**INFORMAL DRAWINGS FOR PROVISIONAL PATENT APPLICATION**

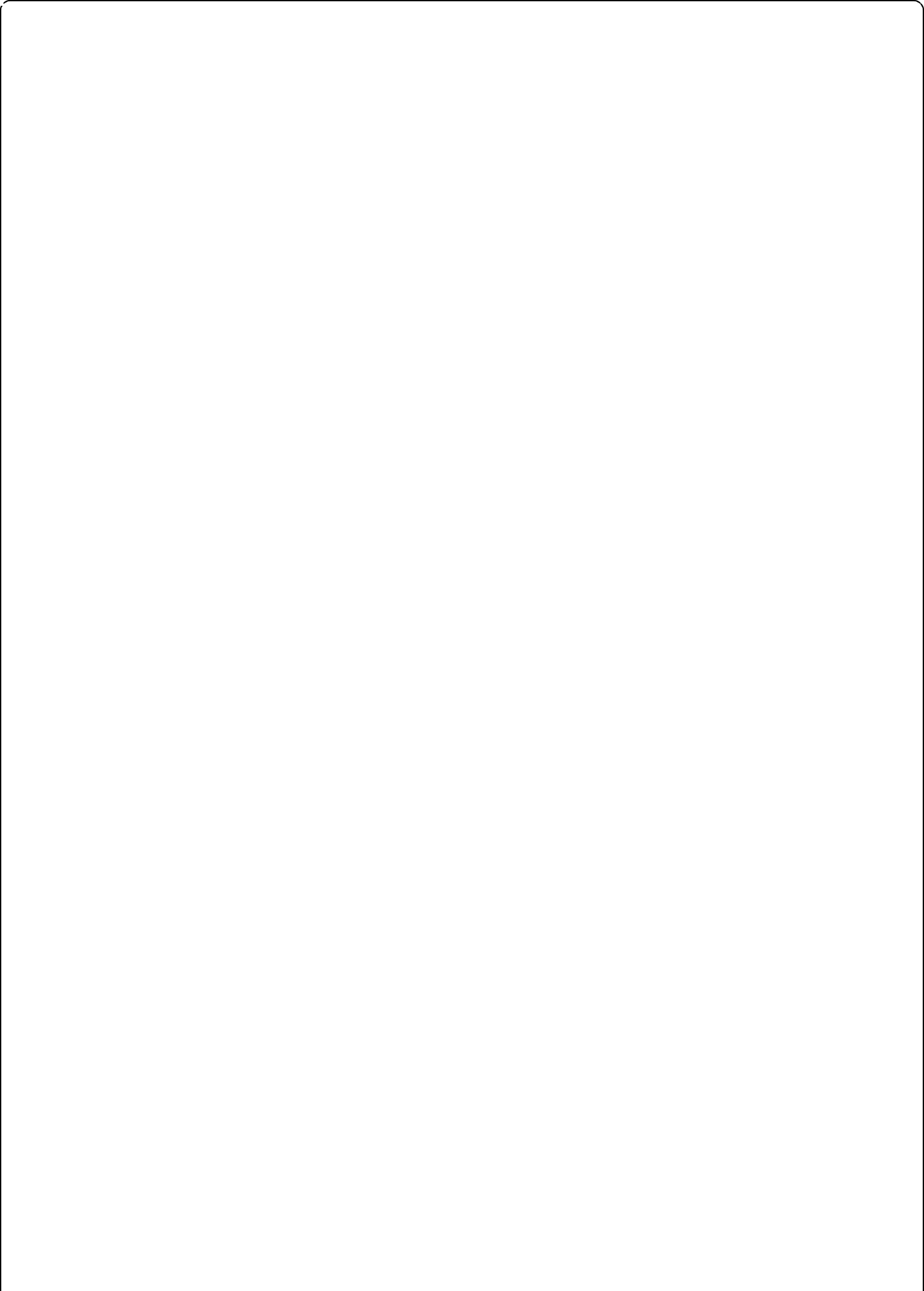
**Docket No.:** RUTHERFORD-016-PROV

**Title:** DELIBERATE ERROR TOLERANCE ARCHITECTURE (DETA)



**FIGURE 1: SYSTEM ARCHITECTURE**

**Hierarchical Processing Layers**

┌─────────────────────────────────────────────────────────────┐

│

THREAT INPUT LAYER

│

│

Network Traffic | System Logs | Sensor Data

│

└─────────────────────┬───────────────────────────────────────┘

│

┌─────────────────────▼───────────────────────────────────────┐

│ PREDICTIVE QUANTUM STATE CACHE │

│ ┌──────────┐ ┌──────────┐ ┌──────────┐ ┌──────────┐ │

│ │1M Threat │ │ O(1) │ │Quantum │ │Background│ │ │ │ States │◄─┤ Lookup │◄─┤ Hash │ │Evolution │ │

│ └──────────┘ └──────────┘ └──────────┘ └──────────┘ │

│ │ │

│ Cache Miss → Interpolation │

└─────────────────────┬───────────────────────────────────────┘

│

┌─────────────────────▼───────────────────────────────────────┐

