XDF XILINX DEVELOPER FORUM

FPGA Design in the cloud – Basics to Optimization

Presented By

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Title: Founder, COO
Date: 2nd October 2018

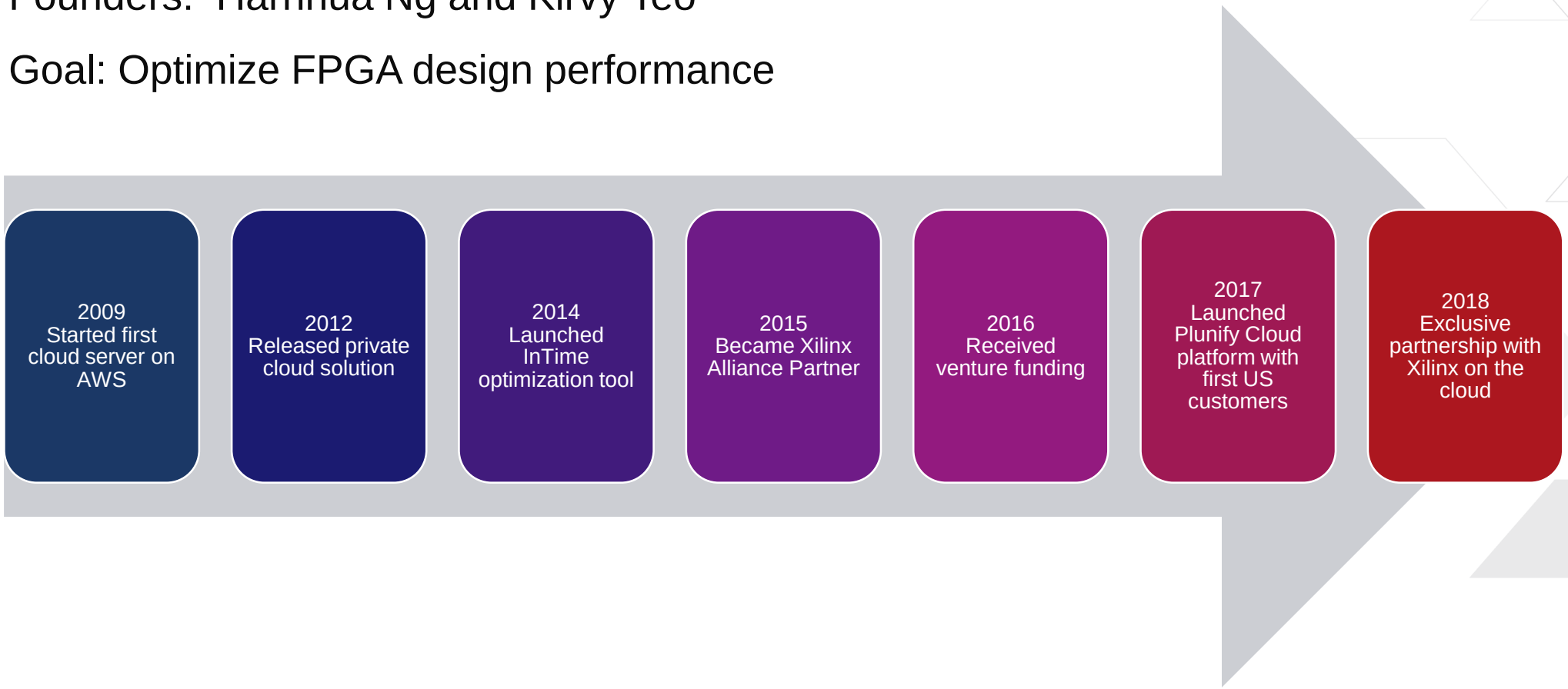
XILINX

Agenda

- **About Plunify**
  - Xilinx and Plunify Partners in the Cloud
- **First-time Cloud Users**
- **Tools for FPGA Design in the Cloud**
  - AI Lab
  - FPGA Expansion Pack
- **Optimization in the Cloud**
  - What is InTime
  - Methodology
  - Results / Case Study
- **Q&A**

About Plunify

- Started in 2009
- Founders: Harnhua Ng and Kirvy Teo
- Goal: Optimize FPGA design performance



Xilinx & Plunify Cloud Partnership

- Drive effective use of the cloud for FPGA design and performance optimization
- Link Xilinx and Plunify tools and flows
  - Fully-featured licenses. This includes Vivado, SDAccel and SDSoC.
  - On-demand
  - Unlimited quantities

100 hours x 1 copy of Vivado == 1 hour x 100 copies of Vivado

http://globenewswire.com/news-release/2018/07/25/1542033/0/en/Plunify-Enables-InTime-FPGA-Development-in-the-Cloud.html

Considerations for first-time cloud users

1. **What types of workloads are best?**
   - >> Supermarket (on-demand) versus Fridge (on-premise)
   - >> Interactive or batch mode
   - >> **Suggestion:** Use only for on-demand

2. **Understand costs involved**
   - >> Servers (CPU / RAM capacity, Spot/On-demand)
   - >> Storage (IO speed / Capacity)
   - >> Network Bandwidth (**Hidden!** – 30% of your costs. Netlists can be huge)
   - >> People (You will need experts, DevOps for maintenance)

Considerations for first-time cloud users

3. Do-it-all-yourself or use a managed service?

- Burden of managing the cloud falls on you
- Or use a 3rd-party solution like Plunify Cloud

