



Cloud Computing with Abaqus and 3DExperience Platform – first experiences

- Capabilities of Cloud Computing with „Prepaid Credits“

Peter Straetemans

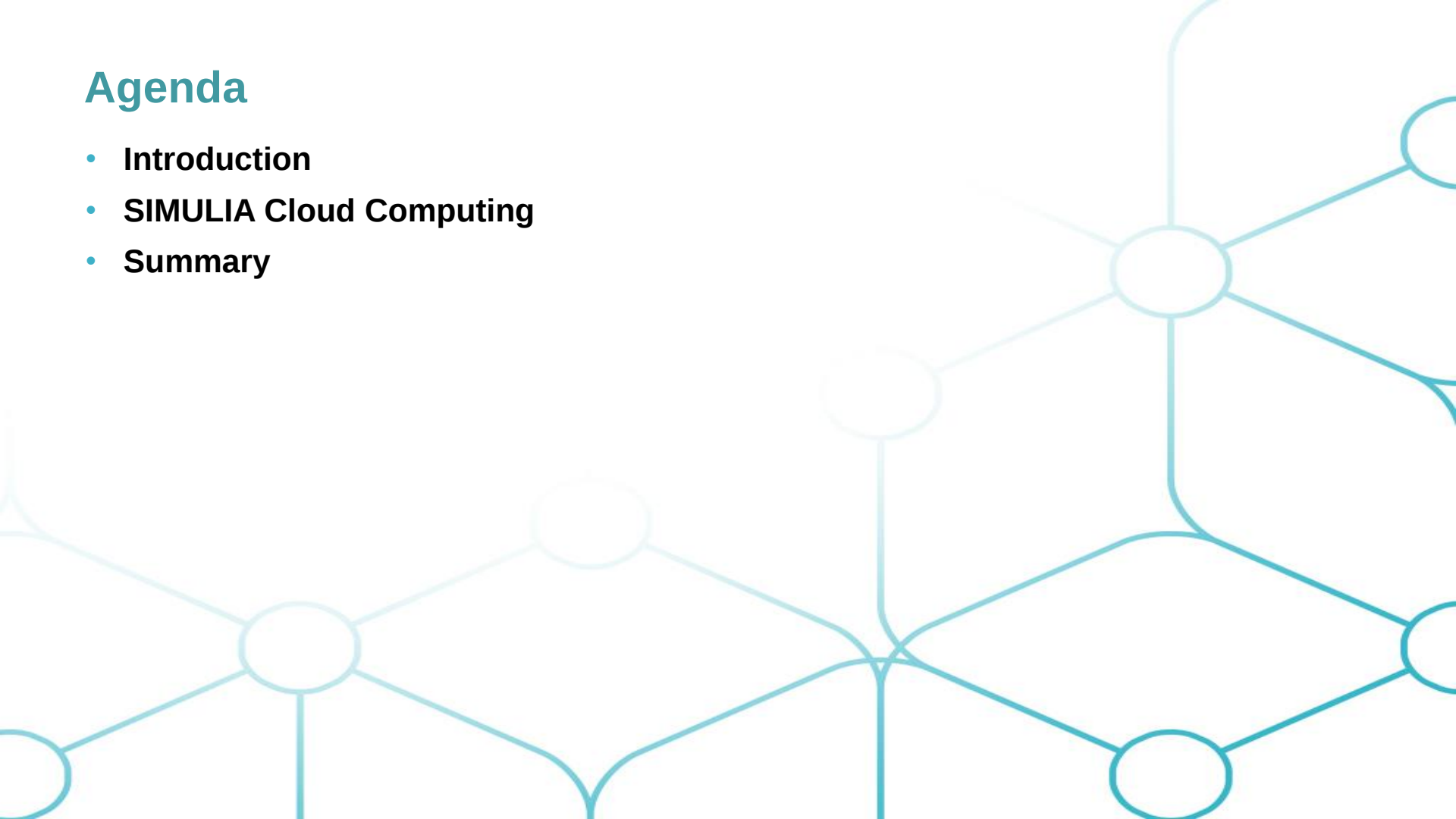
DASSAULT SYSTÈMES User Conference, 6. December 2018

TECHNIA TRANSCAT

ADDNODE GROUP

Agenda

- Introduction
- **SIMULIA Cloud Computing**
- Summary



Agenda

- **Intoduction**
- SIMULIA Cloud Computing
- Summary



TechniaTranscat

- **Reseller, Software-Entwickler, Service-Provider**

Making product creation easier

Bei uns dreht sich alles um Ihr Produkt – von der Idee bis zum Recycling. Während Sie sich auf die Kreativität und Profitabilität konzentrieren, sorgen wir für die richtige PLM-Software, Know how und Service. Damit Ihr Produkt deutlich besser und schneller auf den Markt kommt.