│ DELIBERATE ERROR TOLERANCE CONTROLLER │

│ ┌──────────────────────────────────────────────────────┐ │ │ │ Critical: 0.1% │ High: 0.3% │ Med: 0.5% │ Low: 1.0% │ │

│ └──────────────────────────────────────────────────────┘ │ └─────────────────────┬───────────────────────────────────────┘

│

┌─────────────────────▼───────────────────────────────────────┐

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| │ | QUANTUM PROCESSING LAYER | | | |  | │ |  |  |
| │ ┌────────────┐ ┌────────────┐ ┌────────────┐ | | | | | | | | │ |
| │ │ Photonic │ │FPGA Array │ │ASIC Array │ | | | | |  | │ |  |  |
| │ │ Processor │◄─┤ 16 Units │◄─┤ 4 Units | | | | | │ | │ |  |  |
| │ │ 256 MZI | | │ │143M Cells │ │ 16K PEs │ | | |  | │ |  |  |
| │ └────────────┘ └────────────┘ └────────────┘ | | | | | | | | │ |
| │ | │ | │ | │ | │ |  |  |  |  |
| │ | └──────────────┼───────────────┘ | | | | | | │ |  |
| │ |  | │ |  | │ |  |  |  |  |
| │ | 50ns Syndrome Extraction | | |  | │ |  |  |  |

