Faster, Secure PV Signoff using IC Validator In the Cloud

Avanish Singh, Sr Manager
Synopsys

Agenda

- Synopsys SaaS and ICV
- Customer use model example
- BYOC and ICV

SaaS: Software as a Service

All-in-one usage model

Engineer

CAD Engineer

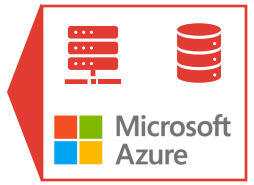
CAD Manager

BROWSER

Synopsys Cloud

Apps

Instances



Portal | Pay-Per-Use | Analytics | Security

Tools, Infrastructure & Flows – **All in One**

- Compute optimized for specific EDA workloads
- Flows set up and ready to use
- Fully controlled access – Project, User, Application, Data

… all delivered on Microsoft Azure

APPS (point tools)

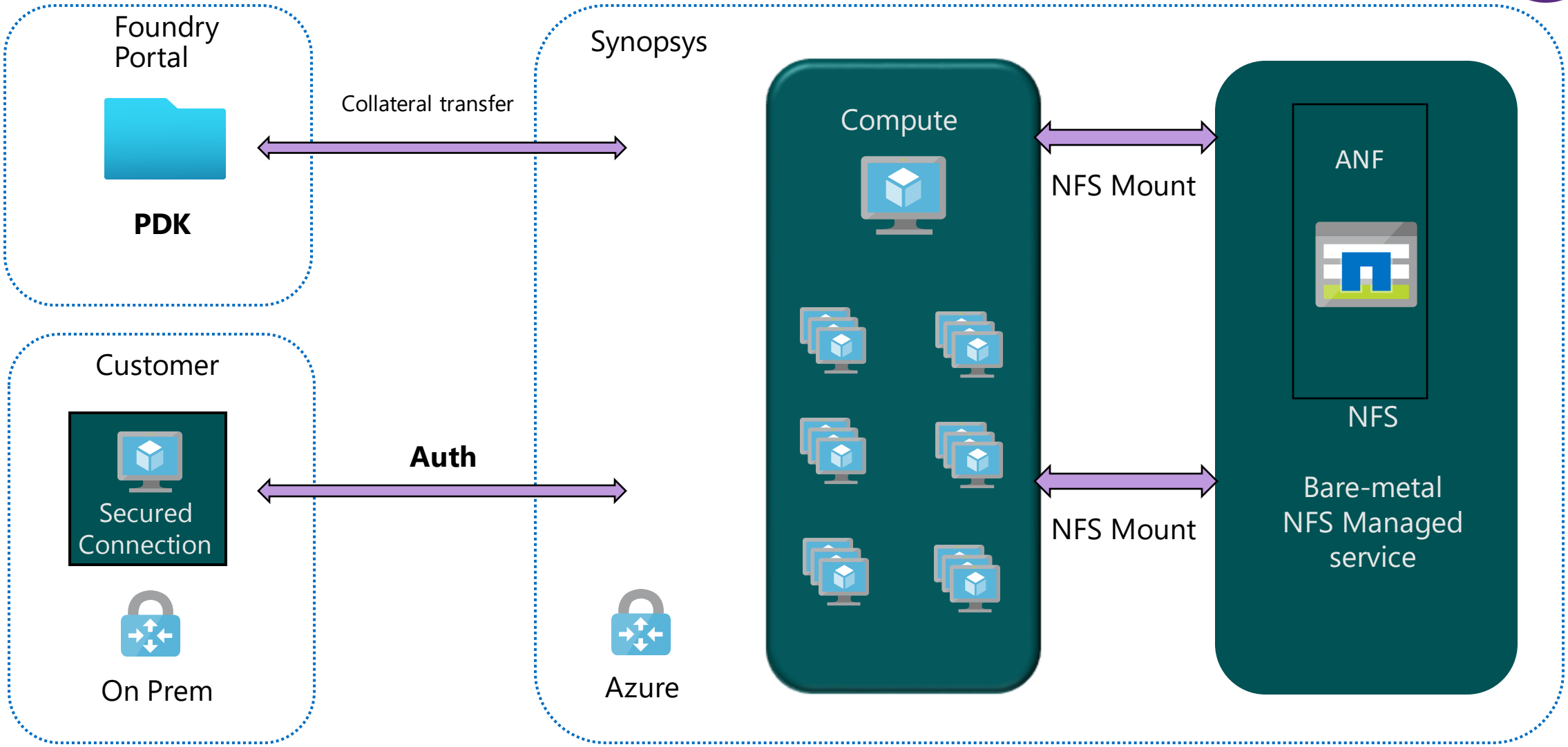
- Verification
- Timing Analysis
- Physical Verification
- Library Characterization
- Circuit Analysis
- Simulation

… and more!

INSTANCES (end-to-end flows)

- Digital Instance
- Analog Instance
- Verification Instance
- Silicon Photonic Instance

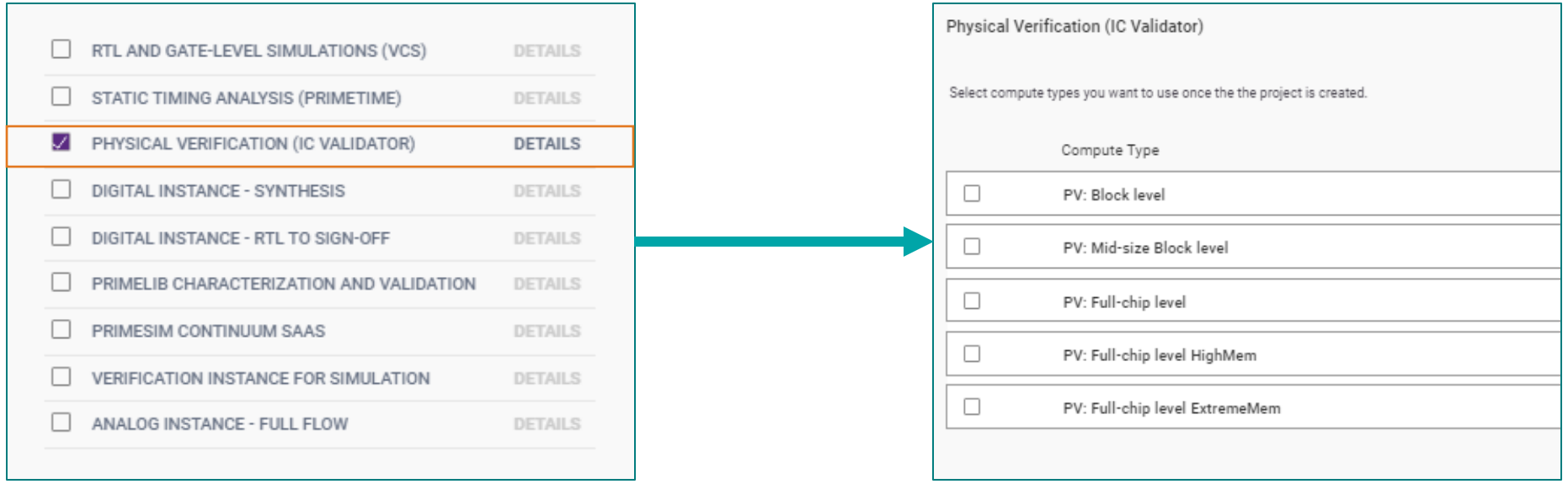
PV Infrastructure setup on Synopsys Cloud



