

When Things Think

AI & GenAI Unlocking the IoT

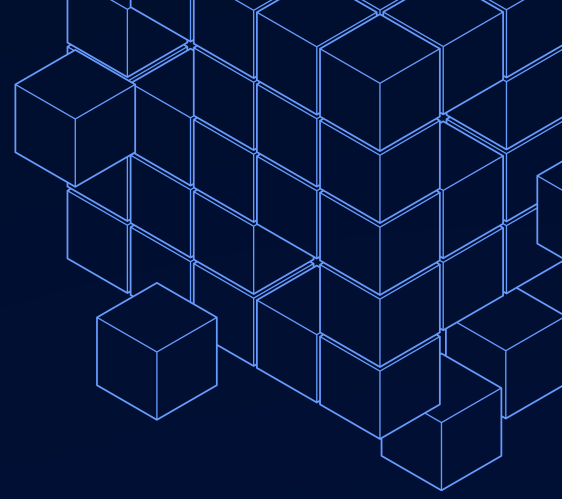


Dr. Fethi Filali

Director of Technology & Research

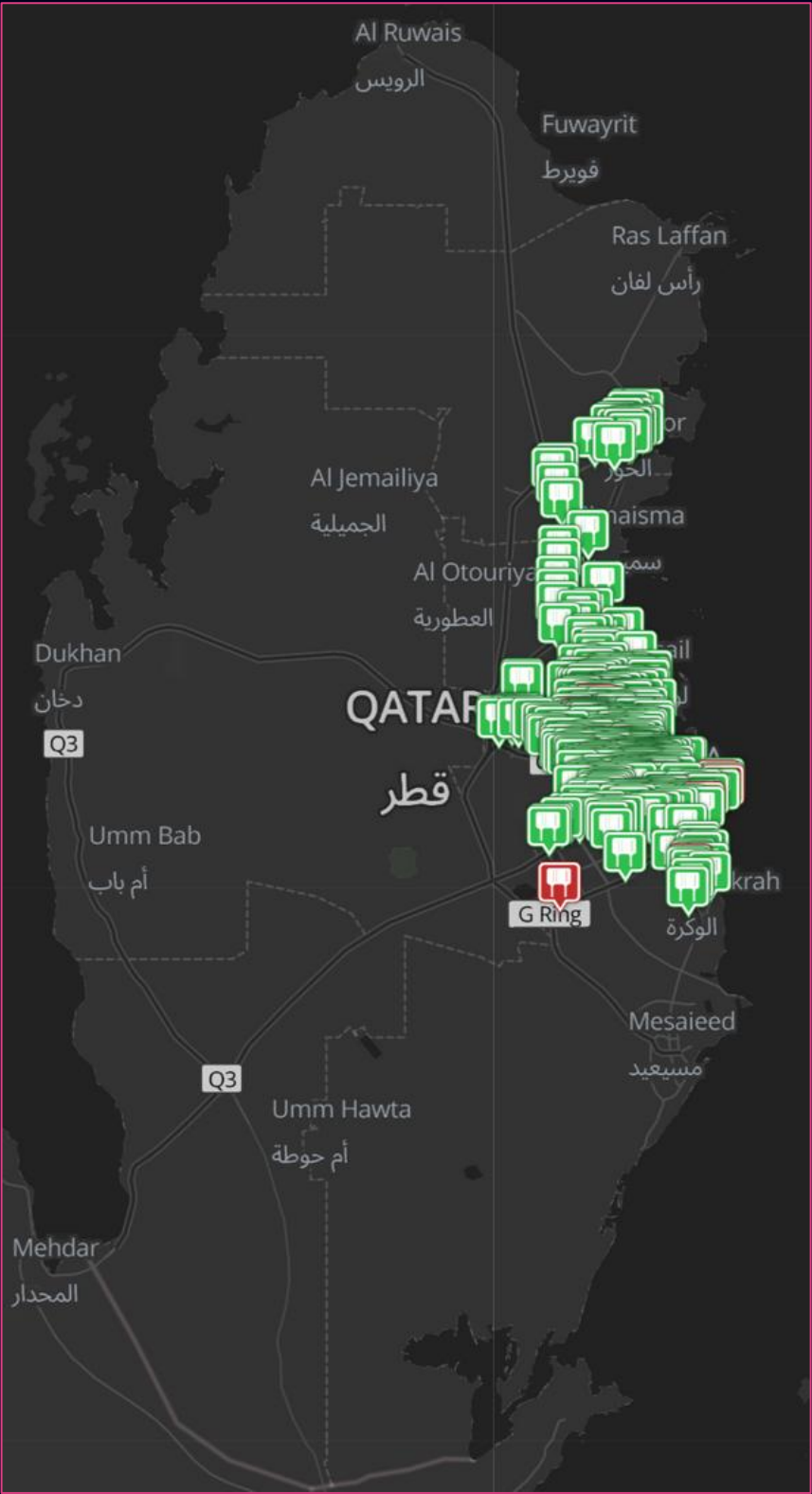


From Connected to Cognitive

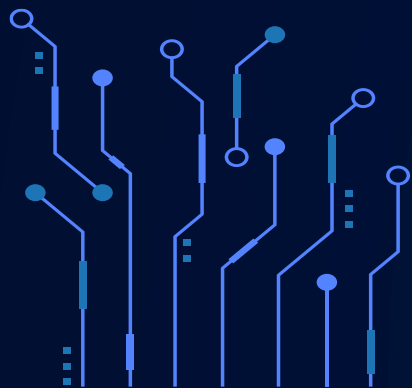


IoT is no longer about connecting devices, but about giving devices
agency and **intent**