└─────────────────────┬───────────────────────────────────────┘

│

┌─────────────────────▼───────────────────────────────────────┐

│

QUANTUM ENTANGLEMENT CORRELATION ENGINE

│

│ Quantum Walks | O(√n) Complexity | Multi-vector

│

└─────────────────────┬───────────────────────────────────────┘

│

┌─────────────────────▼───────────────────────────────────────┐

│ DEFENSIVE AI AGENT LAYER (MWRASP) │

│ Autonomous Response | Sub-10ms Mitigation │

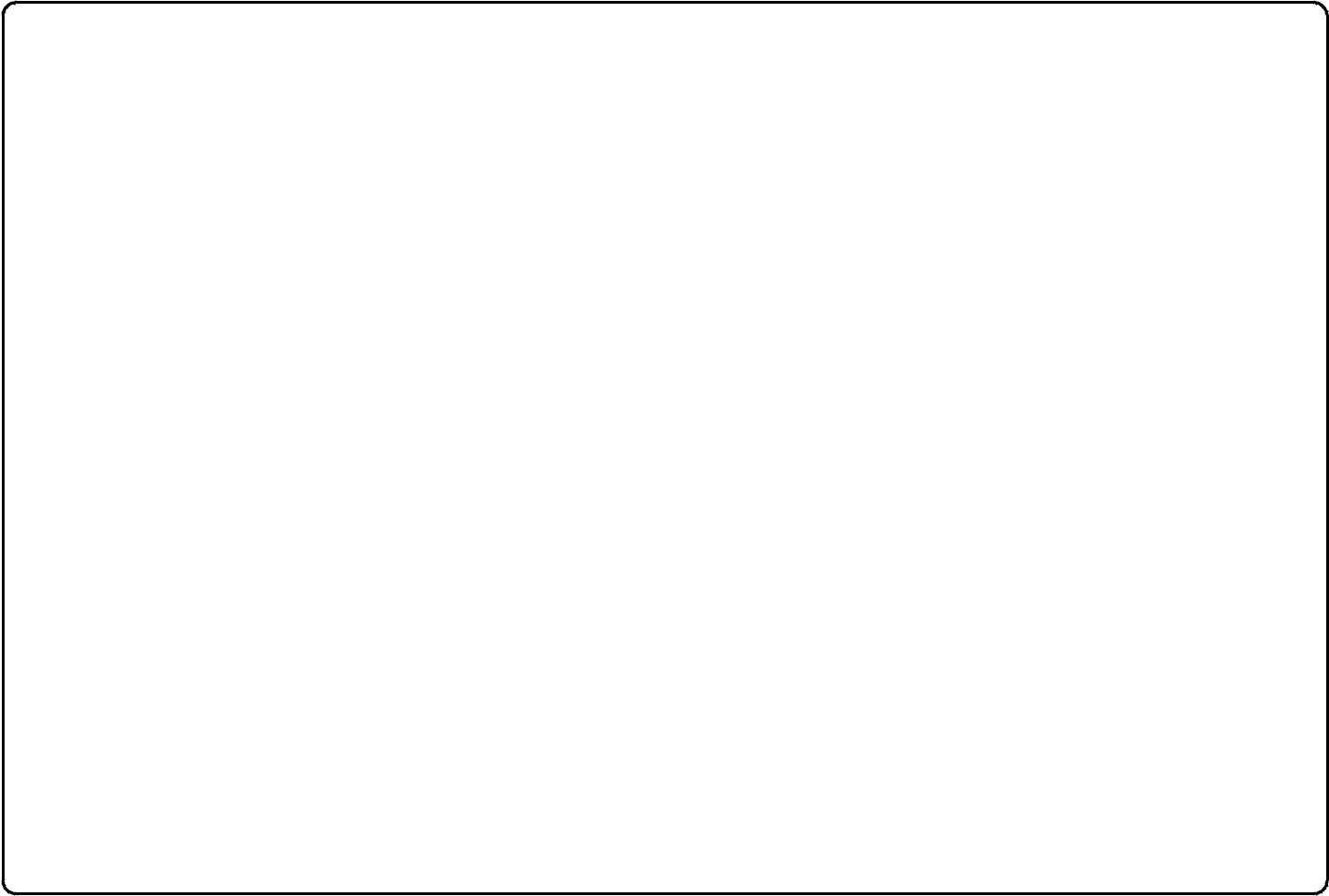


└──────────────────────────────────────────────────────────────┘



**FIGURE 2: ERROR RATE VS LATENCY TRADE-OFF CURVE**

**Optimal Operating Zone**



Latency (ms)

1000 ┤

* Traditional Quantum Computing
* ╱

100┤ ╱

* ╱ IBM Heron
* ╱

10 ┤ ╱ ┌─────────────────┐

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| │╱ | | │ DETA OPTIMAL | | │ |  |
| 8 | ┤●······│ ZONE | | │··········● Critical | |  |
| 5 | ┤ ●····│ | | │······● | High |  |
| 3 | ┤ | ●··│ | │···● | Medium |  |
| 2 | ┤ | ●└─────────────────┘● | | | Low |