SaaS Compute option for Physical Verification

	FXv1	M	E-Series
CPU	Intel Xeon Gold "Cascade Lake"	Intel Xeon Platinum "Skylake"	AMD EPYC 7763v (Milan) processor
Cores/VM	48	4 – 208	32-96
CPU Frequency	3.4 GHz/4.1 GHz	2.5 GHz	3.5 GHz
Memory	21GB/core, 1008 GB	1 – 12 TB	672 GB of RAM
Local Disk	~2 TB NVMe	2 TB SATA	2.4TB
Network	32 GbE	16 GbE	32 GbE

IC Validator Applications on Synopsys SaaS

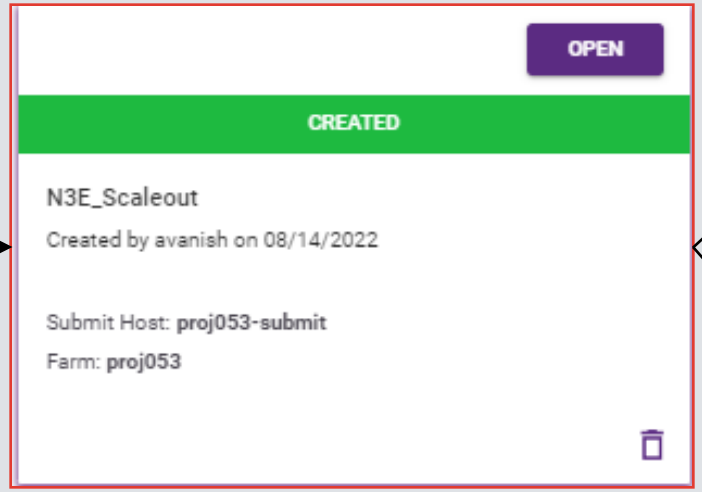


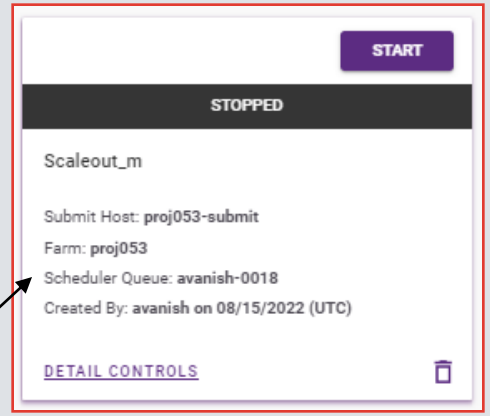
- 4 SaaS applications for Physical Verification
  - Stand-alone app for Physical Verification (IC Validator) Signoff
  - Full digital flow with “Digital Instance”
  - Full analog flow with “Analog Instance”
  - Full Silicon Photonic flow with “Photonic Instances”
- Customizable options to chose different kind of resources as per design type

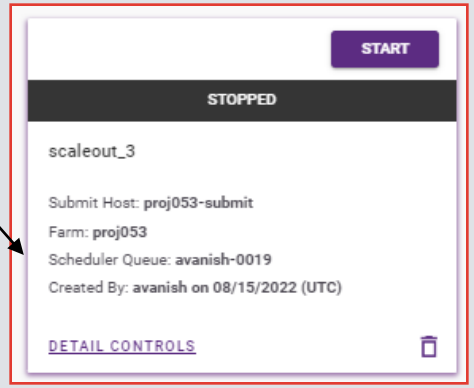
Setting Up Design on SaaS

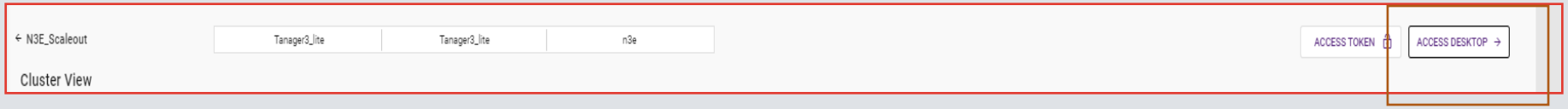
Create project and clusture

- VM selection and Project Creation
  - Select VM type and number of cores
  - Create a project
  - Cerate a cluster









- Once project is created then open “Access Desktop” for the Citrix session

Setting Up Design on SaaS

Create run script and launch job

- Cluster creations automatically sets up the tool path, tool licenses and network disk
- Next, create a run script and start the run. Example run script:

```
#!/bin/sh
#$ -P av
#$
#$
#$

icv -f oasis  -i  /proj053/project/data/Tan                              2.oas -c Tanag                -vue -host_init SGE /proj053/p
roject/data/ICVN                                                        _cloud.encrypt
```

- SaaS default usage LSF for job submission.