Product Lifecycle Management

Ob eine spezifische Software, ein ganzheitliches PLM-System (ENOVIA) oder ein smartes Add-On - TechniaTranscat beherrscht das PLM in seiner ganzen Vielfalt.



Design & Manufacturing

Schneller zum fertigen Produkt - mit CATIA (virtuelle Produktentwicklung) und DELMIA (digitale Fertigung)



Service

Lösungspakete maßgeschneidert für Sie: TechniaTranscat übernimmt für Sie die Planung, Implementierung, Betrieb und Schulungen der PLM-Lösungen.



TechniaTranscat Simulation Department

Technical:

- **Ralf Paßmann**
 - Department Manager
 - 28 Jahre Abaqus
 - BMW Group, SynOpt GmbH
- **Peter Straetemans**
 - Senior Consultant
 - 20 Jahre CATIA Analysis
 - 6 Jahre Abaqus
- **Harsha Krishnamurthy**
 - Consultant
 - 5 Jahre Abaqus und CATIA FEM
- **Dr.-Ing. Zhenhua Dai**
 - Consultant
 - 3 Jahre Abaqus, CATIA Analysis, Ansys
- **Arjuna Mattanavile Nagaraju**
 - Consultant
 - 5 Jahre Abaqus, Ansys, Hyperworks Suite, Ansa

Sales

- **Andreas Strzelczyk**
 - Sales Manager
 - Central and Simulation
- **Claudia Giannino**
 - Senior Sales Representative
 - D/A/CH / Simulation PLM