* ┤

└──┬────┬────┬────┬────┬────┬────┬────┬────┬────┬──

10⁻¹⁵ 10⁻¹² 10⁻⁹ 10⁻⁶ 0.1% 0.3% 0.5% 1% 10%

Error Rate

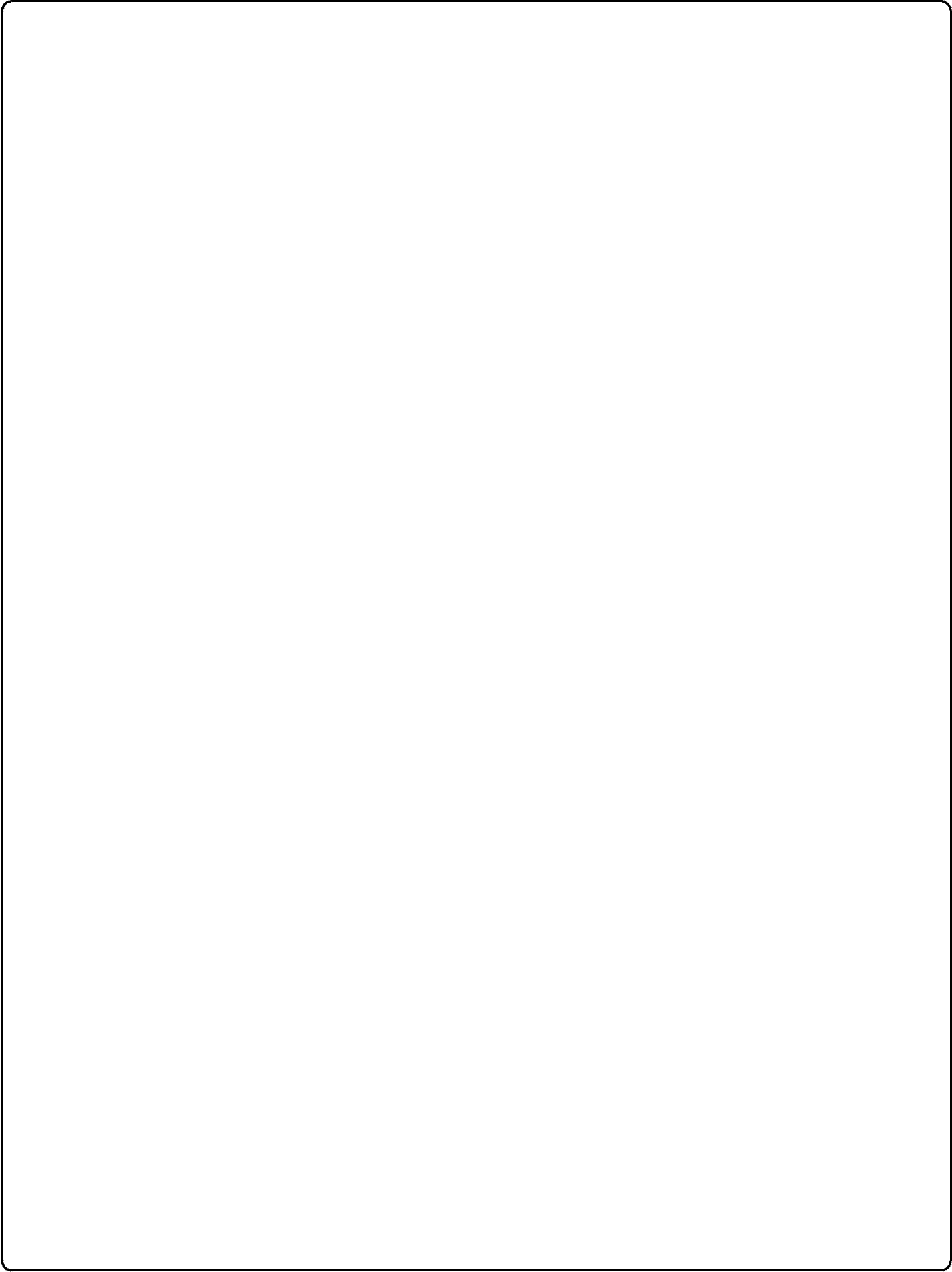
Legend: ● = DETA Operating Points

* = Traditional QC Trajectory



**FIGURE 3: PREDICTIVE QUANTUM STATE CACHE ARCHITECTURE**

**Cache Structure and Interpolation Engine**

┌────────────────────────────────────────────────────────────┐

│ QUANTUM STATE CACHE (1M States) │

├────────────────────────────────────────────────────────────┤

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| │ |  |  |  | │ |  |  |  |
| │ Hash Table | |  | State Memory | | │ |  |  |
| │ ┌─────────┐ | |  |  | ┌──────────────────────┐ | | | │ |
| │ │ Hash(T₁)├─────────────────►│ |ψ₁⟩ Threat State 1 │ | | | | | | │ |  |
| │ ├─────────┤ | |  |  | ├──────────────────────┤ | | | │ |
| │ │ Hash(T₂)├─────────────────►│ |ψ₂⟩ Threat State 2 │ | | | | | | │ |  |
| │ ├─────────┤ | |  |  | ├──────────────────────┤ | | | │ |
| │ │ Hash(T₃)├─────────────────►│ |ψ₃⟩ Threat State 3 │ | | | | | | │ |  |
| │ ├─────────┤ | |  |  | ├──────────────────────┤ | | | │ |
| │ │ | ... │ | │ | ... | │ │ |  |  |  |
| │ ├─────────┤ | |  |  | ├──────────────────────┤ | | | │ |
| │ │Hash(T₁M)├─────────────────►│ |ψ₁M⟩ Threat State │ | | | | | |  | │ |
| │ └─────────┘ | |  |  | └──────────────────────┘ | | | │ |
| │ | │ |  |  | │ |  |  |  |
| │ | │ O(1) Lookup |  |  |  | │ |  |  |
| │ | ▼ |  |  | │ |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| │ ┌─────────────────────────────────────────────────┐ | | | | │ |
| │ │ | Cache Hit (97%) | │ | │ |  |
| │ │ Return State < 100ns | | │ | │ |  |
| │ └─────────────────────────────────────────────────┘ | | | | │ |
| │ | │ | │ |  |  |
| │ │ Cache Miss (3%) | |  | │ |  |
| │ | ▼ | │ |  |  |