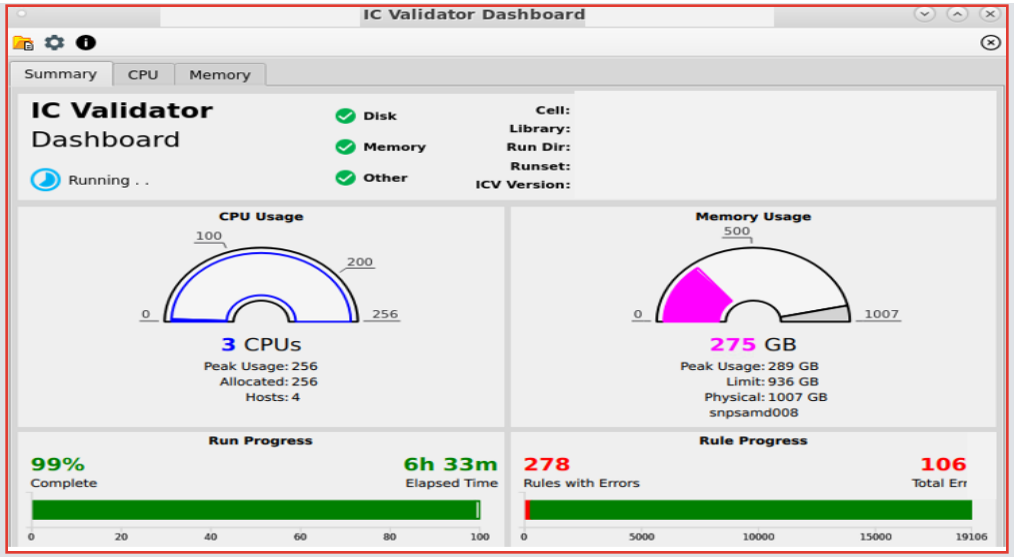
IC Validator™ on Synopsys Cloud Quick Start Guide

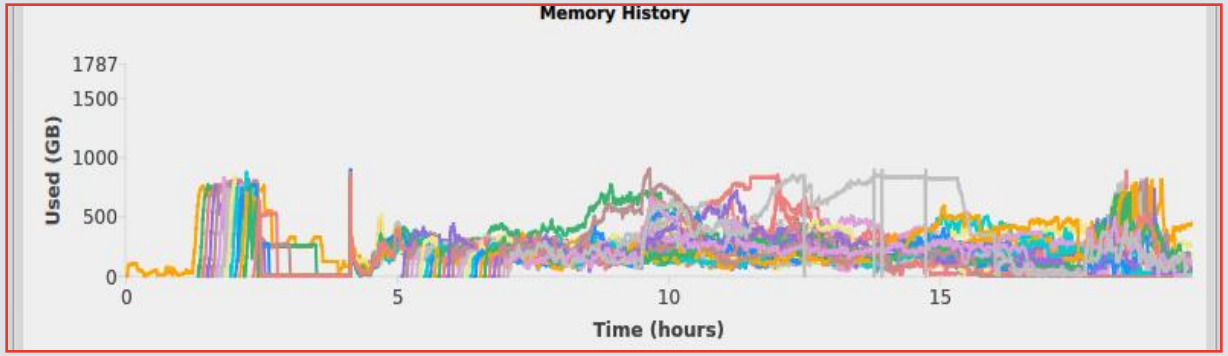
Version 1.0, March 2022

Monitoring IC Validator Run in SaaS

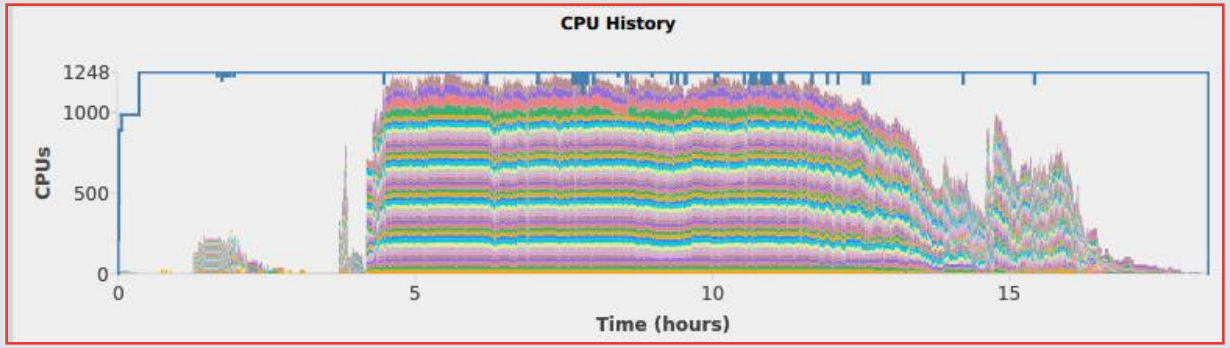
icv_dashboard

- Graphical viewer to monitor ICV runs
- Graph for memory and CPU utilization





Memory Graph



CPU Utilization Graph

Synopsys SaaS use Models and Customers

Cloud Migration Review

Foundry Certified

Node	Number of Checking items
N3	92k
N5	28k
N7	10k

Nodes	Categories	Number of cases
3nm / 5nm / 7nm	IP cases	400+
	Full cell-based cases	10+
	Bump Pad cases	7
	Antenna cases	~10
	SRAM cases	50+
	Real cases	20+
	Issue and Regression cases	20+
	Hierarchy related cases	<5
	RTO cases	<10

Resources:

x **912** cores

- 2 days for environment setup
- 5 days to finish ICV cloud runs on cell-based and LVL cases
- 5 days to finish cross check of on-perm vs cloud

Cloud Migration Review (Dummy Fill)

Cases:

Node	FEOL	BEOL
N3	70+	25+
N5	40	45+
N7	25+	30+
Total case	130+	100+

Resources:

x **480** cores

Total 240+ cases for ICV FILL N3/N5/N7 cloud migration. We complete the whole cloud migration flow within one week

- Data preparation (~1 day)
- Run job (~18h)
- QA review (~1 day)
- Report preparation (~1 day)