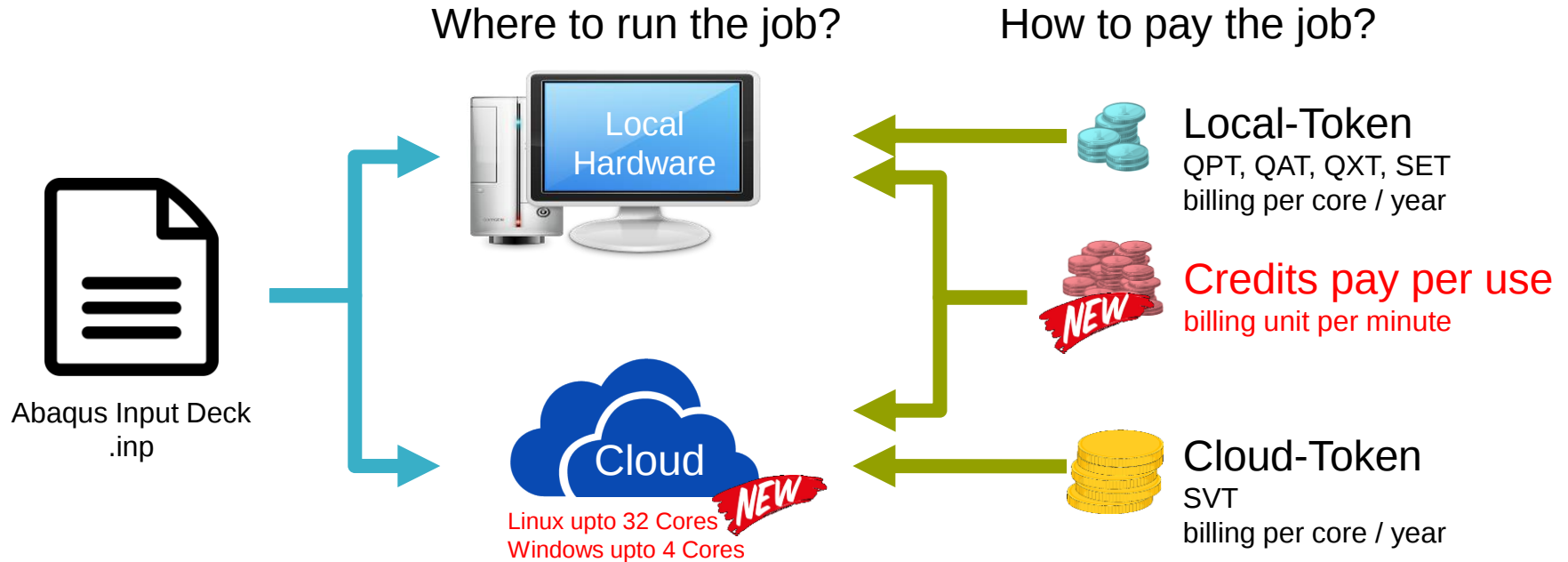


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SIMULIA Cloud Computing

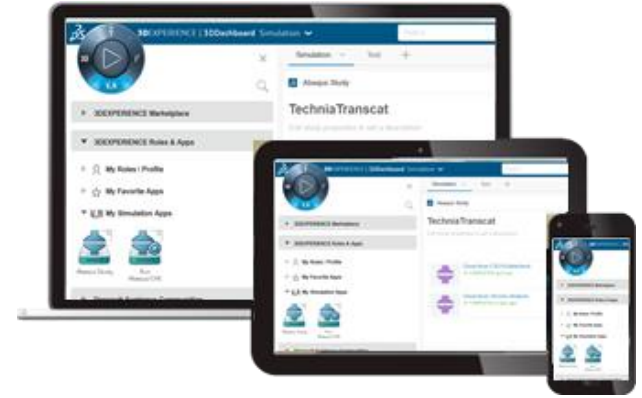
What is Cloud Computing?



SIMULIA Cloud Computing

Process

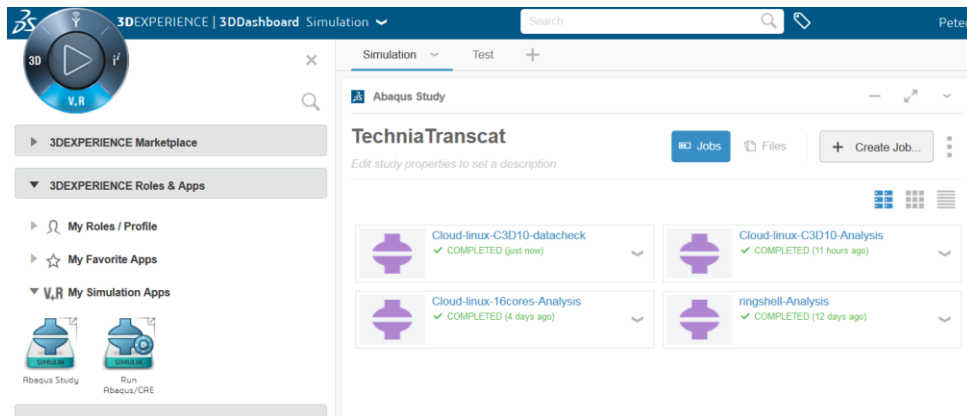
- **Manage Jobs with 3DExperience Platform**
 - Webbased – Usable on PC, Smartphone, Tablet,...
 - Import Input-file to the platform
- **Define Job with 3DExperience**
 - Analysis, datacheck, parametercheck, ...
 - With options z.B. double precision,...
- **Start Jobs with 3DExperience**
 - Run on Cloud or on local hardware
 - On Cloud Linux (upto 32 Cores) or Windows (upto 4 Cores); Upto 144 GB Ram
 - Preview estimated simulation costs per hour
- **Result visualisation**
 - Preview results on 3DExperience viewer or post processing with 3DExperience
 - or download result files



SIMULIA Cloud Computing

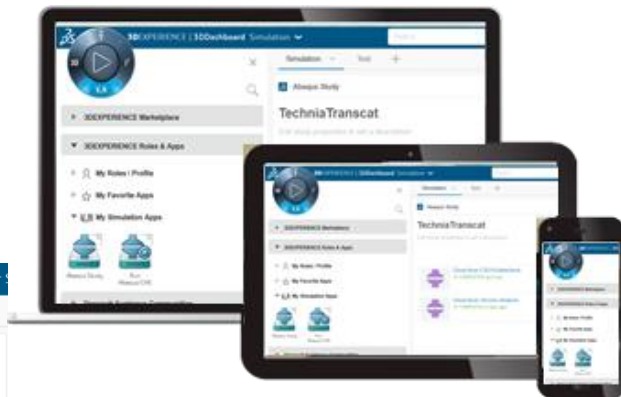
Dashboard

- Web based
- Accessible on PC, Smartphone, Tablet,...