│ ┌─────────────────────────────────────────────────┐ │

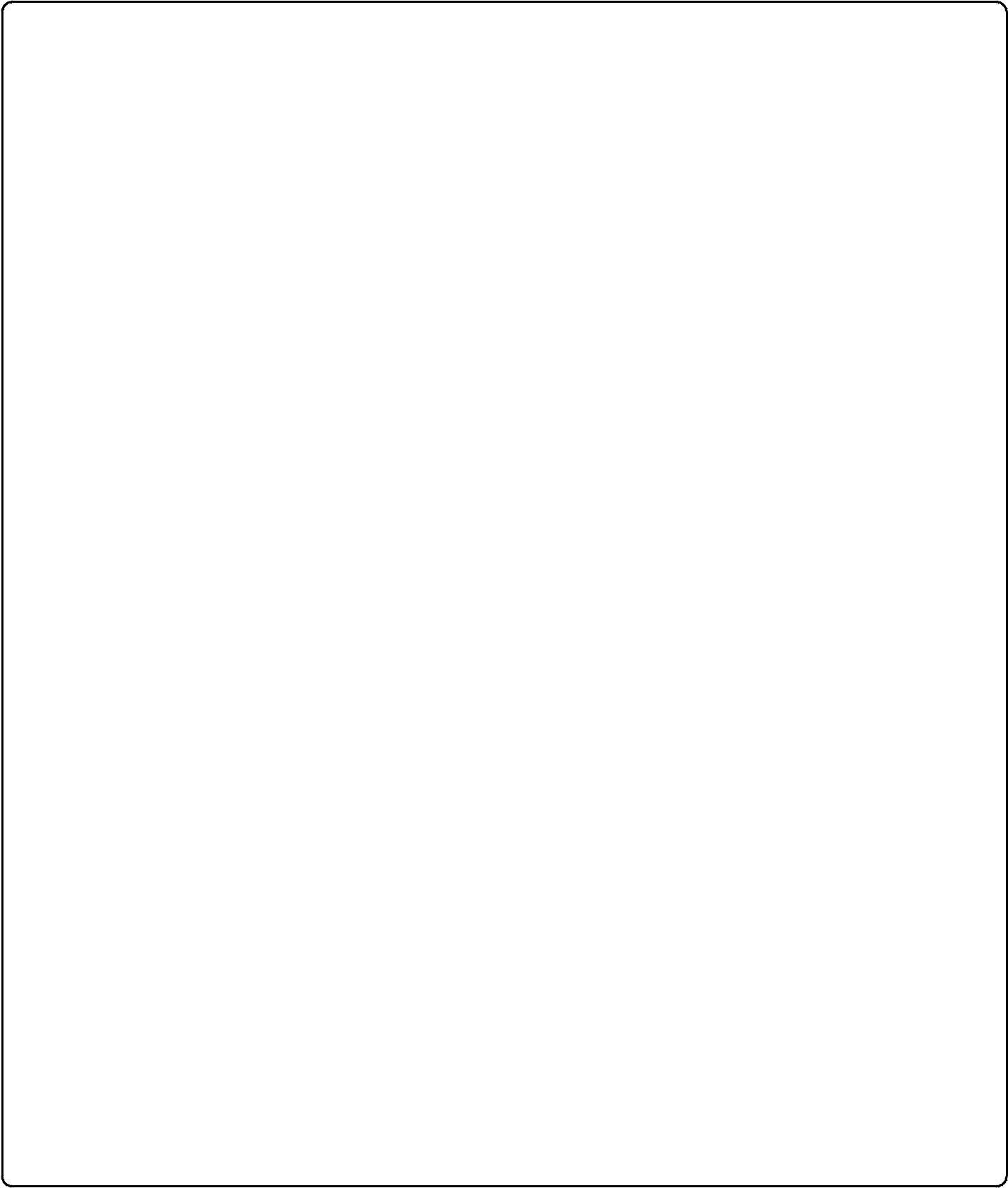
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| │ │ | INTERPOLATION ENGINE |  | │ | │ |  |  |
| │ │ 1. Find k=5 nearest states | | │ | │ |  |  |  |
| │ │ 2. Compute Hilbert distances | | │ | │ |  |  |  |
| │ │ 3. Weighted superposition | | │ | │ |  |  |  |
| │ │ 4. Fast evolution (94% fidelity) | | │ | │ |  |  |  |
| │ │ Total Time: < 1 microsecond | | │ | │ |  |  |  |
| │ └─────────────────────────────────────────────────┘ | | | | | | │ |
| │ |  | │ |  |  |  |  |
| │ Background Evolution Process (Idle Time) | | |  | │ |  |  |
| │ ┌─────────────────────────────────────────────────┐ | | | | | | │ |
| │ │ Update cached states based on new threats | | | | │ | │ |  |
| │ │ Maintain freshness through continuous evolution│ | | | | | │ |  |
| │ └─────────────────────────────────────────────────┘ | | | | | | │ |