Customer Example

Achronix

Scalability Run Numbers

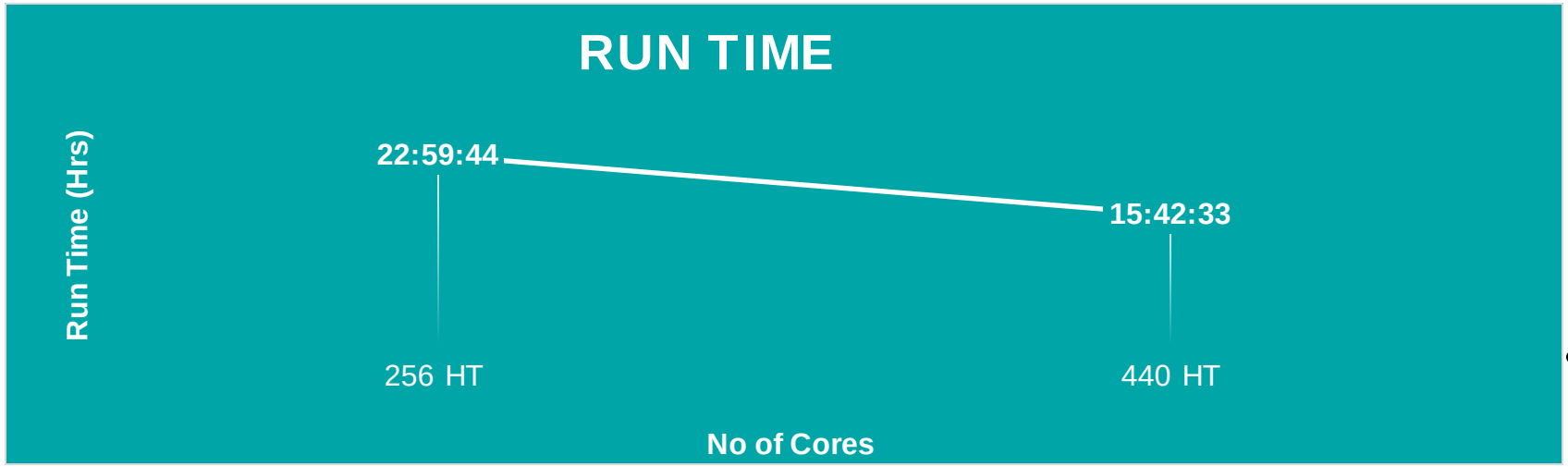
Design Size: **360mm2**

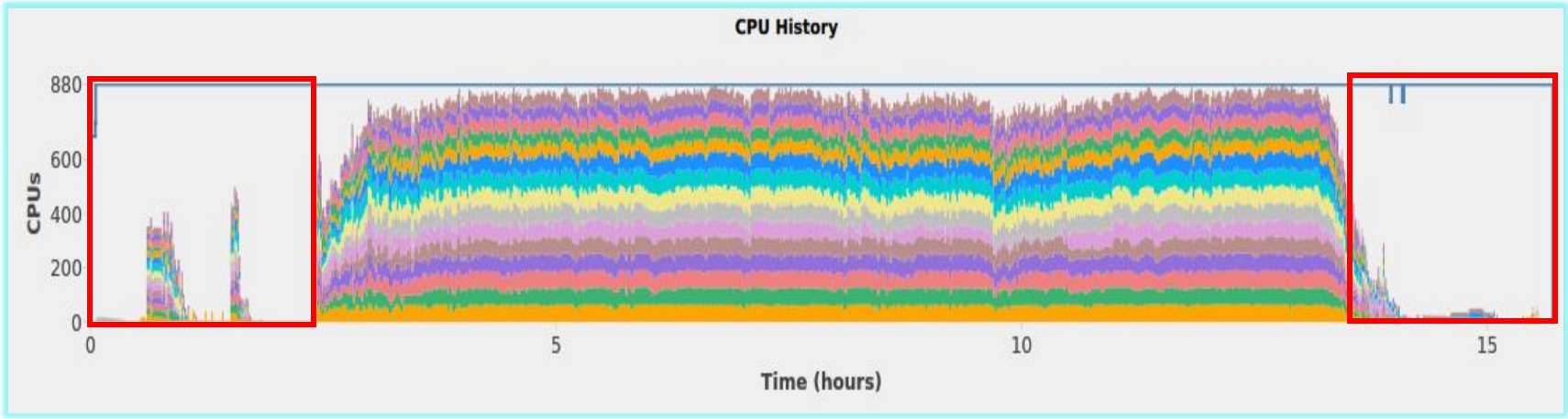
TSMC7nm Process

No of Cores	VM's	Run Time (Hrs.)	Peak Mem (GB)	Licenses used
256 HT	8*32HT (512GB RAM , Standard_E64ds_v5)	22:59:44	486.9	64
440 HT	10*32HT (512GB RAM, Standard_E64ds_v5) + 5*24HT (1TB RAM, 1X FX48md)	15:42:33	879.787	110

- Good scalability with more cores.
- Running all rules, including LUP, ESD, VDR, and G0.
- Different kinds of VMs can be used for the same run.

Scalability Run Numbers



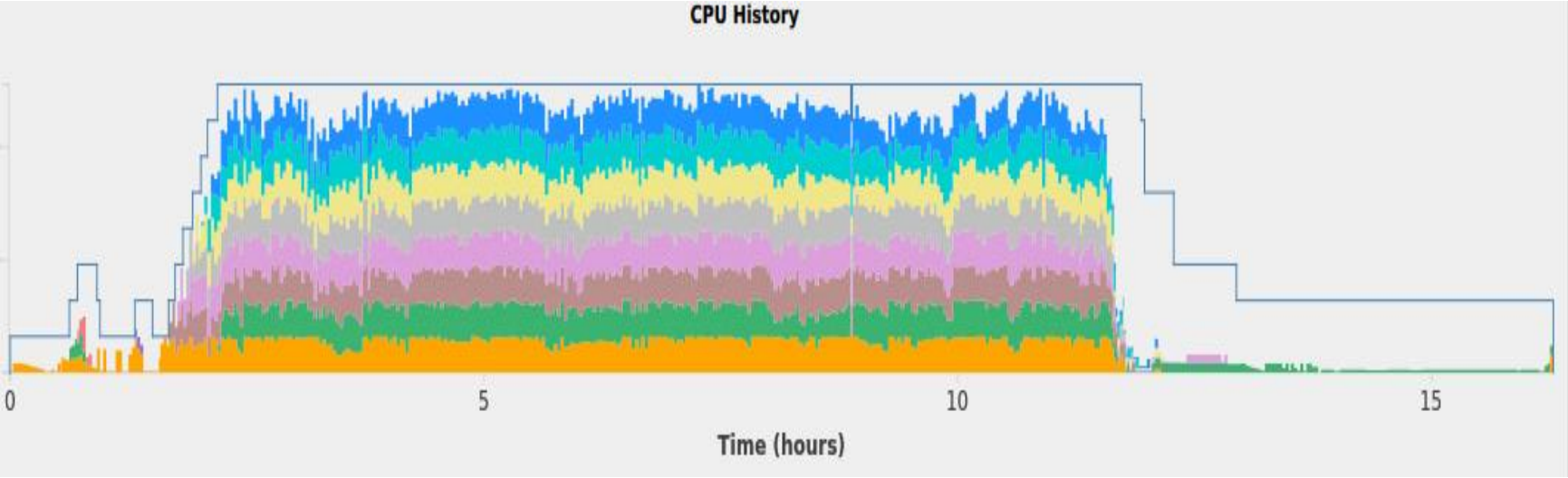


- All machine resources and licenses are locked during the run.
- Resources are not fully utilized.