Rolls and Apps

Abaqus Study



Abaqus Study

New Job - Abaqus

1 Eingabedateien zur Erfassung auswählen

2

3

4

Keine Eingabedateien in dieser Studie gefunden

📁

Datei(en) hochladen...

🔍

Suchen und hinzufügen...

oder hierher ziehen und ablegen

Abaqus Study

TechniaTranscat

Jobs Dateien + Job erst...

Studieneigenschaften bearbeiten, ...

Cloud-linux-C3D10-D...
✓ ABGESCHLOSSEN (3 da...)

Test-GPU-cloud-win
✓ ABGESCHLOSSEN (6 da...)

Test-GPU-Cloud
✓ ABGESCHLOSSEN (7 da...)

ZSB_Standardclip_G...
✓ ABGESCHLOSSEN (16 d...)

P18-05029-Halter-C...
...

P18-05029-Halter-C...
...

Credits and Tokens

License Usage

License Consumption.

Type	Available	In Use	Expiration	License Pool
Simulation Credits (ECR)	143957	0	Sat Apr 13 2019 23:59:00 GMT	R1132100118808
Simulation Credits (ECR)	122500	0	Sat Apr 13 2019 23:59:00 GMT	R1132100118808
Simulation Tokens (SCT)	250	0	Sat Apr 13 2019 23:59:00 GMT	R1132100118808

Job Monitor - Meine Aufgaben

Meine Aufgaben | 25

🕒

P18-05029-Halter-C...
✓ 3 days ago

🕒

Cloud-linux-C3D4-8C...
✓ 3 days ago

🕒

Cloud-linux-C3D10-D...
✓ 3 days ago

🕒

Test-GPU-cloud-win
✓ 6 days ago

🕒

Test-GPU-Cloud
✓ 7 days ago

🕒

ZSB_Standardclip_G...
✓ 16 days ago

SIMULIA - Simulation Review - Physiksimulation00001983

z

x y

1

ENOVIA - Collaborative Lifecycle - R1132100118807 - TechniaTranscat

Privat

In

Abgeschlosse...

Dokument

Veraltet

↺ ↻ ↺

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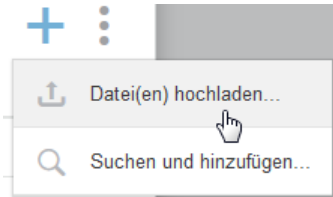
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⚙️

SIMULIA Cloud Computing

Define a new job

1. Select Input Files to Include



Inputdeck

- Assembly
- Flat
- Includes

2. Set Solver Arguments

Command Preview

```
job=Cloud-linux-C3D10 analysis input=Cloud-linux-C3D10.inp r...
```

[Add/Remove options](#)

Analysis Type

- ☒ analysis
- ☐ datacheck
- ☐ parametercheck
- ☐ syntaxcheck
- ☐ continue
- ☐ recover

job *

input

resultsformat

3. Select Compute Environment

4. Select Files to Save

Add/Remove options

- | | |
|---|---|
| ☒ job * | ☐ after |
| ☐ convert | ☐ cpus |
| ☐ domains | ☐ double |
| ☐ dynamic_load_balancing | ☐ fil |
| ☐ globalmodel | ☐ gpu |
| ☐ information | ☒ input |
| ☐ memory | ☐ mp_host_split |
| ☐ mp_mode | ☐ oldjob |
| ☐ output_precision | ☐ parallel |

SIMULIA Cloud Computing

Defining a new job - Select cloud or local hardware

3. Select Compute Environment

4. Select Files to Save

Compute Location

- ☒ Compute on 3DEXPERIENCE Cloud
- ☐ Compute on Your Hardware

License Type

Credits (ECR)

Features ?

Linear static, Buckling

92 credits/hr

Model Size ?

0 - 125,000 nodes

5 credits/hr

Performance ?