QMIC's IoT Smart System



Opening on 20-11-22



400+ WaveTraf IoT Sensors

How AI Transforms IoT

AI integrated into IoT systems unlocks new levels of **automation**, operational **efficiency**, and **real-time** intelligence across connected environments.



1

Predictive Intelligence

- Anticipates failures before they happen
- Enables real-time optimization of operations and resource use

Lower downtime, reduced OpEx, higher asset reliability



2

Autonomous Decision-Making

- Edge AI enables instant, local decisions without cloud latency
- Systems self-adjust and self-heal as conditions change

Faster response times and more resilient operations



3

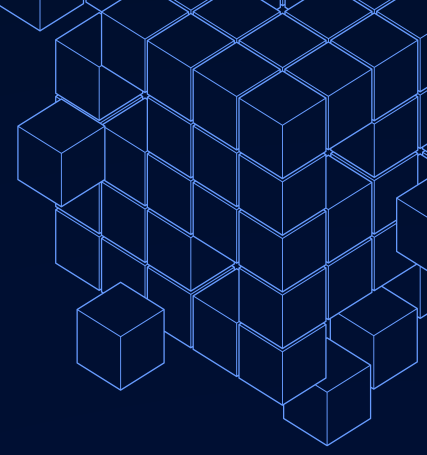
Pattern Recognition at Scale

- Extracts insights from massive volumes of sensor and operational data
- Detects anomalies with high accuracy for proactive intervention

Better forecasting, improved safety, stronger quality control



The Cognitive IoT Stack



01 Edge Layer – Autonomous Perception & Action

Models run directly on devices where decisions happen

- Quantized models (INT4/8: Yolo-NAS, Whisper) • Sub-10ms inference for control • Operates offline (99% uptime without cloud)

02 Coordination Layer – Collective Intelligence

Multiple devices coordinate as a system

- Swarm agents across intersections, fleets, facilities • Federated learning + on-prem orchestration • Local data sovereignty

03 Cloud Layer – Strategic Intelligence & Planning

Global models, long-horizon reasoning, simulation

- City-scale digital twins & demand forecasting • Foundation models trained on multimodal IoT data • Optimization + governance policies

04 Human Layer – Natural Interaction

People set goals, not manual commands

- Natural-language command interfaces • AR/visualization for situational awareness. • Human-in-the-loop governance & auditability

2025 Turning Point for AIoT

01 GenAI shifts to the edge

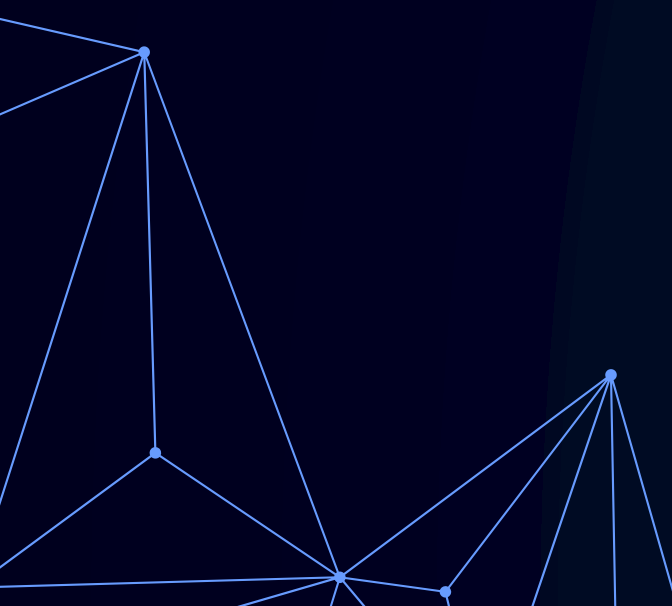
AI moves from cloud-only to **device-native** intelligence

- Foundation models and **GenAI** are being optimized to run directly on **devices** and **gateways**
- Agentic AI patterns enable **autonomous** workflows, reducing human intervention

02 Economic pressure

AI-powered **efficiency** becomes a necessity, not an option

- Operations, energy, and supply chain teams require **measurable ROI** from **automation**
- Running **inference on devices** cuts **cloud costs** and improves **responsiveness**



