Fingerprint Solution R&D

Pilot Deployment

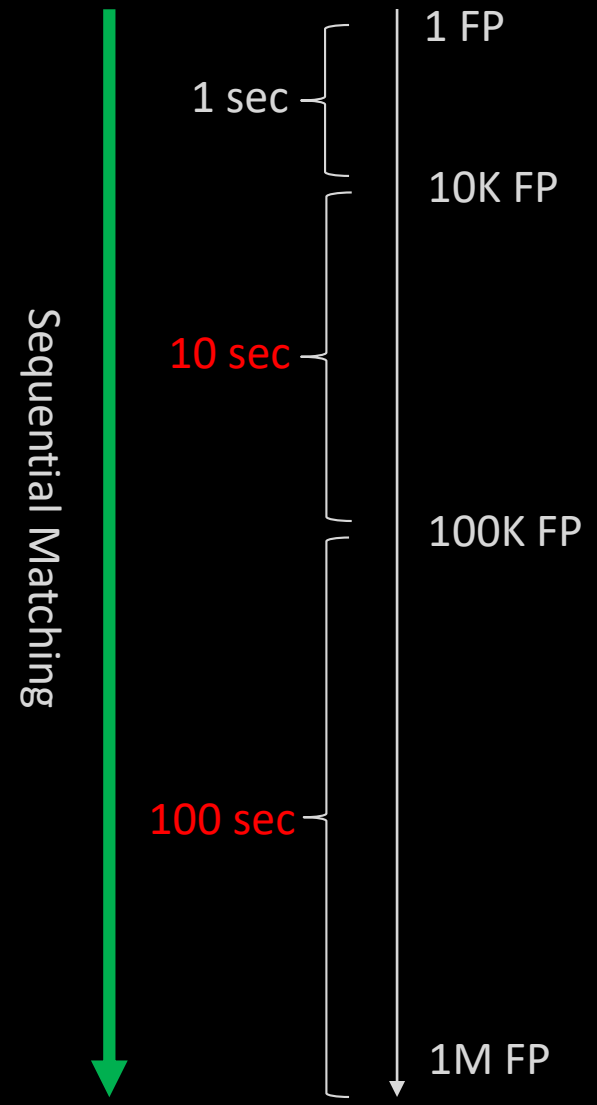
Commercial Solution Challenges

1. Cost of large-scale commercial solutions
2. Security concerns due to proprietary solution
3. Integration to our existing systems
4. Cannot be customized further

In-House Solution Challenges

1. Significant processing in matching fingerprint vs number
2. Most fingerprint tools (SDK) advertise 10K/sec matching speed
3. Unacceptable delay when 50K or more
4. Skills and knowledge required
5. Development time required