Economical

Estimated Number of Cores

1

Operating System

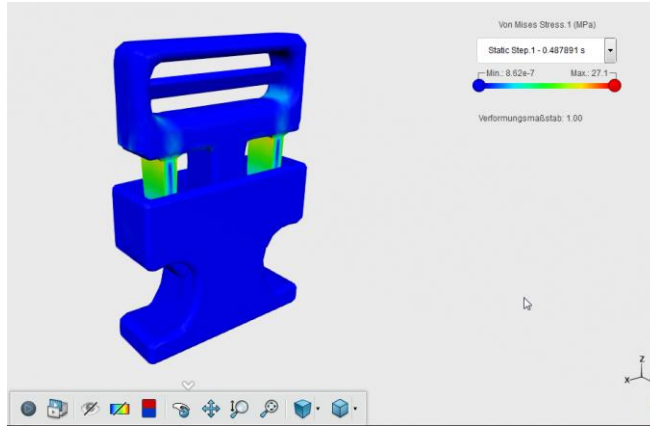
Windows

Estimated Software Cost

SIMULIA Cloud Computing

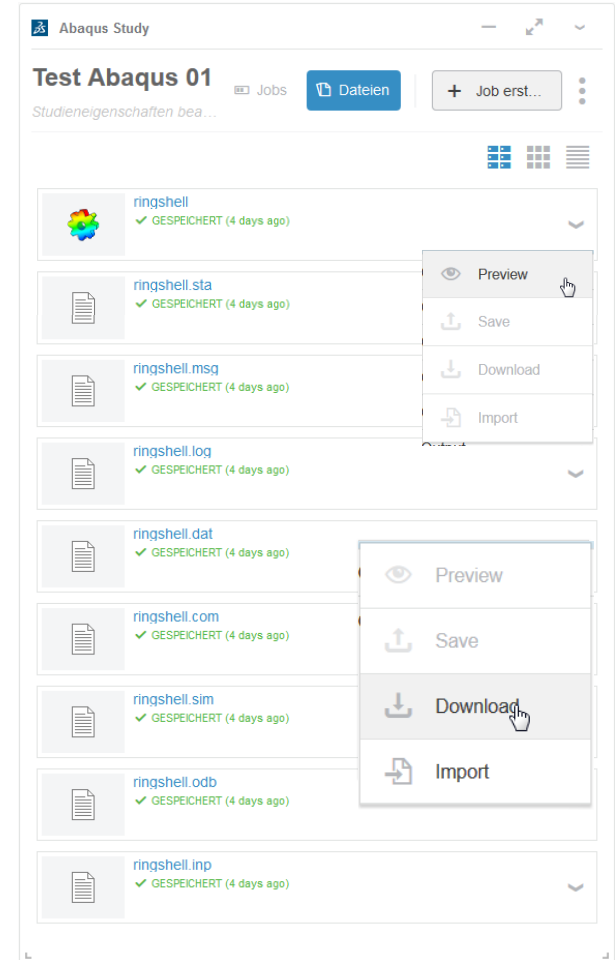
Result

- Preview Results



or

- Export Results to Abaqus/CAE



SIMULIA Cloud Computing

Credit Consumption

Content Monitor Warnings Log Properties

```
1 Cannot locate environment file: custom_v6.env
2 Analysis initiated from SIMULIA established products
3 Abaqus JOB cranehook_includes
4 Abaqus 3DEXPERIENCE R2018x HotFix 3
5 Begin Analysis Input File Processor
6 7/17/2018 9:42:00 PM
7 Run pre.exe
8 7/17/2018 9:42:03 PM
9 End Analysis Input File Processor
10 Begin Abaqus/Standard Analysis
11 7/17/2018 9:42:03 PM
12 Run standard.exe
13 7/17/2018 9:42:11 PM
14 End Abaqus/Standard Analysis
15 Starting credit consumption at 96.3 credits per hour
16 4.3 credits per hour for hardware
17 92.0 credits per hour for software
18 Job ran for 1 minutes, and consumed a total of 5 credits
19 4 credits for hardware
20 1 credits for software
21 Begin Convert MFS to SFS
22 7/17/2018 9:42:13 PM
23 Run SMASimulink
24 7/17/2018 9:42:13 PM
25 End Convert MFS to SFS
26 Abaqus JOB cranehook_includes COMPLETED
27
```