4. What may cause unnecessary grief or easily get overlooked

- User Experience
  - Required operations: Users authentication, start servers, mount tool volumes, transfer project files, run builds, retrieve results etc. involve many steps
- Automation
  - Convert build scripts, backup, testing
- Policies & license management
  - Where to host your licenses, how to secure data transfers, data retention

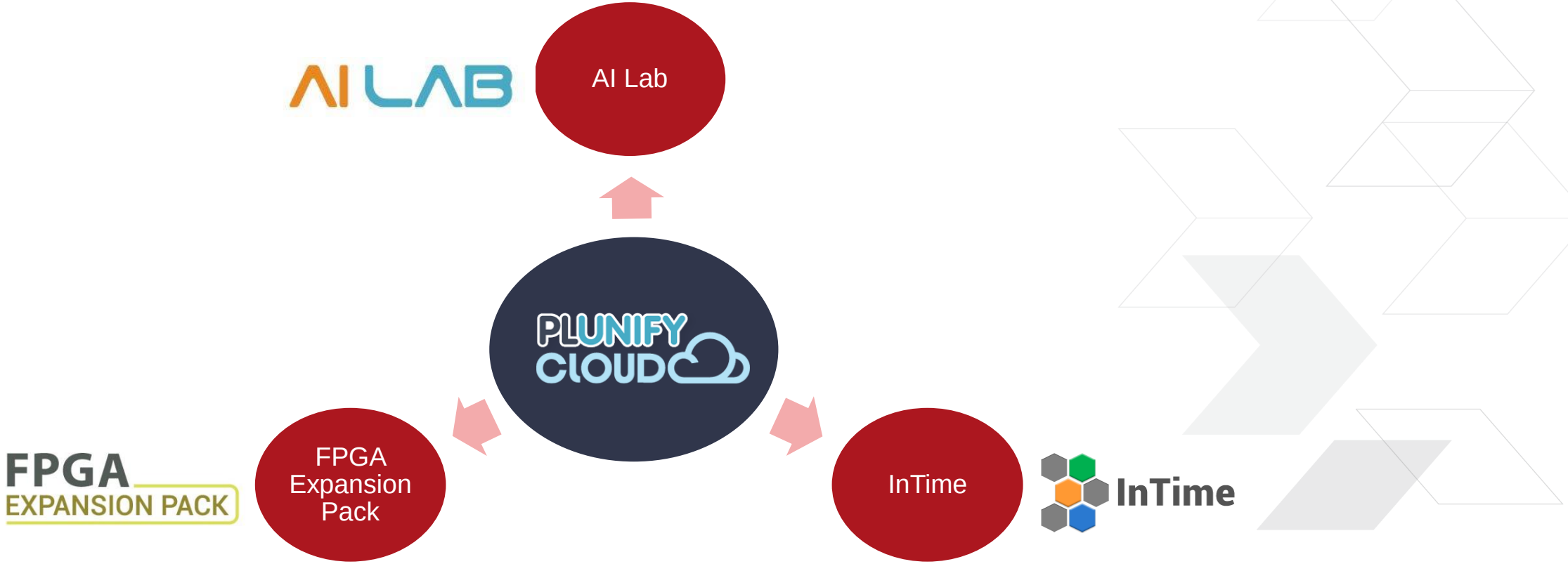
Cloud Basics:
How to build your design (easily)

PLUNIFY CLOUD

Plunify Cloud Platform & Tools

> **Seamless and fuss-free FPGA design experience with the cloud**

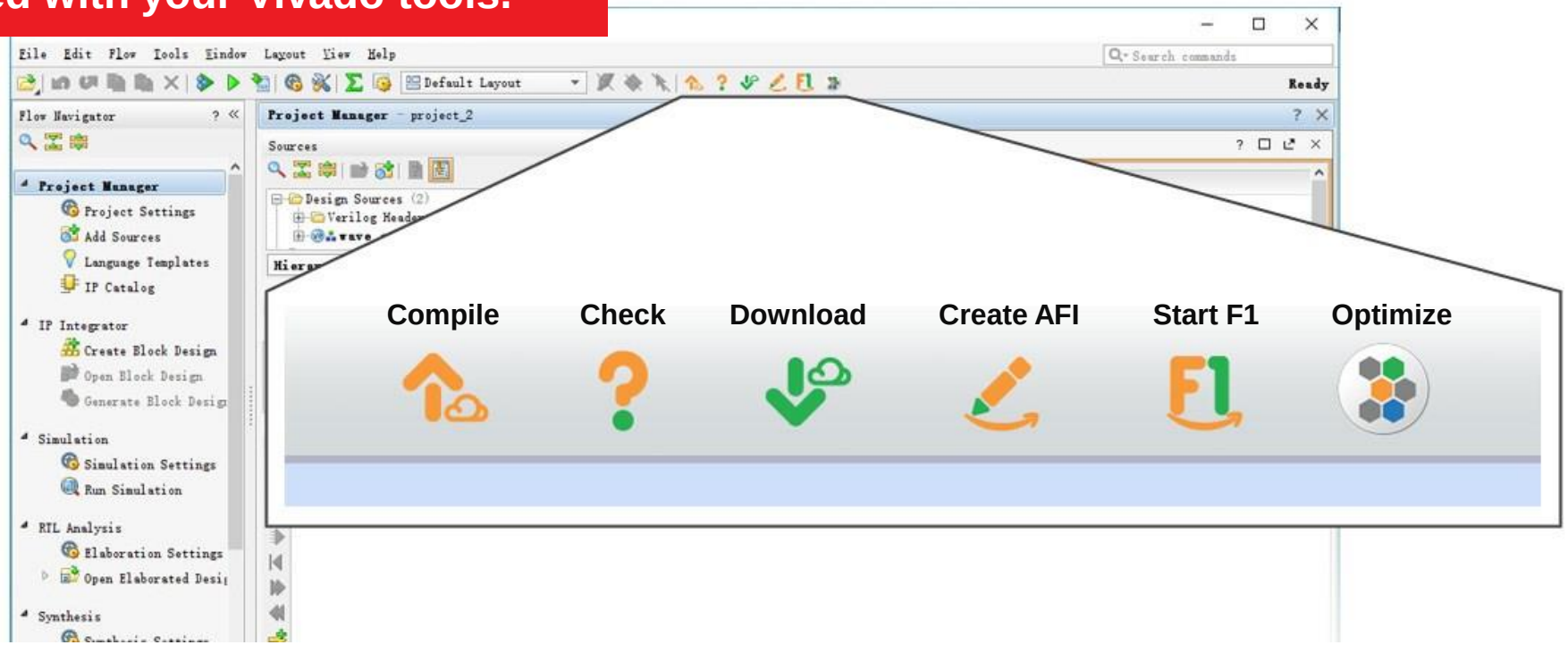
> **Provides automation, ease-of-use and cloud maintenance**