Elastic Run

No of Cores	VM's	Run Time (Hrs.)	Peak Mem (GB)	Licenses used
Elastic Run, 320 HT	10*32HT (512GB RAM , Standard_E64ds_v5)	16:17:55	462.23	Min 8, Max 80

- Tool started the run with 1 VM.
- Added and released VMs automatically.



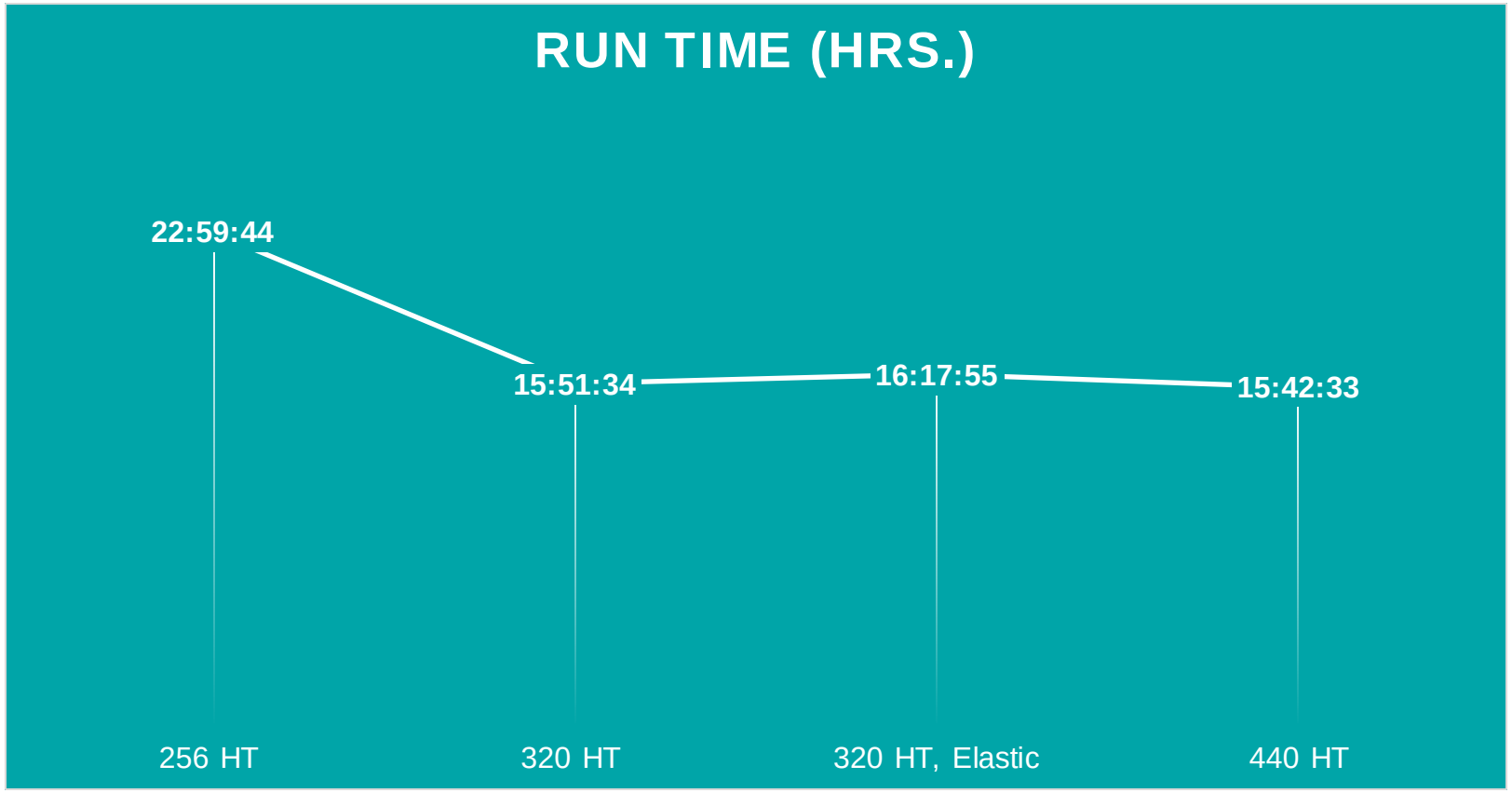
Elastic Run

No of Cores	VM's	Run Time (Hrs.)	Peak Mem (GB)	Licenses used
Elastic Run, 320 HT	10*32HT (512GB RAM , Standard_E64ds_v5)	16:17:55	462.23	Min 8, Max 80
320 HT	10*32HT (512GB RAM , Standard_E64ds_v5)	15:51:34	460.73	80

33% Resource saving with less than 5% run time penalty

Run Time Details

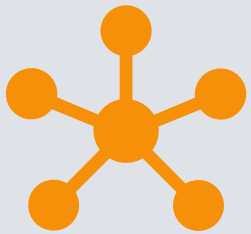
Running all rules, including LUP, ESD, VDR and G0.