SIMULIA Cloud Computing

Cloud hardware

- Data server located at **3 OUTSCALE** in Paris
- Every simulation can run up to 32 physical cores
 - 3.0 GHz Intel Skylake processors
 - 72 vCPUs and 144 GB of memory
 - Up to 25 Gbps of network bandwidth using ENA (Elastic Network Adapter) – based enhanced networking

Benchmark hardware

- Intel(R) Xeon(R) W-2195 CPU @ 2.30GHz (Skylake-W)
- 18 CPUs and 256 GB of memory
- NVIDIA Quadro V100 (GV100GL-A)



SIMULIA Cloud Computing

Benchmark example datacheck

- **Model**

- datacheck
- *Static
- 2.942.046 Nodes
- 8.623.581 DOF
- C3D10
- *Contact
- 32 Cores (min. through system)
- Linux on Cloud

- **Result**

- Compute time: 5 min
- Consumption: 89 credits

PROBLEM SIZE	
NUMBER OF ELEMENTS IS	1713615
NUMBER OF ELEMENTS DEFINED BY THE USER AND *TIE	1639461
NUMBER OF INTERNAL ELEMENTS GENERATED FOR CONTACT	74154
NUMBER OF NODES IS	2942046
NUMBER OF NODES DEFINED BY THE USER	2793132
NUMBER OF INTERNAL NODES GENERATED BY THE PROGRAM	148914
TOTAL NUMBER OF VARIABLES IN THE MODEL (DEGREES OF FREEDOM PLUS MAX NO. OF ANY LAGRANGE MULTIPLIER VARIABLES. INCLUDE *PRINT,SOLVE=YES TO GET THE ACTUAL NUMBER.)	8623581

MEMORY ESTIMATE			
PROCESS	FLOATING PT OPERATIONS PER ITERATION	MINIMUM MEMORY REQUIRED (MB)	MEMORY TO MINIMIZE I/O (MB)
1	7.85E+13	8820	138295

Job ran for 5 minutes, and consumed a total of 89 credits
61 credits for hardware
28 credits for software

SIMULIA Cloud Computing

Benchmark example small

- **Model**

- *Static
- 521.000 Nodes
- C3D4
- *Contact
- 8 Cores
- Linux on Cloud

- **Result Cloud**

- Compute time: 28 minutes
- Consumption: 178 credits

```
Job ran for 28 minutes, and consumed a total of 178 credits
 15 credits for hardware
 163 credits for software
Begin Convert MFS to SFS
Mon 03 Dec 2018 10:54:50 AM UTC
Run SMASimUtility
Mon 03 Dec 2018 10:54:50 AM UTC
End Convert MFS to SFS
Abaqus JOB Cloud-linux-C3D4-8Cores COMPLETED
```

```
PROBLEM SIZE

NUMBER OF ELEMENTS IS                1681293
NUMBER OF ELEMENTS DEFINED BY THE USER AND *TIE 1639461
NUMBER OF INTERNAL ELEMENTS GENERATED FOR CONTACT 41832
NUMBER OF NODES IS                    521492
NUMBER OF NODES DEFINED BY THE USER  437222
NUMBER OF INTERNAL NODES GENERATED BY THE PROGRAM 84270
TOTAL NUMBER OF VARIABLES IN THE MODEL 1458885
(DEGREES OF FREEDOM PLUS MAX NO. OF ANY LAGRANGE MULTIPLIER
VARIABLES. INCLUDE *PRINT,SOLVE=YES TO GET THE ACTUAL NUMBER.)
```

- **Result TT Benchmark Hardware**

- 8 Cores
- Compute time: 23 minutes
-

SIMULIA Cloud Computing

Benchmark example large

- **Model**

- *Static; 2 Steps
- 2.942.046 Nodes
- 8.623.581 DOF
- C3D10
- *Contact
- 32 Cores
- Linux on Cloud

- **Result**

- Compute time: 10 hours
- Consumption: 3488 credits

```
End Abaqus/Standard Analysis
Job ran for 595 minutes, and consumed a total of 3488 credits
  610 credits for hardware
  2878 credits for software
```

P R O B L E M S I Z E	
NUMBER OF ELEMENTS IS	1713615
NUMBER OF ELEMENTS DEFINED BY THE USER AND *TIE	1639461
NUMBER OF INTERNAL ELEMENTS GENERATED FOR CONTACT	74154
NUMBER OF NODES IS	2942046
NUMBER OF NODES DEFINED BY THE USER	2793132
NUMBER OF INTERNAL NODES GENERATED BY THE PROGRAM	148914
TOTAL NUMBER OF VARIABLES IN THE MODEL (DEGREES OF FREEDOM PLUS MAX NO. OF ANY LAGRANGE MULTIPLIER VARIABLES. INCLUDE *PRINT,SOLVE=YES TO GET THE ACTUAL NUMBER.)	8623581