└────────────────────────────────────────────────────────────┘



**FIGURE 4: ROOM-TEMPERATURE PHOTONIC PROCESSOR LAYOUT**

**256 Mach-Zehnder Interferometer Array**



┌────────────────────────────────────────────────────────────┐

│ SILICON PHOTONIC CHIP (298K Operation) │

├────────────────────────────────────────────────────────────┤

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| │ |  | │ |  |  |  |  |  |  |  |  |
| │ Input Waveguides | | MZI Array (16x16) | | │ |  |  |  |  |  |  |
| │ ││││ | | │ |  |  |  |  |  |  |  |  |
| │ ▼▼▼▼ | |  | │ |  |  |  |  |  |  |  |
| │ ┌─────────────────────────────────────────────────┐ | | | | | | | | | | │ |
| │ │ ╔═╦═╦═╦═╦═╦═╦═╦═╦═╦═╦═╦═╦═╦═╦═╦═╗ | | | | | | │ | │ |  |  |  |
| │ │ ║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║ Row 1 | | | | | | | | │ | │ |  |
| │ │ ╠═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╣ | | | | | | │ | │ |  |  |  |
| │ │ ║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║ Row 2 | | | | | | | | │ | │ |  |
| │ │ ╠═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╣ | | | | | | │ | │ |  |  |  |
| │ │ ║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║ Row 3 | | | | | | | | │ | │ |  |
| │ │ ╠═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╣ | | | | | | │ | │ |  |  |  |
| │ │ | ... (256 Total MZIs) ... | │ | │ |  |  |  |  |  |  |  |
| │ │ ╠═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╬═╣ | | | | | | │ | │ |  |  |  |
| │ │ ║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║M║ Row 16 | | | | | | | | │ | │ |  |
| │ │ ╚═╩═╩═╩═╩═╩═╩═╩═╩═╩═╩═╩═╩═╩═╩═╩═╝ | | | | | | │ | │ |  |  |  |
| │ └─────────────────────────────────────────────────┘ | | | | | | | | | | │ |
| │ ││││ | | │ |  |  |  |  |  |  |  |  |
| │ ▼▼▼▼ | |  | │ |  |  |  |  |  |  |  |
| │ Output Waveguides → SNSPD Array (2.5K, 93% efficiency) | | | | | | │ |  |  |  |  |
| │ |  | │ |  |  |  |  |  |  |  |  |
| │ Control Electronics: | |  | │ |  |  |  |  |  |  |  |
| │ ┌─────────────────────────────────────────────────┐ | | | | | | | | | | │ |
| │ │ • Barium Titanate Modulators (100GHz, <1V) | | | | │ | │ |  |  |  |  |  |
| │ │ • Wavelength Multiplexing (1000+ operations) | | | | │ | │ |  |  |  |  |  |
| │ │ • Four-wave mixing for entanglement | | | │ | │ |  |  |  |  |  |  |
| │ │ • Total Power: 80W photonics + 100W cooling | | | | │ | │ |  |  |  |  |  |
| │ └─────────────────────────────────────────────────┘ | | | | | | | | | | │ |

