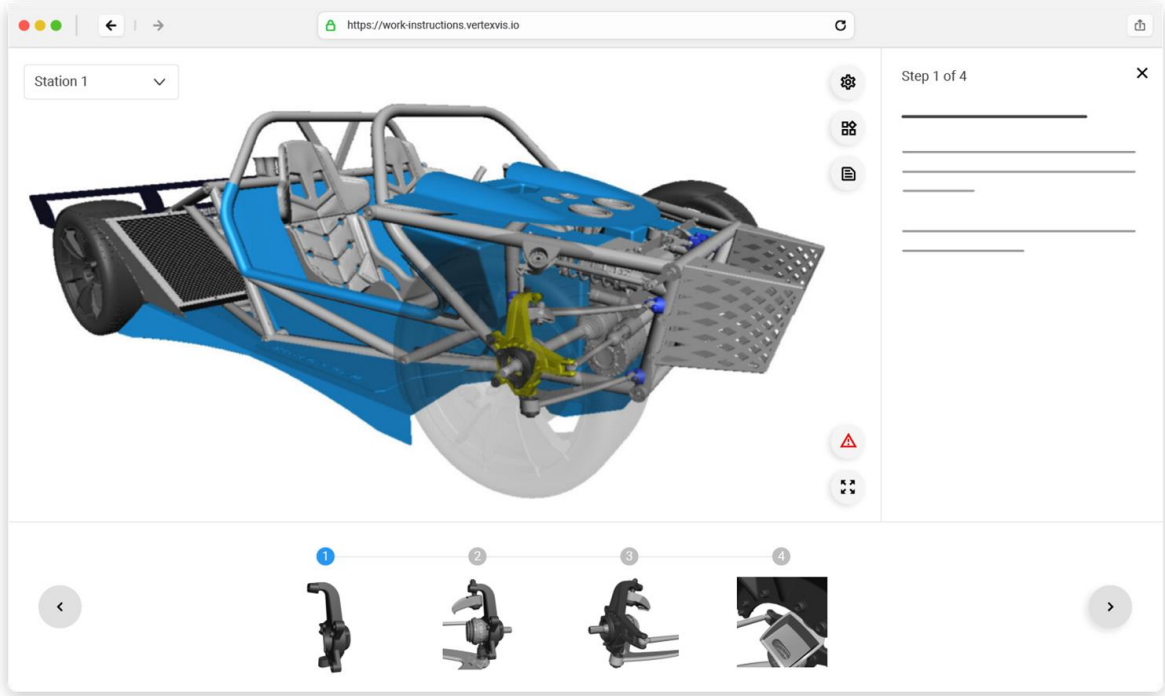
Static, out-of-date 2D work instructions disconnected from the product data, leading to wasted time, miscommunication, defects, and rework.

Solution

Digital twin-based instructions and MBD to the shop floor. Vertex enables shop floor operators and factory managers to virtual digital twins of product, fixtures, and tooling for use in up-to-date work instructions low-powered devices.

Benefits

- Improved takt time and increased quality by referencing a real-time virtual representation instead of a 2D drawing
- Improved understanding of process for highly custom and complex orders
- Close feedback loop between manufacturing and engineering
- Helps training and understanding for new personnel. Same work instructions can be leveraged for onboarding