FPGA Expansion Pack

FPGA EXPANSION PACK

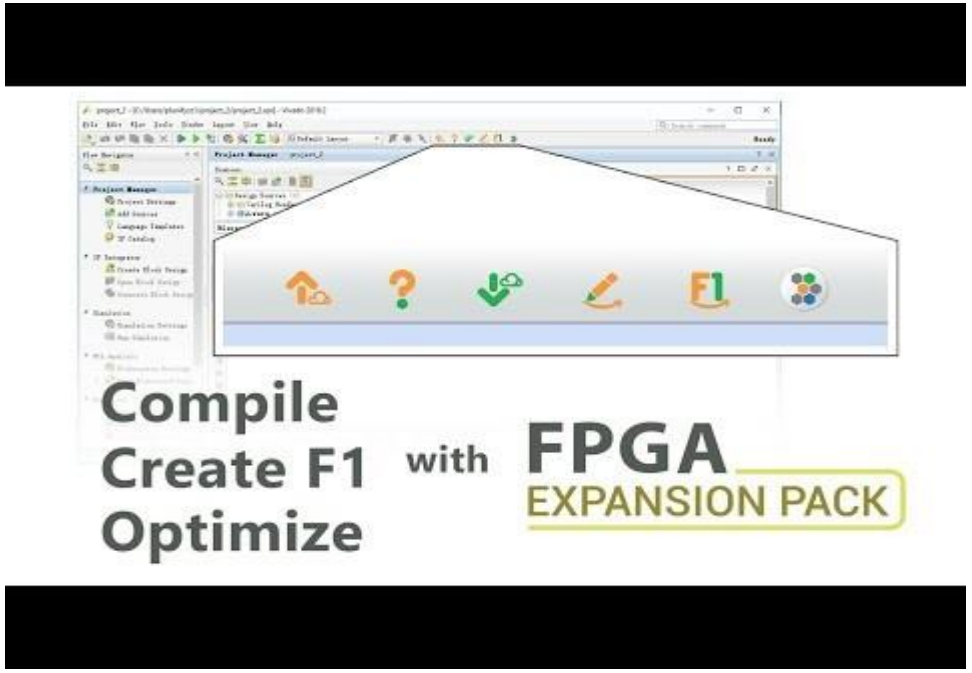
Fully integrated with your Vivado tools.



https://www.plunify.com/en/fpga-expansion-pack/

FPGA Expansion Pack

GUI Mode



https://www.youtube.com/watch?time_continue=31&v=7dN9iRozzT8

Tcl Mode (Project Mode)

```
set design_list [list "A/A.xpr" "B/B.xpr" "C/C.xpr" "D/D.xpr" "E/E.xpr"]
foreach each_design $design_list {
    open_project "$each_design"
    reset_run synth_1
    launch_runs synth_1 impl_1
    wait_on_run impl_1
    close_project
}
```

```
foreach each_design $design_list {
    fep::runCloudCompile -project "$each_design" -serverclass 3
}
```

Why use FPGA Expansion Pack?