TSMC N3E design run Numbers

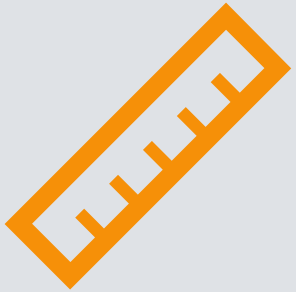
Run in SaaS Env

Design & Flow Details



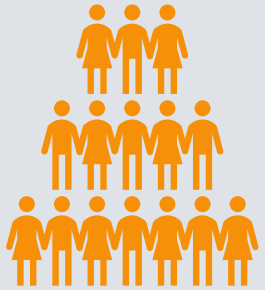
Technology

TSMC N3E



Design Size

304mm2



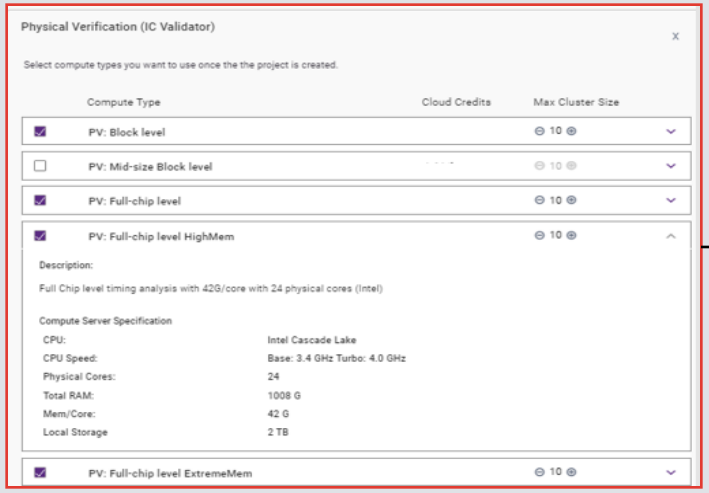
Rules

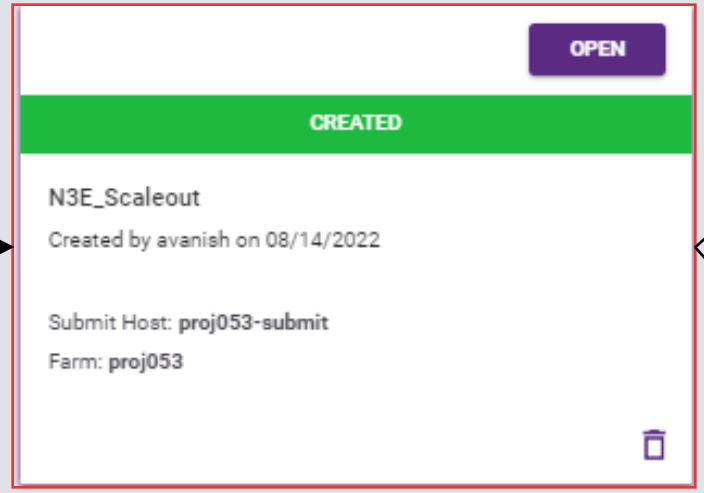
All DRC rules incusing ESD, LUP, VDR

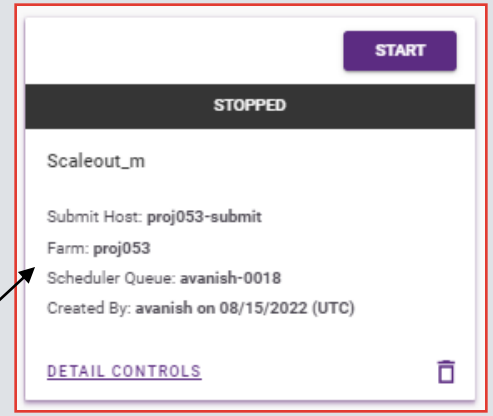
Setting Up Design on SaaS

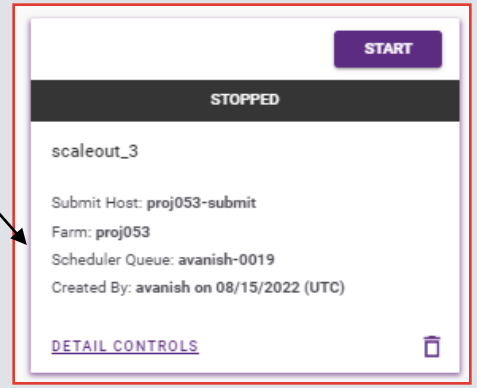
Create project and clusture

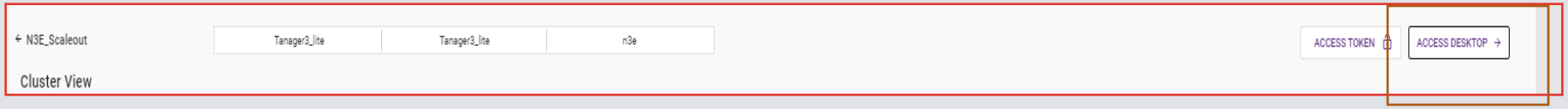
- VM selection and Project Creation
  - Select VM type and number of cores
  - Create a project
  - Cerate a cluster