QMIC's IoT Cognitive System



SMART PARKING (GATE)

monitor-2 - 01/12/21 18:19:38

P23
DEV21SC002
In: 9 IO: 0
Out: -101 : 0
+ 186
-45

TRAFFIC & ROAD INCIDENTS MONITORING

QUEUE LENGTH
Automating measurement of traffic congestion intersections to ease traffic flow

مقياس طول الازدحام على التقاطعات بشكل تلقائي

FALCON-I

VEHICLES COUNTING AND CLASSIFICATION

SMART INTERSECTION & PROTECTED ZONES

SMART INTERSECTION MANAGEMENT

إدارة التقاطعات الذكية

FALCON-I

FIFA WORLD CUP Qatar 2022

Parking Monitoring Reports Settings

Al Janoub Education City Al Bayt More

Map Satellite

Al Janoub (الجنوب)
4800 Available (80%)
4000 available parkings of total 6000

P22
200 Available
1600 Occupied
80%

P23
600 Available
400 Occupied
60%

P24
400 Available
600 Occupied
60%

P24
0 Available
100% Occupied

450 P36
100 P33
35% Education City
120 P34
570 P38

Updated at: 01/09/2020, 14:40:40



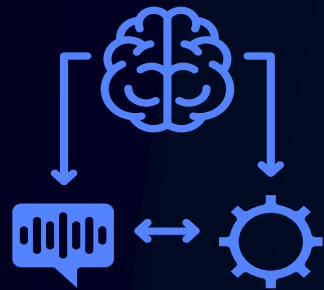
The GenAI Revolution

GenAI is transforming how we build, manage, and understand IoT systems by enabling **natural** interactions, **faster** development, and **intelligent** automation at scale unlocking significant **efficiency** and **operational** gains!



Natural Language Interface

- “Show me all temperature anomalies in Building 4.”
- “Generate maintenance schedule for critical assets.”
- “Explain why energy consumption spiked yesterday.”



Synthetic Data Generation

- Train AI models with realistic simulated scenarios
- Test edge cases without real-world risks
- Accelerate development cycles by 10x



Automated Code & Configuration

- GenAI writes device firmware updates
- Auto-generates integration code for new sensors
- Creates human-readable documentation instantly



Real-World Use Cases

INDUSTRIAL OPERATIONS



- Multimodal anomaly detection (vibration + thermal + acoustics) with GenAI-assisted root-cause

HEALTHCARE



- On-device summarization for wearables
- Shelf-cams with generative restocking suggestions

CONNECTED MOBILITY



- Generative perception enhancement on dash/edge; driver-assist copilots

SMART FACILITIES & ENERGY



- Agentic optimization for HVAC/lighting/EV chargers; 10–20% energy savings targets

Challenges in AI-Native IoT

Security & Trust

- Devices must defend **themselves**: **autonomous** threat detection & self-healing firmware
- Hardware-rooted identity + zero-trust per device, not per network

Interoperability & Semantic Understanding

- GenAI creates semantic digital twins of devices to enable plug-and-interoperate systems
- From protocol translation to intent-level interoperability

Data Governance & Local Intelligence

- Privacy-preserving learning (federated, on-device fine-tuning)
- **Local inference** reduces the need to move sensitive data across borders

Energy & Compute Efficiency

- On-device inference cuts cloud traffic and energy draw dramatically
- Emerging neuromorphic + event-driven chips promise orders-of-magnitude lower power

Why Devices Themselves Must Think

We can't stream everything to the cloud. The edge becomes the brain.



More Connected Devices

21.1B connected IoT devices in 2025;
on track for ~39B by 2030
(IoT Analytics)

Local decisions, not central processing



Cellular IoT

~4B cellular IoT connections
end-2024; >7B by 2030
(~11% CAGR, Ericsson)

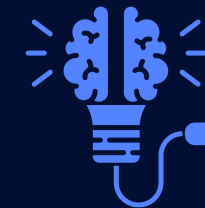
Networks carry events, not raw streams



Edge AI market

Edge AI market ~\$25–26B in 2025;
projected >\$140B by 2034
(Precedence Research)

Intelligence shifts into endpoints



Edge ML Tech.

TinyML going mainstream across
MCUs; new AI-capable
microcontrollers (e.g., STM32N6)

Devices now capable of running models

Roadmap to Autonomous Systems

AI is rapidly reshaping connected systems: moving IoT from **basic** data collection to **predictive** intelligence, **autonomous agents**, and fully **self-managing** environments.



2025: Predictive

Edge AI predicts failures and patterns (e.g., predictive maintenance).

Reduced downtime and operational cost savings.

2030+: Autonomous

A fully autonomous, collaborative ecosystem of devices and agents, optimized by AI.

Transformational operational agility and entirely new business models.

2024: Reactive

IoT devices collect data. Humans analyze it. AI is in the cloud.

Efficiency depends heavily on manual analysis.

2027: Agentic

On-device Gen AI creates "agents" that understand context and perform multi-step tasks.

Faster decisions, lower latency, and more adaptive operations.

Let's Connect!

DR. FETHI FILALI

EMAIL

filali@qmic.com

LINKEDIN