FPGA EXPANSION PACK

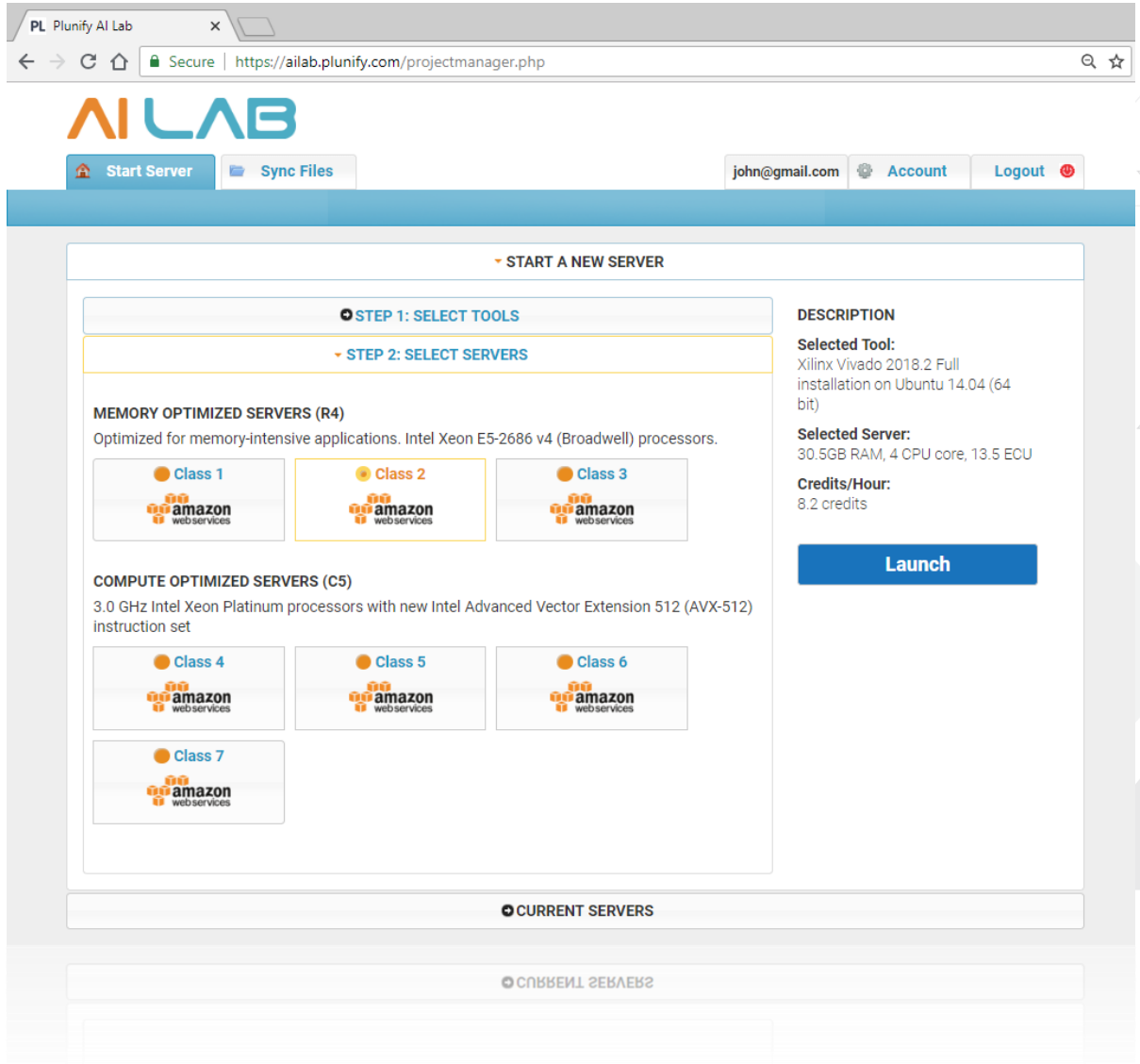
Features	Benefits
Launch builds directly into the cloud. Instant access to additional cloud resources Use F1 instances	Reduce compile time with higher performance servers. On-demand scalability.
Integrated with Vivado	No learning curve. Familiar and easy to use.
Data transmission and storage security. Cloud infrastructure for the tool version, licenses, billing and usage.	No cloud knowledge or management required
Optimization in the cloud (with InTime) Get results back in 1-7 days.*	Better Quality of Results Timing Optimization