M E M O R Y E S T I M A T E			
PROCESS	FLOATING PT OPERATIONS PER ITERATION	MINIMUM MEMORY REQUIRED (MB)	MEMORY TO MINIMIZE I/O (MB)
1	7.85E+13	8820	138295

- **Result TT Benchmark Hardware**

- 8 Cores - Compute time: 6h 30min
- 16 Cores - Compute time: 5h 15min
-

SIMULIA Cloud Computing

Benchmark example Explicit

- **Model**

- *Dynamic, Explicit
- 306.866 Nodes
- 1.093.089 DOF
- S3
- *Contact

- **Result Cloud**

- 16 Cores, double precision
- Linux on Cloud
- Compute time: 5:15 hours
- Consumption: 3790 credits
- Cost: 380 € (with Simcloud Offering)

```

| | | | | P R O B L E M   S I Z E
| | | | |
NUMBER OF ELEMENTS IS                316699
NUMBER OF ELEMENTS DEFINED BY THE USER AND *TIE  316694
NUMBER OF NODES IS                    306866
NUMBER OF NODES DEFINED BY THE USER          306866
TOTAL NUMBER OF VARIABLES IN THE MODEL      1093089
(DEGREES OF FREEDOM PLUS MAX NO. OF ANY LAGRANGE MULTIPLIER
VARIABLES. INCLUDE *PRINT,SOLVE=YES TO GET THE ACTUAL NUMBER.)