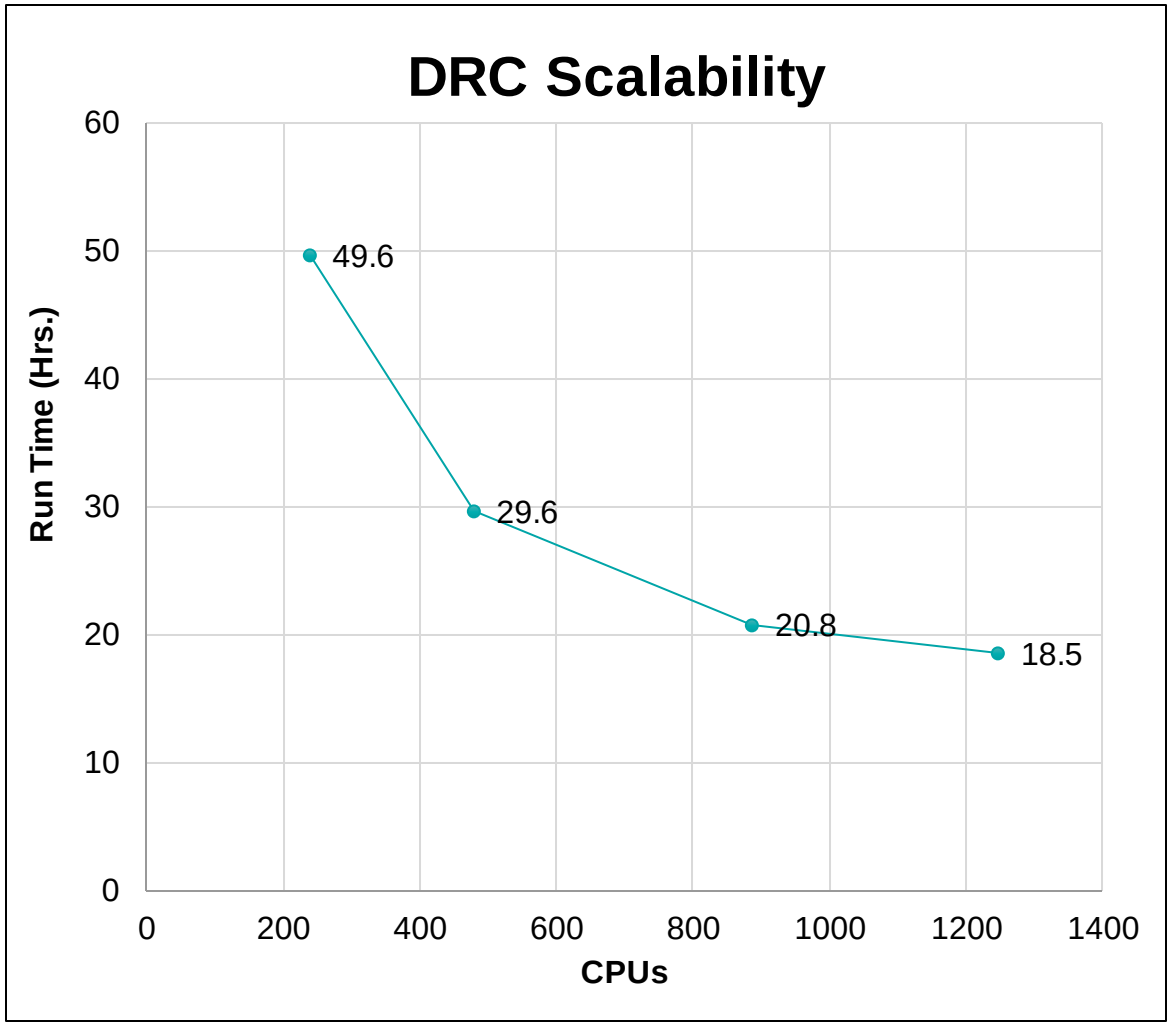






- Once project is created then open “Access Desktop” for the Citrix session

Results: DRC Scalability to 1200 CPU Cores

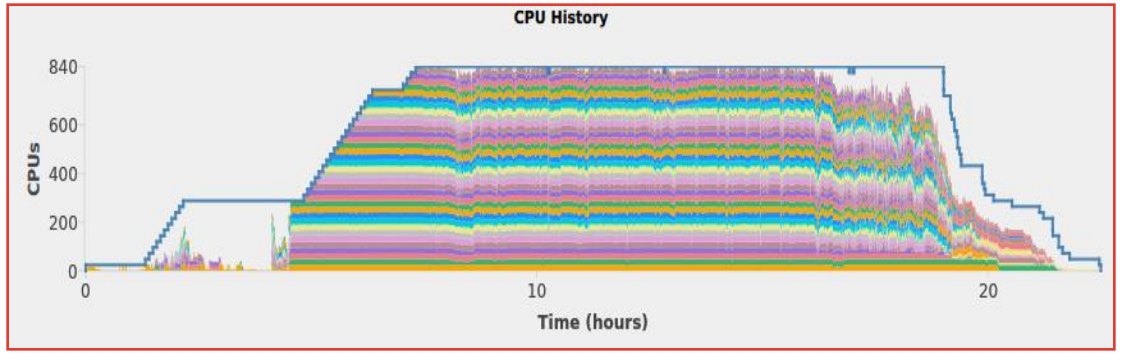


- Design: Large TSMC N3E case
- IC Validator scales to 1200+ cores on Synopsys SaaS
- Full-chip DRC runtime: ~18 hrs.
  - Includes all rules LUP/ESD, VDR
  - Excellent scalability

Results: Elastic CPU Saves 25% Resources

- Elastic CPU automatically optimizes CPU resources based on job requirements
- Flexibility on cloud to dynamically provision resources and optimize computes costs
- Easy to use, fully automated, no user intervention

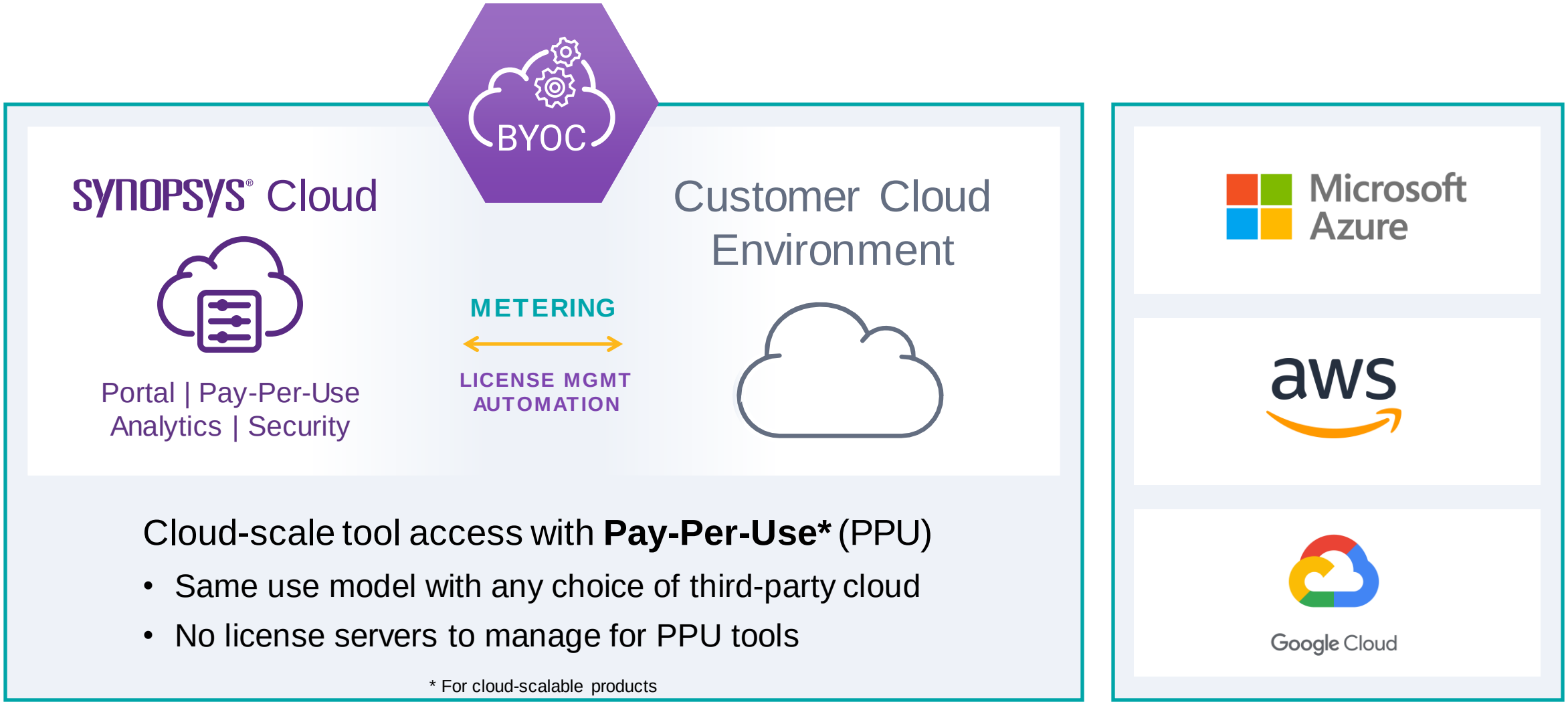
	VMs	CPUs	Runtime (hours)	Allocated CPU hours
Non-Elastic	37	888	20:41	18,367
Elastic	37 (Peak)	888 (Peak)	22:47	13,716