Digital Twin - Manufacturing - Quality Reporting & Resolution

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Challenge

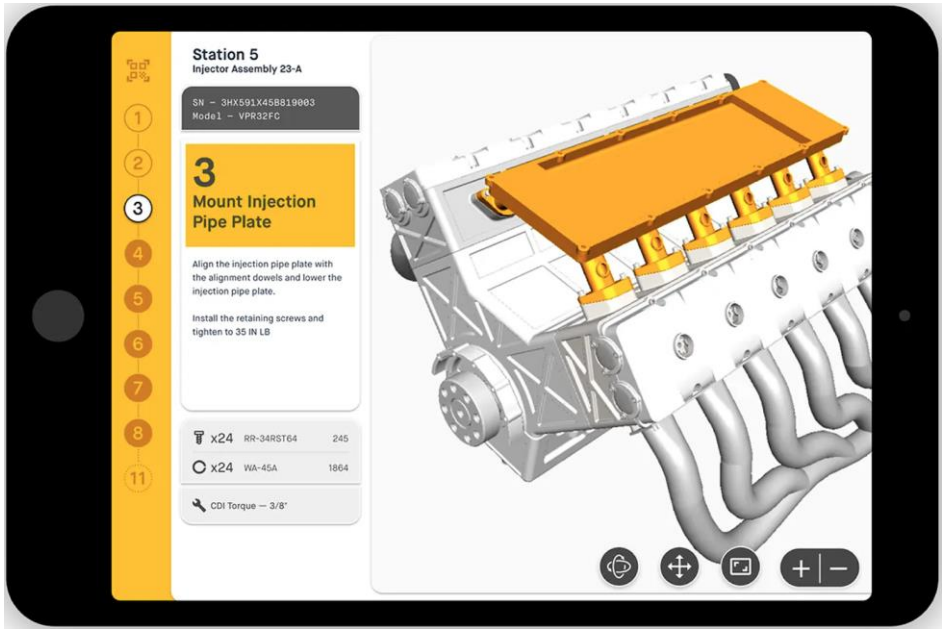
Manual data collection methods that rely on highly experienced personnel making it difficult to interpret, provide feedback and resolve quickly.

Solution

Quality Inspectors use virtual digital twins for creating pinpoint accuracy on issues automatically populated with work order, serial number, part number, and exact locations of issues.

Benefits

- Improved product and process quality through quantitative data on part defects
- Improved issue/defect identification, remediation time, and associated rework costs for manufacturing supervisors.
- Increased uptime for shop floor technicians, improving productivity
- Helps training and understanding for new personnel



Digital Twin - Smart Factory and Product IoT Visualization

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Challenge

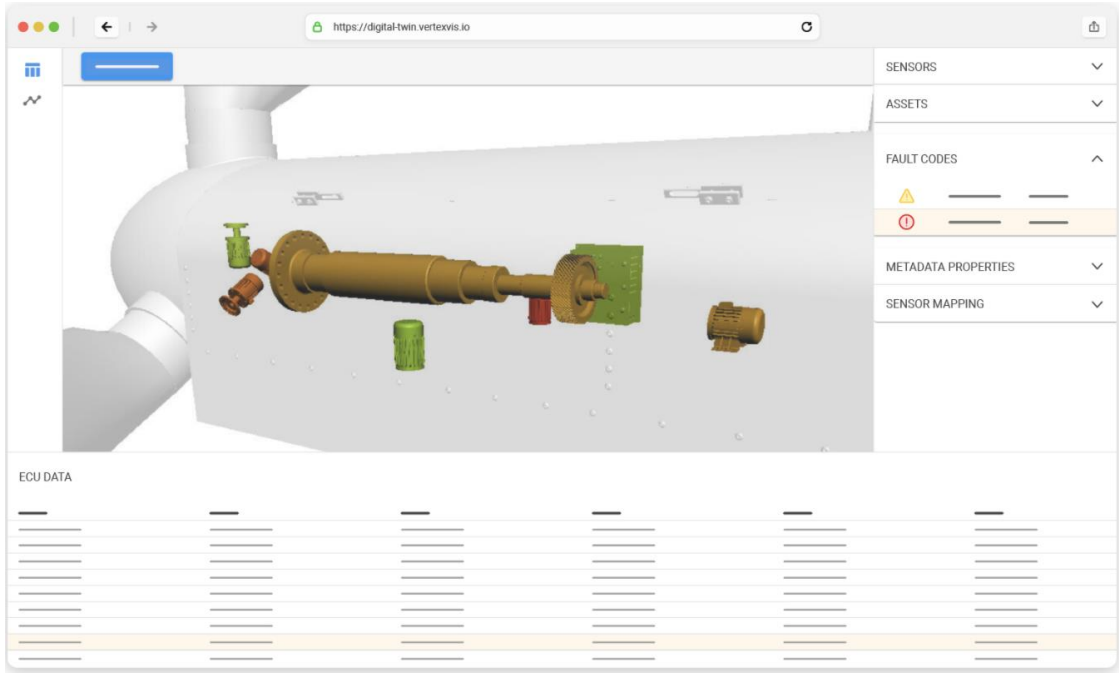
Factories and Connected Products collect vast amounts of telemetry, but the potential to gain insights from that data is largely unrealized by all departments

