Pegasus at the Edge Workflow Management System

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What is the Pegasus WMS?

- Fully featured workflow management system
 - Scientists can develop, run, monitor, debug workflows
 - Utilizes HTCondor as its execution engine
- Jobs can run in shared and non shared file system environments



Outline

- 1. Pegasus WMS
- 2. Pegasus at the Edge
- 3. IoT Hardware and Your Workloads
- 4. Conclusion



Exploring Pegasus at the Edge: HTCondor Worker Provisioning

- Created HTCondor 9 ARM and X86_64 worker containers
- Built a simple provisioning tool as part of Pegasus
 - If (num idle jobs in queue / num idle workers of same architecture) > load threshold: spin up worker
 - If any worker container sits idle > max_idle_duration: tear down container to free up resources*
 - HTCondor workers are very well optimized and have low overhead, but we will try to free things up
- Ran experiments locally on X86_64 machine and plan to test on a heterogeneous environment incorporating CHI@Edge resources



Exploring Pegasus at the Edge: HTCondor Worker Provisioning

job queue and worker pool





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Benchmarking FFMPEG on IoT Devices

• Benchmarked FFMPEG performance on RPI4 and Jetson Nano as part of the FlyNet project



Benchmarking FFMPEG on IoT Devices



- Encode: 4K @ 30 | 4x 1080p @ 30 | 9x 720p @ 30 (H.264/H.265)



Benchmarking FFMPEG on IoT Devices

• Benchmark

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- 5 identical videos (3 minutes 14 seconds long @ 25fps, h264 encoded) of various resolutions
- scenarios
 - RPI4 streaming to 2019 MBP client saving individual frames
 - 2019 MBP to RPI4 client saving individual frames
 - Jetson nano streaming to 2019 MBP client saving individual frames
 - 2019 MBP streaming to Jetson nano client saving individual frames

resolution	mp4 size	individual frame size	total size of all frames
240x160	4.7 MB	~ 113 KB	~ 550 MB
480x360	19 MB	~ 507 KB	~ 2.4 GB
720x480	36 MB	~ 1 MB	~ 4.8 GB
1024x768	75 MB	~ 2.3 MB	~ 11 GB
1920x1080	169 MB	~ 6 MB	~ 29 GB



Benchmarking FFMPEG on IoT Devices: Results



Benchmarking FFMPEG on IoT Devices: Results



Benchmarking FFMPEG on IoT Devices: Results

ffmpeg command duration reported by time



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Wrapping Things Up

- CHI@Edge makes it possible for us to test Pegasus on these edge platforms
 - consistent and reliable usage of the python-chi API when interacting with CHI@Edge would be great!
- RPI and Jetson Nano have hardware limitations that can be worked around
 - SD card write speed can be a bottleneck for IO heavy workloads
 - take advantage of main memory when possible



Thank You





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