

# Qomp White Paper

Quantum Preprocessor Module (QPM)

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## Abstract

The Quantum Preprocessor Module (QPM) is a lightweight, photonic quantum computing unit built for edge and mobile applications. Powered by quantum dots (QDs), it performs real-time probabilistic optimization and decision acceleration without requiring millions of physical qubits or cryogenic environments. QPM bridges the gap between near-term quantum capability and practical deployment, making quantum-enhanced computation available to consumer electronics, AI systems, and quantum-secure networks.

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## 1. Introduction

Quantum computing holds the potential to transform problem solving through probabilistic and entangled computation. However, today's platforms are bulky, error-prone, and inaccessible. QPM introduces a scalable middle ground: a low-qubit module operating at room temperature, optimized for mobile and edge devices. By executing quantum pre-processing before full classical execution, QPM accelerates computation, reduces power usage, and unlocks real-time quantum use cases on-device.

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## 2. Core Concept: Quantum Preprocessing

QPM is not a full-scale quantum computer. Instead, it's a **decision-guiding quantum accelerator** designed to:

- Collapse high-dimensional solution spaces into high-probability regions
- Guide classical processors via early convergence
- Execute universal quantum gates (Hadamard, CNOT, Toffoli, Phase) on small-scale circuits

Through **Grover's search**, **QAOA**, and **quantum sampling**, the module functions like a co-pilot—offloading the most computationally expensive early logic.

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### 3. Use Cases and Quantum Workloads

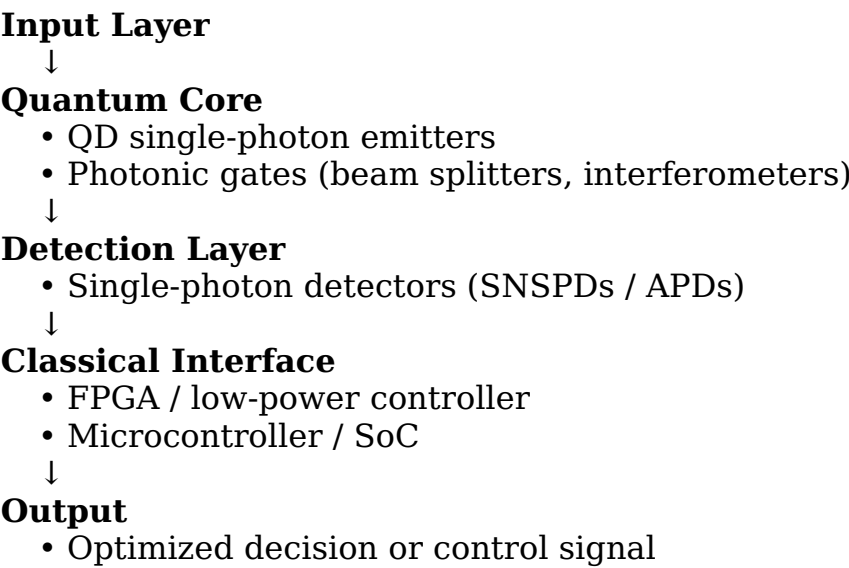
| Application                  | Quantum Technique         | Qubits Required |
|------------------------------|---------------------------|-----------------|
| Search / Ranking             | Grover’s Algorithm        | 5-30            |
| Routing / Scheduling         | QAOA / VQE                | 20-50           |
| Bayesian Inference           | Quantum Sampling          | 10-40           |
| Pattern Recognition          | QFT + Filters             | 10-50           |
| Cryptographic Key Generation | QRNG (Randomness)         | 1-2             |
| ML Model Selection           | Quantum Kernel Estimation | 20-40           |

These tasks operate within **NISQ (Noisy Intermediate-Scale Quantum)** conditions and are achievable using quantum dots and photonic logic components.

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### 4. System Architecture

#### Module Composition



## Technology Stack

- **Quantum Dots** (InAs, CdSe, perovskite-based)
  - **Photonic Logic** (waveguides, phase shifters, splitters)
  - **Detectors** (Avalanche photodiodes, superconducting nanowires)
  - **Classical Bridge** (FPGA, embedded processors)
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## 5. Integration Pathways

QPM is designed to integrate into a wide variety of consumer and industrial platforms, including:

- Smartphones and wearables
- Autonomous navigation systems
- Secure mobile communication platforms
- Quantum edge servers and gateways
- Satellite communication and sensing devices

Via standard I/O protocols, the module can be embedded or co-packaged with CPUs or mobile SoCs, enabling seamless hybrid workloads.

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## 6. Software and Control Layer

The QPM includes a basic software stack for:

- Circuit abstraction (define superpositions, gates, and measurement)
- Precompiled algorithms (Grover, QAOA, QRNG)
- Classical post-processing integration
- API endpoints for native OS interaction

The interface allows developers to access quantum logic with minimal quantum programming experience, enabling broader adoption in edge AI and signal processing.

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## 7. Development Roadmap

### Phase 1 (0-6 Months): Feasibility & Validation

- Fabrication of QD-based single-photon sources
- Grover's search demonstration using 5-10 qubits
- Basic white-box architecture prototypes

### Phase 2 (6-12 Months): Prototype and Integration

- Photonic gate routing on silicon photonics
- FPGA-controlled QPM prototype
- Mobile device integration for QKD and decision logic

## Phase 3 (12-24 Months): Optimization and Rollout

- Energy-efficient QPM for embedded and wearable tech
  - Launch SDK for app-level quantum acceleration
  - Begin partner testing for field and aerospace use cases
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## 8. Strategic Value

QPM is the foundation of a **new quantum-classical hybrid architecture**:

- **Quantum edge intelligence** with real-time performance
- **Quantum-resilient security** for future networks
- **Ultra-efficient computing** without exotic cooling or large-scale arrays

By removing barriers of cost, size, and complexity, QPM unlocks the quantum layer for everyday computation—laying the groundwork for a photon-based computational future.

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