Use cases: Run regressions, accessing F1 instances, resource crunch

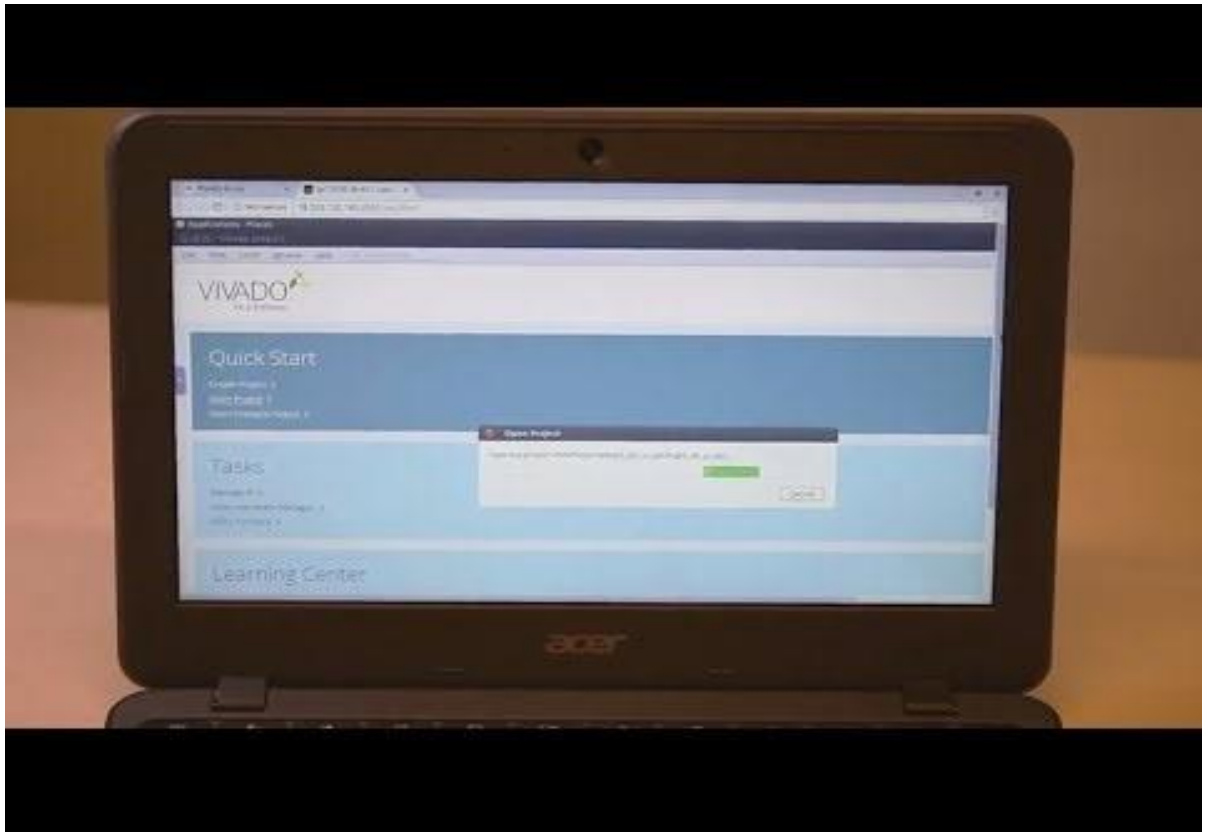
AI Lab

- **Web Browser Interface**
- **Launch a virtual desktop pre-loaded with FPGA tools on the cloud**
- **Access remote desktop with a browser and WiFi connection.**
- **No tool installation required. Instant setup.**

https://www.plunify.com/en/ailab/



AI Lab – Vivado on Chromebook (And Ultra96)



https://www.youtube.com/watch?v=xufZF--zzO0

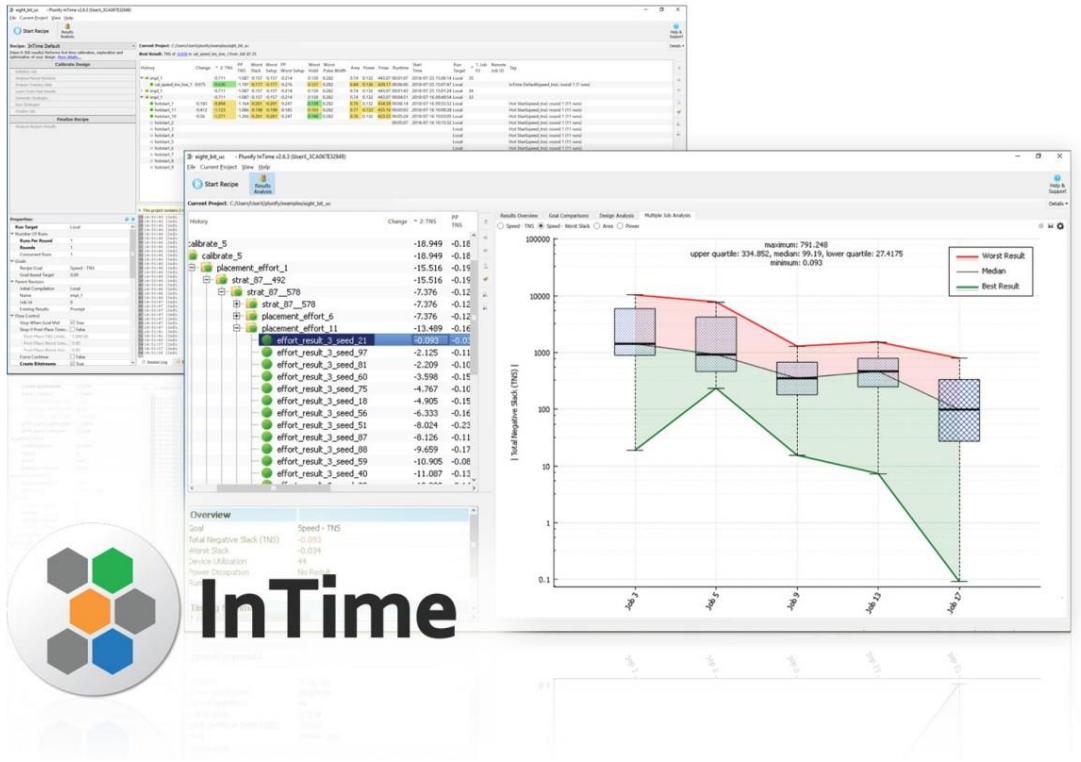
Why use AI Lab

Features	Benefits
No installation and setup.	Ease of Use. No downloads required.
Works on any computer with a browser	Greater access to Xilinx tools. No restrictions on OS.
Converts IT to an operating expenditure. Eliminates capital expenditure and on-premise maintenance.	More accurate forecasts. Scales based on actual demand. No maintenance required.