Sequential Fingerprint Matching

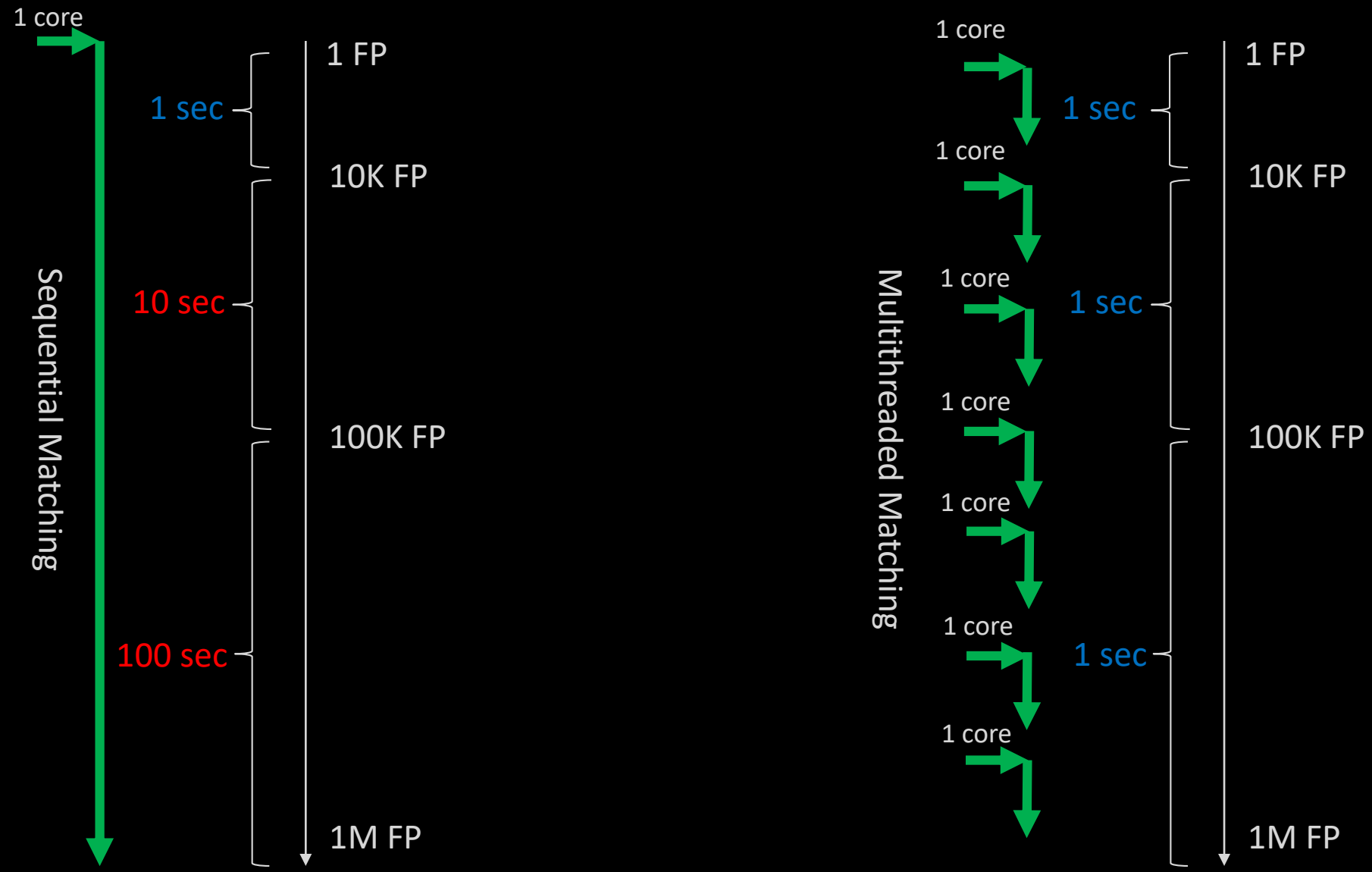


Benchmark Results for Sequential Matching

Processor Type	Fingerprints	Seek Time
3rd Gen Intel Core i5-2430M	17K	1 sec
Dual Core @ 2.4GHz	1M	58 sec
	10M	588 sec (9.8 min)
2x Quad-Core Intel Xeon E5450	12.5K	1 sec
2x4 Cores @ 3.0GHz	1M	80 sec (1.3 min)
	10M	800 sec (13 min)