25% Cost Savings on Cloud with Elastic CPU Technology

BYOC: Bring Your Own Cloud

Simplified use model



Cloud-scale tool access with **Pay-Per-Use*** (PPU)

- Same use model with any choice of third-party cloud
- No license servers to manage for PPU tools

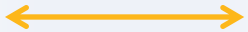
* For cloud-scalable products

BYOC: Bring Your Own Cloud

Simplified use model

IC Validator

Customer Managed



Customer Cloud Environment

License and infrastructure managed by customers

* For cloud-scalable products

Microsoft Azure

aws

Google Cloud

AMD Case Study: Scales to 4000+ Cores

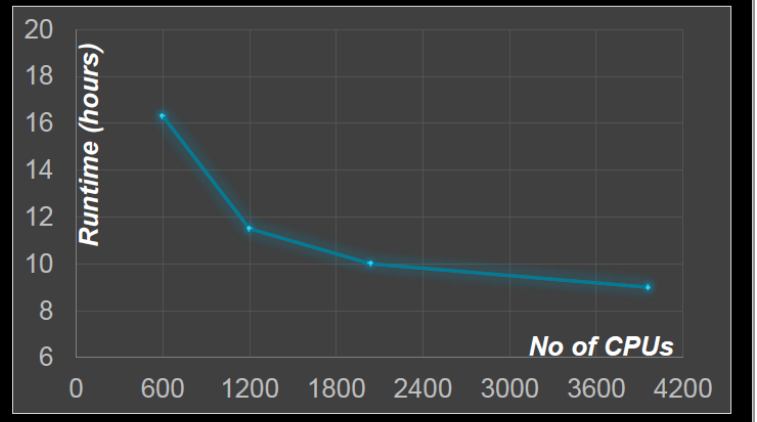
400 sq-mm, TSMC N7 design

[AMD Public Use]

IC Validator Scaling Results to 4000 CPUs

- Scale with multiple HBv2 instances
  - From 5 VMs (600 CPUs) to 33 VMs (3960 CPUs)
  - Deployed using Azure VM Scale Set
- Excellent IC Validator DRC scalability
  - Scales to ~4000 CPUs
  - Achieved overnight runtimes

# VMs	5	10	17	33
# CPUs	600	1200	2040	3960
Runtime (hours)	16.2	11.5	10.2	9



27 | TSMC OIP 2

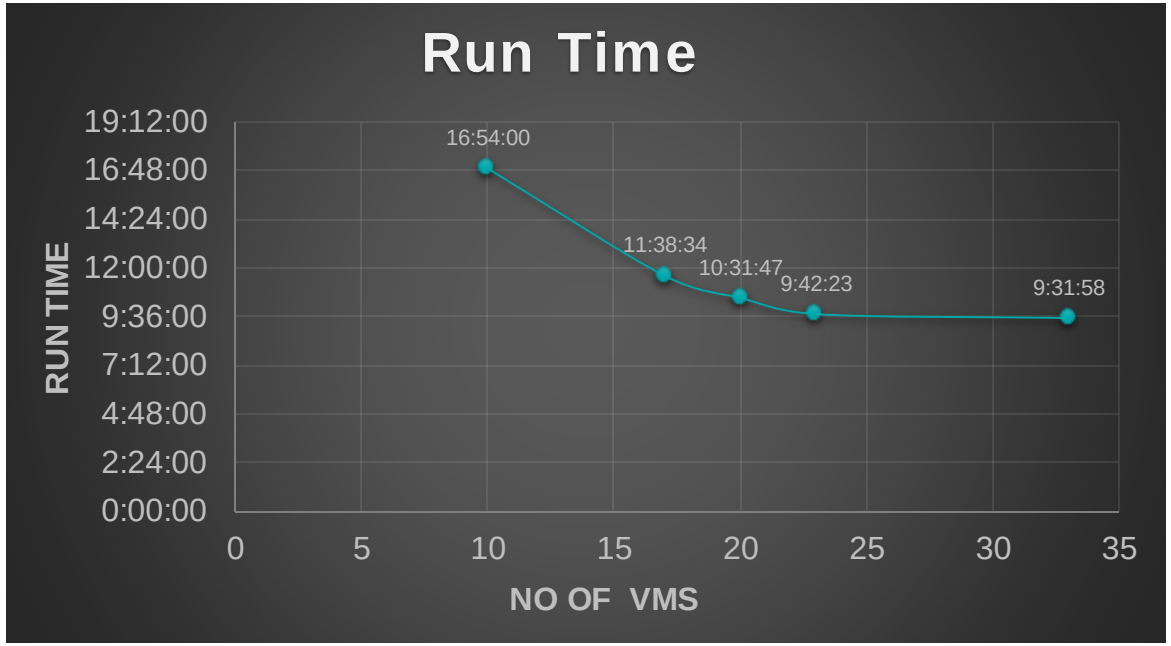
AMD

Webinar: TSMC collaboration; IC Validator Scaling on Azure Cloud

- Deployed on Azure cloud
- Scales to 4000+ cores
- Overnight full chip DRC runtime

AWS- ICV Run Times

x2ezn



- Design size – 320mm2
- Scalability runs up to 1056 cpus.
- Less than 500 GB of machine memory used.

No of Cores	No of Hosts	Run time (Hrs)	Peak Memory (GB)	Peak Disk (GB)	Comments
320 (160 HT)	10	16:54:00	463.322	1107.4	x2ezn
544 (272 HT)	17	11:38:34	446.028	1222.191	x2ezn
640 (320 HT)	20	10:31:47	417.59	1197.251	x2ezn
736 (368HT)	23	9:42:23	372.159	1026.83	x2ezn
1056 (528 HT)	33	9:31:58	368.8	1086.2	x2ezn

Summary

- SNPS SaaS, fully tested and ready for all kinds of PV needs
- ICV fully enabled with all cloud providers.


THANK YOU
YOUR
INNOVATION
YOUR
COMMUNITY