Use cases: Run an evaluation, test a new or ancient version of the tools, training / education

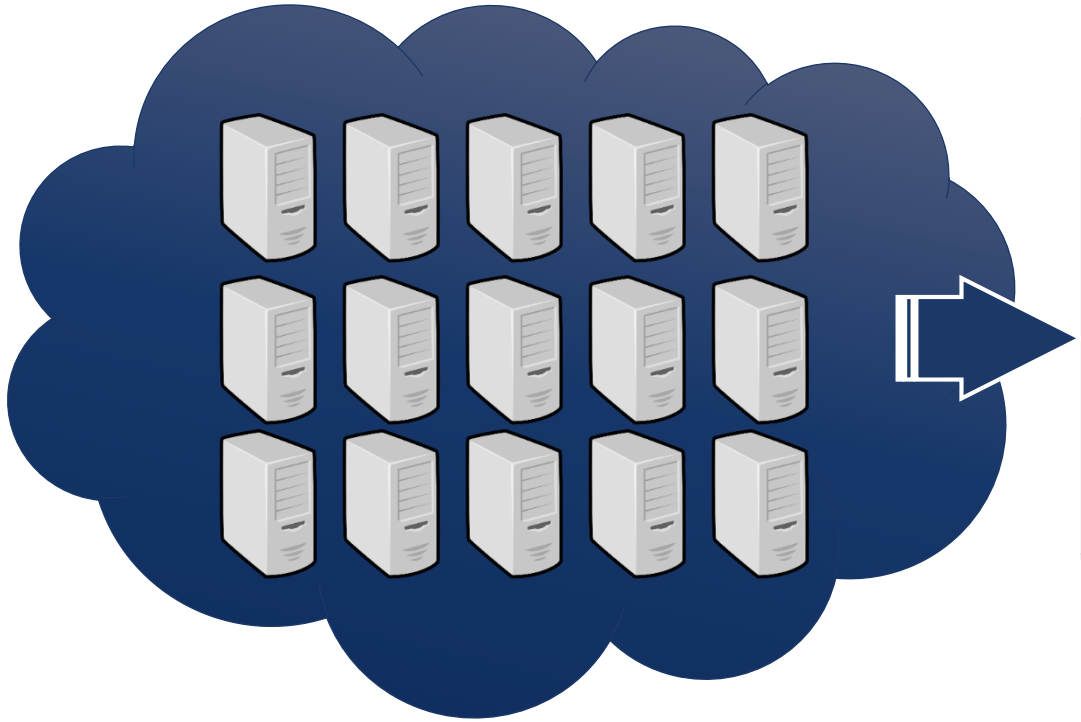
InTime – Timing Closure and Optimization

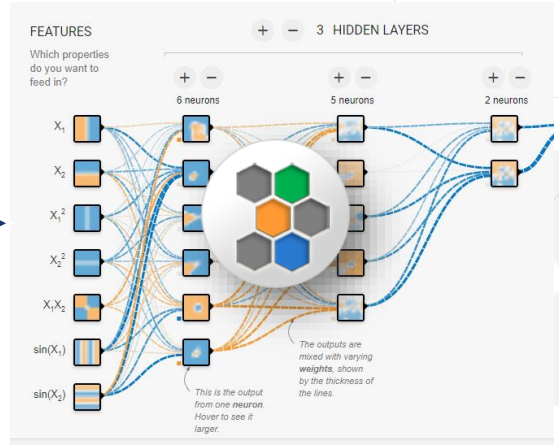
- **Machine Learning Optimizes FPGA**
  - timing and performance.
- **Identifies good settings for synthesis and place-and-route.**
  - Actively learns and improves from many builds
- **Integrates UltraFAST timing closure techniques recommended by**
  - Xilinx FAE in a box
  - 50% better results from the FPGA tools.