The Research Project

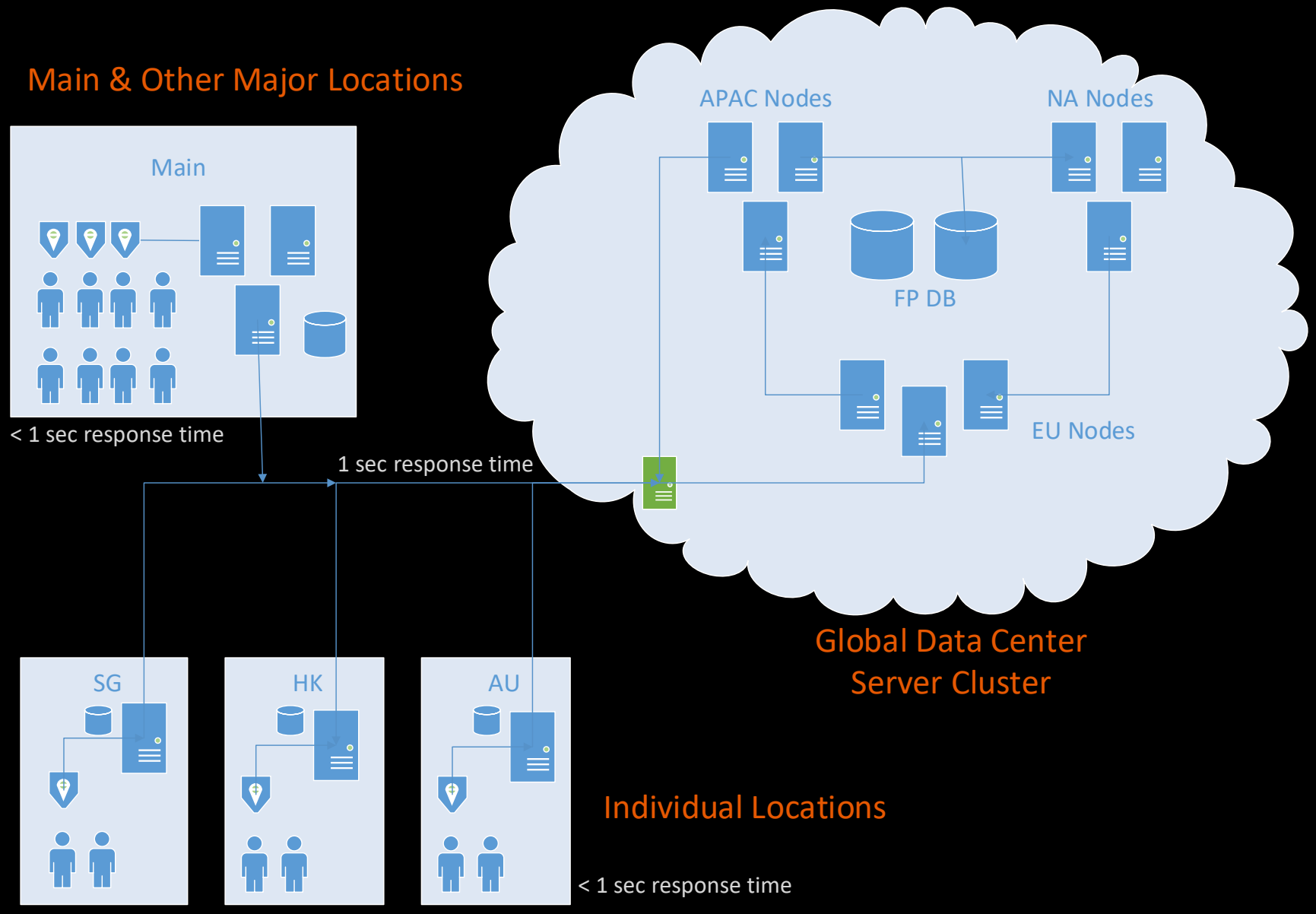
Sequential vs Multithreaded



Multithreaded Benchmark Results

Processor Type	Fingerprints	Seek Time	CPU Core
3rd Gen Intel Core i5-2430M	17K	1 sec	1 Core
Dual Core @ 2.4GHz	1M	1 sec	58 Cores
	10M	1 sec	588 Cores
2x Quad-Core Intel Xeon E5450	12.5K	1 sec	1 Core
2x4 Cores @ 3.0GHz	1M	1 sec	80 Cores
	10M	1 sec	800 Cores

Solution Diagram



Speed Optimization and Cost Reduction Measures

1. Multi-core and multithreaded matching
2. In-app memory cache in server cluster
3. Search priority based on location with in-premise cache
4. Search priority based on frequency of attendance
5. Real-time cache reduction algorithm
6. Server clustering and utilization of existing servers
7. Option of renting commercial cloud servers

Solution Summary & Benefits

1. In-house software and hardware solution
2. We hold the source code, we control the security
3. Integrates well with our existing systems and processes
4. We can utilize our existing hardware to maximize cost savings
5. Can be extended and improved when the need arises

Cost Factors

1. Fingerprint Scanners ($50 to $75 each)
2. Fingerprint Matching Server (64 to 128-core)
3. Workstations for the main and satellite locations (regular PCs or touchscreens)
4. Fingerprint SDK Licenses (matching utility)
    - Paid Option – Griaule SDK @ $5,500 USD per 150 PCs
    - Open source – Free (needs to be tested)
5. Other software licenses
6. Premises construction expenses
7. Deployment timeline

Cost Estimates

Estimates for data center and main location (1M Fingerprints for 1 sec):

1. Fingerprint Scanners = 25 x $75 = $1,875
2. Server Cluster Hardware 64-Core = $2,500
   1U Server X7DCA-L 2x Xeon L5420 2.5ghz Quad Core x 8 @ $200
3. Workstations for fingerprint device = 10 x $500 = $5,000
4. Misc. expenses = $5,000
5. Licenses -

TOTAL: $14,375 USD

Estimate per satellite location deployment:

1. Fingerprint Scanners = 2 x $75 = $150
2. Touchscreen Workstation (Kiosk) = 1 x $700 = $700
3. Internet Access -

TOTA: $850 USD

Research Summary

Completed research areas:

- System architecture design
- Linear matching speed (10K – 17K/sec)
- Multicore matching speed (up to 8-core, ~100K/sec)
- Single-node server cluster (local-internet-local)

Pending research areas:

- End-to-end single-user testing
- End-to-end simultaneous users (10+)
- Multiple clustered servers testing (if needed)
- Long-term system stability and overall user experience
- Detailed costing

Preliminary conclusion:

- Low cost over commercial solutions
- More advantages over commercial solutions
- Research is very positive and implementation looks very feasible