Solution:

Vertex integrates PLM, BIM, and IoT data sources to combine asset telemetry with actual 3D geometry to visualize IoT in-context along with other process data coming from MES and ERP.

Benefits

- Increased factory process insights to improve overall equipment efficiency
- Reduced feedback loop time for manufacturing process engineers
- Improved issue/defect identification/RCA and remediation time and associated rework costs for maintenance workers and manufacturing supervisors



Digital Twin - Enterprise Digital Thread Visualization

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Challenge

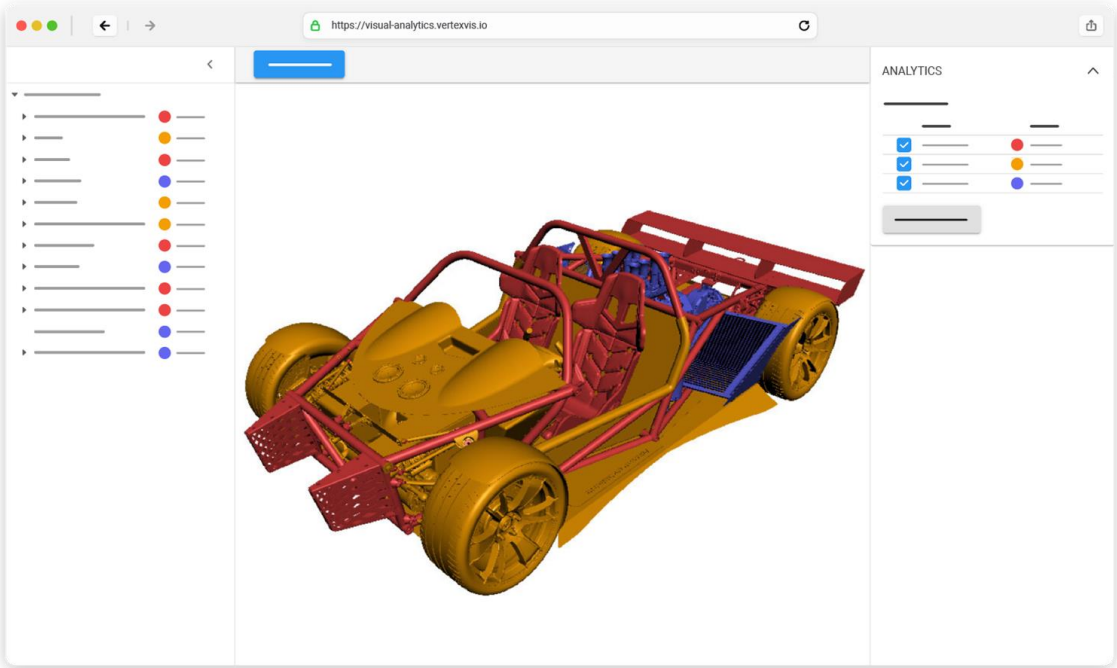
The digital thread contains a wealth of untapped information but it is often a tangled mess with siloed teams, databases, and knowledge. This data is often hard to contextualize based simply on configuration, part numbers, etc.

Solution

Develop digital twin applications connected to reports and queries from structured data warehouses and unstructured data lakes.

Benefits

- Data science is contextualized to the product and factory
- Understanding of data and insights is improved from the shop floor to the top floor



Thank you!

Matt Heying

Vice President of Product, Vertex Software

Reach out to me: matt.heying@vertexvis.com

Or find me on LinkedIn: https://www.linkedin.com/in/mattheying/

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