Why use InTime on the cloud

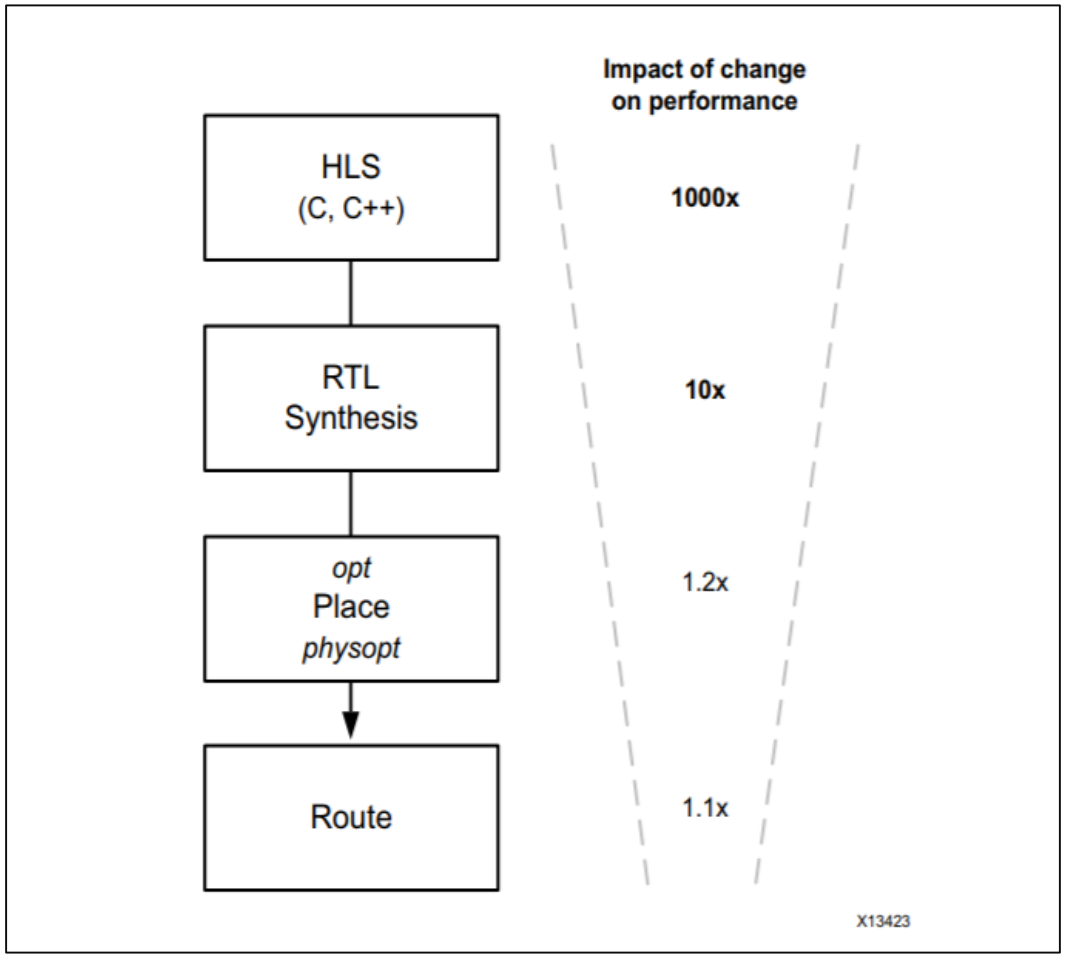
- Run compilations concurrently → Significantly reduces turnaround time
- More results (good & bad) → Converge much faster.





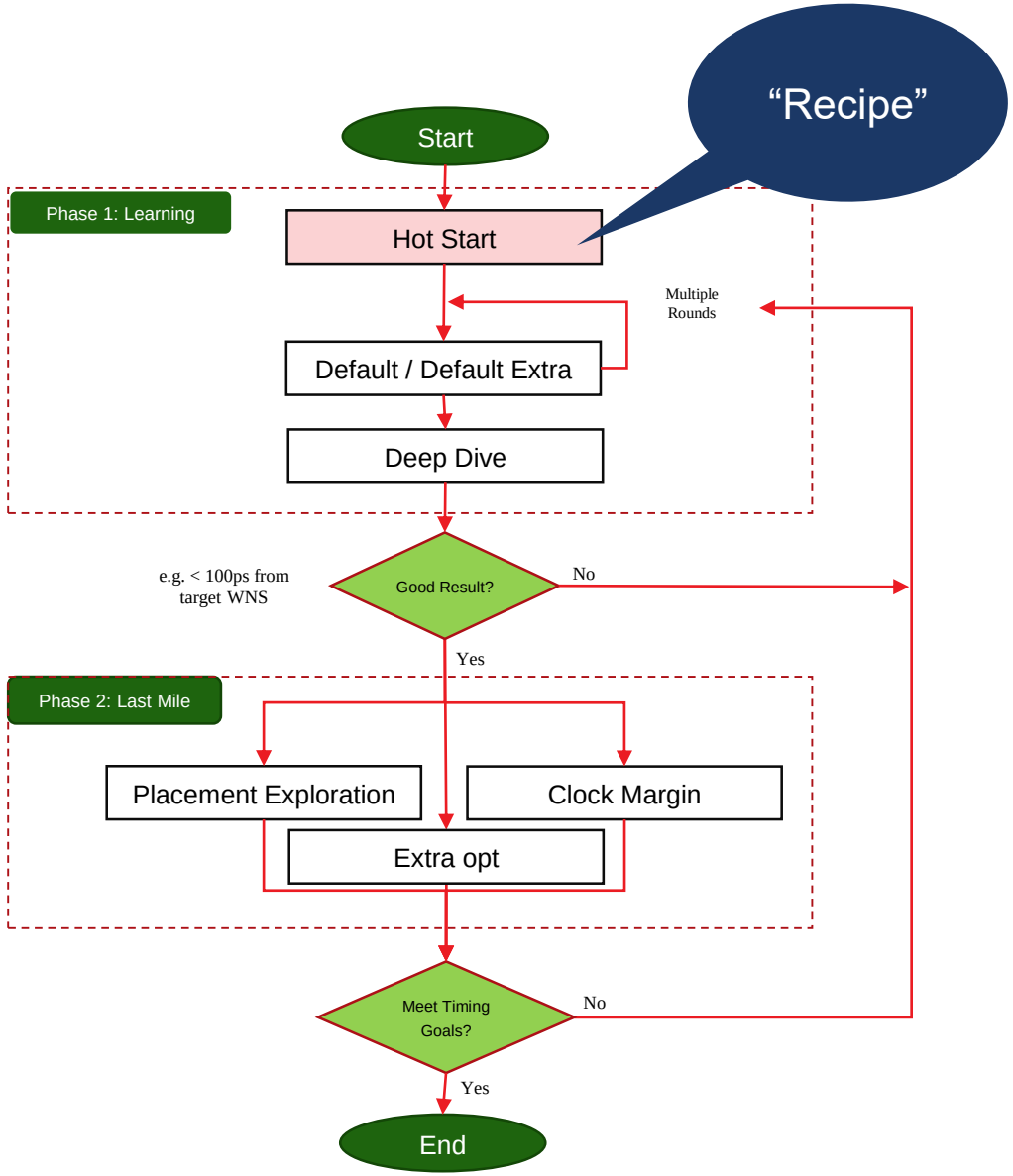
Why InTime works (or not)?