└────────────────────────────────────────────────────────────┘

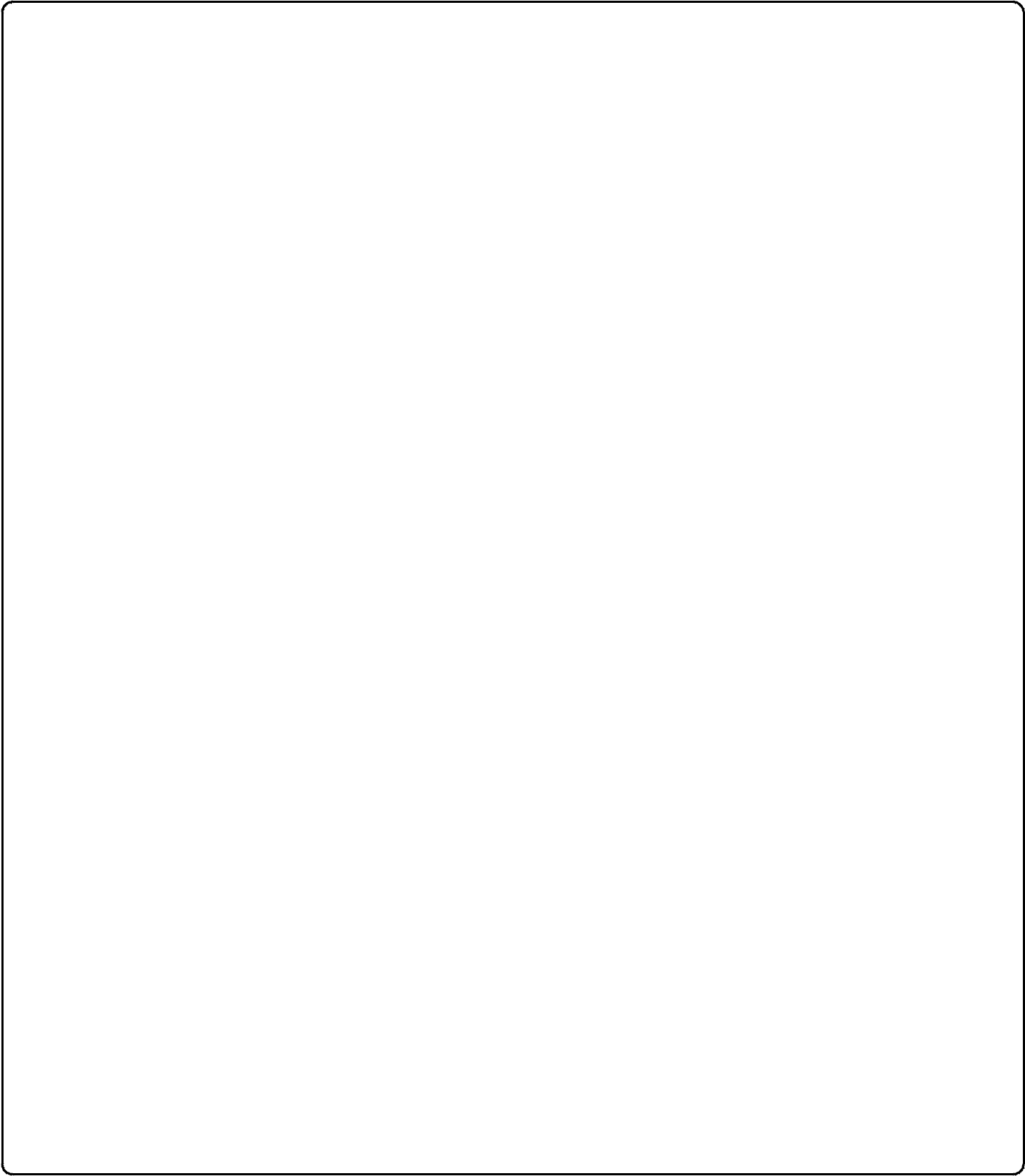
Legend: M = Mach-Zehnder Interferometer

* = Optical Waveguide ║ = Phase Shifter



**FIGURE 5: COMPARATIVE PERFORMANCE METRICS**

**DETA vs Current State-of-the-Art**



DETA IBM Google IonQ

System Heron Willow Forte

┌─────────────────────────────────────────────────────────────┐

│ Latency │ <10ms │ >100ms │ >100ms │ >500ms │

├─────────────────────────────────────────────────────────────┤

│ Error Rate │ 0.1-1% │ 0.5% │ <0.1% │ 0.02% │

├─────────────────────────────────────────────────────────────┤

│ Power │ <1kW │ 25kW │ 30kW │ 15kW │

├─────────────────────────────────────────────────────────────┤

│ Temperature │ 298K │ 15mK │ 20mK │ 77K │

├─────────────────────────────────────────────────────────────┤

│ Throughput │ 10M/sec │ 10K/sec │ 5K/sec │ 1K/sec │

├─────────────────────────────────────────────────────────────┤

│ Syndrome │ 50ns │ 1-10μs │ 63μs │ 100μs │

├─────────────────────────────────────────────────────────────┤ │ Deployment │ Standard │ Quantum │ Quantum │Quantum │

│ │ Rack │ Facility │ Facility │Facility│

└─────────────────────────────────────────────────────────────┘

Performance Improvement Factors:

┌────────────────────────────────────┐

|  |  |  |
| --- | --- | --- |
| │ Speed: | 100-1000x | │ |
| │ Power: | 25-30x | │ |

│ Deployment: Immediate vs Years │

│ Cost: 100x lower │

└────────────────────────────────────┘

Threat Detection Accuracy:

┌────────────────────────────────────┐

│ DETA:

99.5% @ 10ms

│

│ Classical: 95% @ 100ms │

│ Traditional QC: 99.99% @ 1000ms │ └────────────────────────────────────┘

Key Insight: 99.5% accuracy in 10ms provides superior

real-world protection compared to 99.99% in 1000ms



**DRAWING NOTES FOR USPTO**

1. These are informal drawings suitable for provisional patent application
2. Formal drawings will be prepared for non-provisional filing

1. All drawings are original work created for this invention
2. No copyrighted material has been incorporated
3. Drawings illustrate the key technical innovations claimed

**Prepared by:** Brian James Rutherford

**Date:** [Current Date]

**Docket No.:** RUTHERFORD-016-PROV