```

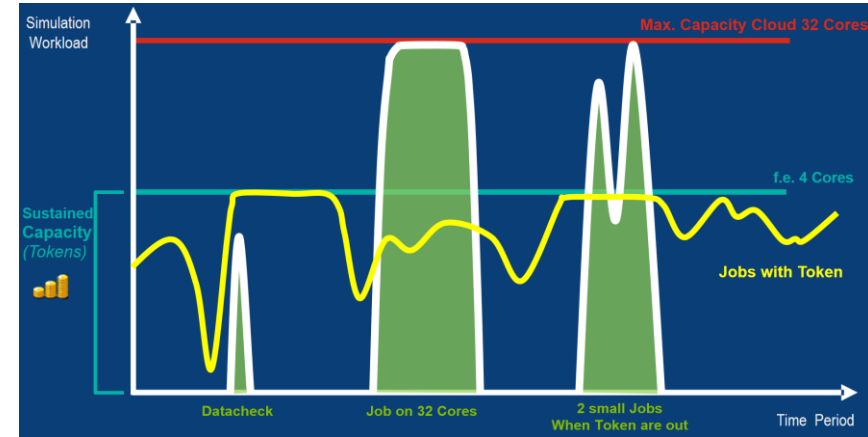
- **Result TT Benchmark Hardware**

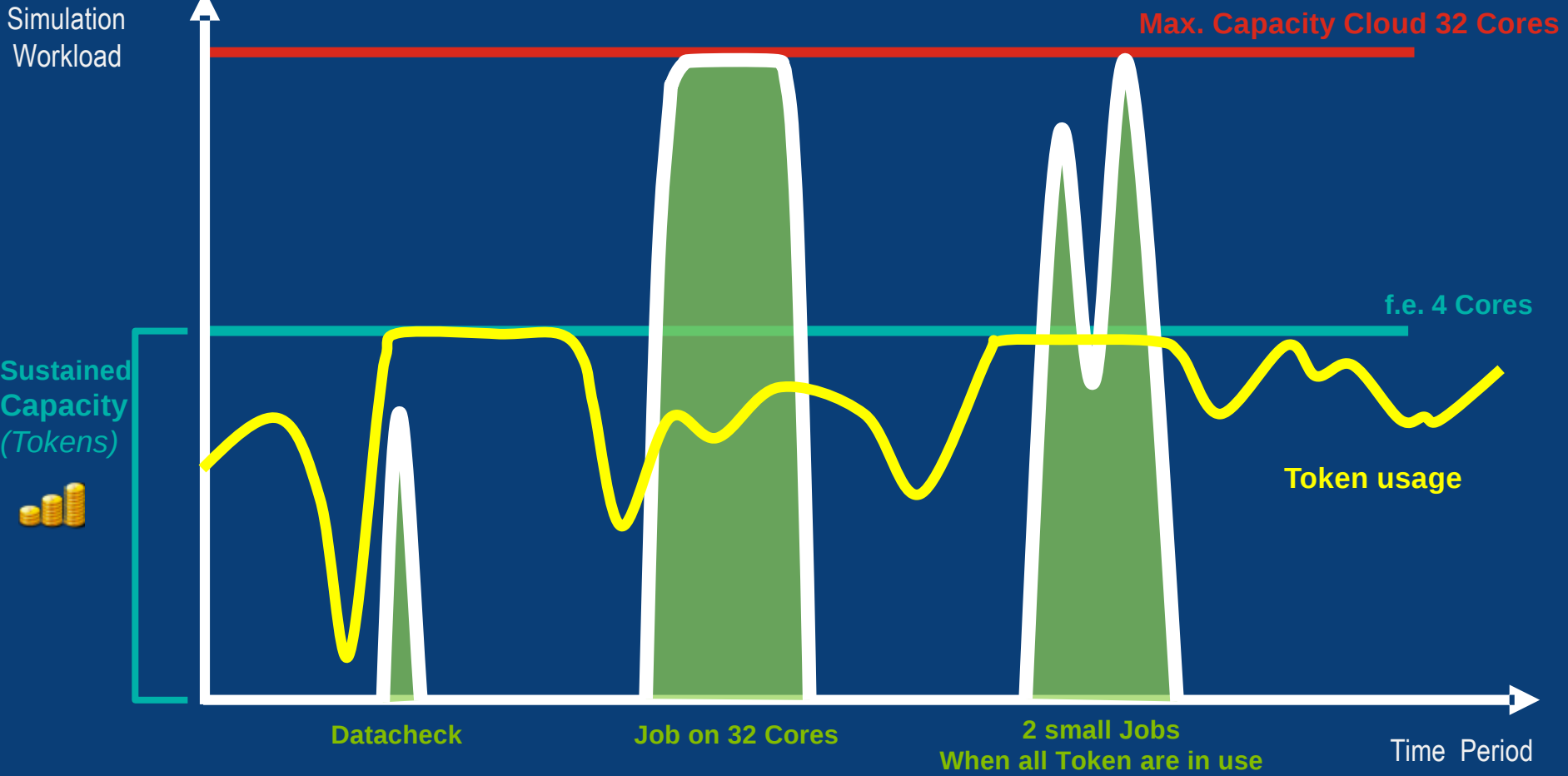
- 16 Cores, double precision
- Compute time: 4:45 hours
-

SIMULIA Cloud Computing

When using Cloud Computing?

- Run a datacheck at any time when all local token are in use
- Run a small job at any time when all local token are in use
- Run sometimes a large job on 32 cores without having the need of 21 local token or having the hardware





SIMULIA Cloud Computing

Limitations

- Virtual machine on Cloud limited to 32 cores
- Restart not yet possible
- Job suspend and resume not yet possible
- Use compiled UMAT possible starting with 2019x
- On Cloud only latest solver version yet possible
- Data lost after user terminate job

SIMULIA Cloud Computing

Advantages

- Run jobs with simulation credits on cloud or on local hardware
- Run a datacheck at any time when all local token are in use
- Run a small job at any time when all local token are in use
- Run sometimes a large job on 32 cores without having the need of 21 local token or having the hardware with 32 cores
- Download results for local
- Credits are usable also on cloud computing for
 - 3DExperience roles
 - Electromagnetic simulation with CST
 - CFD simulation with Xflow
 - Multi body simulation with Simpack

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SIMULIA Cloud Computing

Summary

- Abaqus/Standard jobs takes more time on cloud compared to an equivalent local hardware
- Abaqus/Explicit jobs takes only little more time on cloud compared to an equivalent local hardware
- Simulation credits is an extension to classic Token licensing
- Cloud computing and Simulation credits cover simulation load peaks
- Cloud computing to reduce simulation time with 32 cores on cloud

Vielen Dank für Ihre Aufmerksamkeit!



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ADDNODE GROUP