- **Works well for congested designs**
  - Solving issues manually takes a long time
  - Finding the right synthesis/placement parameters makes a huge difference in results
  - Also good for multi-die devices
- **Doesn't work well for heavily floor planned or constrained designs**
  - No freedom or room to optimize



Optimization Methodology

- **Phase 1: Learning Recipes**
  - Run builds in parallel to save time.
  - Minimize WNS to continue to Phase 2
- **Phase 2: Last-Mile Recipes**
  - Works better with good results from Phase 1
  - Placement (InTime brought “seed-like” effects back!)
  - Iterative optimization
- **When should you give up?**
  - Rule of thumb: At least 50% off the best WNS from “Hotstart”
- **Tip!**
  - Use post-place timing to estimate final results and save 50% runtime(!)



https://support.plunify.com/en/2018/03/20/how-to-reduce-your-build-time-by-50/

InTime Case Study (xcvu190)

	Original								InTime					
Projects	TNS (ns)	WNS (ns)	WHS (ns)	CLB Utilization (%)	DSP	LUT	FF	Mem Blocks (BRAM)	Compilations	TNS (ns)	WNS (ns)	TNS Improvements(%)	WNS Improvements(%)	WHS Improvements (%)
A1	-33137.63	-1.38	0.016	88.72	12	635969	657152	1508	127	-1536.563	-0.198	95.36%	85.65%	0.00%
B1	-99541	-2.689	0.016	86.86	12	635849	657021	1508	37	-726.021	-0.183	99.27%	93.19%	0.00%
C1	-25112.76	-0.843	0.016	74.26	12	508562	495391	1222	37	-0.633	-0.062	100.00%	92.65%	18.75%
D1	-4789.12	-0.803	0.016	69.98	12	456637	499008	819	37	-0.002	-0.002	100.00%	99.75%	0.00%
E1	-123092.7	-9.446	-0.506	60.12	12	414,173	395,907	976	37	-302.274	-0.283	99.75%	97.00%	103.16%
F1	-117562.6	-3.299	0.016	58.92	12	405900	434045	654.5	238	-1502.151	-0.27	98.72%	91.82%	0.00%
G1	-150163	-2.125	0.03	90.84	0	701074	665461	718.5	578	-495.731	-0.269	99.67%	87.34%	0.00%
A2	-11609.56	-0.731	0.016	89.79	12	635678	657298	1508	256	-1319.127	-0.228	88.64%	68.81%	0.00%
B2	-6644.22	-0.519	0.016	91.74	12	635737	657293	1508	37	-2306.747	-0.266	65.28%	48.75%	25.00%
C2	-10229.04	-1.203	0.016	75.71	12	508882	495025	1222	131	-770.995	-0.187	92.46%	84.46%	0.00%
D2	-7362.009	-1.088	0.016	66.41	12	456693	498646	819	37	-2.137	-0.127	99.97%	88.33%	0.00%
E2	-32691.9	-9.615	0.016	59.11	12	413,997	396,108	976	37	-426.359	-0.249	98.70%	97.41%	0.00%
F2	-5906.046	-1.18	0.016	58.18	12	405711	433918	654.5	105	-38.762	-0.167	99.34%	85.85%	0.00%
G2	-132991	-2.393	0.014	90.21	0	733554	677075	734.5	158	-55318.66	-1.077	58.40%	54.99%	-28.57%
F1	-5841.436	-0.725	0.016	80.15	12	572470	630091	1154	37	-1124.917	-0.237	80.74%	67.31%	0.00%
F2	-5018.338	-0.554	0.016	81.84	12	572725	630094	1154	37	-1273.956	-0.293	74.61%	47.11%	0.00%

- **Requirements:** Go below -300ps.
- **Server Type:** 4 CPU, 31 Gb RAM
- **Average Cloud Hours / Project**: 957 hours

Case Study Takeaways

9 of the 14 projects required fewer than 40 compilations

> Not every design require machine learning. E.g. you can start with incremental compile.

WNS improvements can be more than 90%

> FMax improvements up to 79.7%

Longest project took about 6 days to meet optimization targets

> Actual Wait Time: 1.32 to 6.24 days

Summary

Plunify Cloud is a managed cloud platform solution

> Cloud automation, ease-of-use and tools license and maintenance.

AI Lab - virtual desktop pre-loaded with FPGA tools

> Access with a web browser.

FPGA Expansion Pack enable cloud compile from Vivado

> Launch directly from Vivado or Tcl. No cloud setup.

InTime enables timing optimization in the cloud

> Vivado is capable of massive performance improvements with the right settings

Contact Us

Sign up for an InTime evaluation:
https://www.plunify.com/en/free-evaluation/

Sign up for Plunify Cloud
https://cloud.plunify.com/register

More information:
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