

10 Practical Considerations for IoT Product Development

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When developing IoT products, teams often face numerous real-world challenges. Here are ten practical considerations to keep in mind throughout the development process:

1. Battery Life Optimization

Battery life can make or break an IoT product. Consider these practical steps:

- ▶ Implement aggressive sleep modes when the device is idle.
- ▶ Use low-power components and optimize their usage.
- ▶ Batch data transmissions to reduce radio on-time.
- ▶ Optimize your firmware to reduce processing time.



Practical tip: Use a power profiler like Nordic's Power Profiler Kit II to measure real-world power consumption and identify power drains.



Use Case:

A startup developing a wildlife tracking device struggled with poor battery life. By switching to low-power components and implementing sleep modes when the device was not actively transmitting, they extended battery life from one week to three months, significantly reducing maintenance trips to replace batteries.

2. Reliable Wireless Connectivity

Connectivity issues are common in real-world deployments. Address these by:

- ▶ Implementing robust error handling and reconnection mechanisms.
- ▶ Using mesh networking for extended range and reliability.
- ▶ Considering multi-radio solutions (e.g., Wi-Fi + BLE) for flexibility.
- ▶ Testing in various real-world environments, not just lab conditions.



Practical tip: Use tools like Wireshark to analyze network traffic and identify connectivity issues in your prototypes.



Use Case:

An agricultural company faced connectivity problems with their soil moisture sensors in remote fields. By adding a mesh networking protocol and testing in various environmental conditions, they ensured consistent data transmission across all devices, even in challenging terrains.

3. Environmental Durability

IoT devices often operate in harsh environments. Ensure durability by:

- ▶ Choosing appropriate IP-rated enclosures.
- ▶ Using conformal coating on PCBs for moisture resistance.
- ▶ Implementing temperature compensation in sensor readings.
- ▶ Testing prototypes in environmental chambers to simulate extreme conditions.



Practical tip: Partner with an experienced mechanical design firm for enclosure development if your team lacks this expertise.



Use Case:

A company creating outdoor air quality sensors found their devices failing in humid conditions. After incorporating conformal coatings and upgrading to IP65-rated enclosures, their sensors became reliable.

4. Over-the-Air (OTA) Update Infrastructure

OTA updates are essential for long-term support. Implement a robust system by:

- ▶ Using A/B partitions for failsafe updates.
- ▶ Implementing version rollback capabilities.
- ▶ Ensuring updates can resume if interrupted.
- ▶ Testing update processes thoroughly, including power loss scenarios.



Practical tip: Use RNDSquare IOT RMS or similar services for managing your OTA update infrastructure instead of building it from scratch.



Use Case:

A fleet management company needed to deploy a critical software update to all their vehicle trackers. Using OTA with A/B partitioning, they successfully updated 1,000 devices with zero failures, even when some devices experienced power interruptions during the update.

5. Data Management and Storage

Efficient data handling is crucial for IoT devices. Consider:

- ▶ Implementing efficient data compression before transmission.
- ▶ Using appropriate data storage (e.g., SPIFFS for small filesystems).
- ▶ Implementing data caching mechanisms for offline operation.
- ▶ Ensuring data integrity with checksums or error-correcting codes.



Practical tip: Use database solutions designed for IoT, like InfluxDB, for time-series data storage and analysis.

6. Debugging and Logging

Effective debugging is vital for development and post-deployment support:

- ▶ Implement comprehensive logging with multiple verbosity levels.
- ▶ Use SEGGER's J-Link for advanced debugging capabilities.
- ▶ Implement remote logging for deployed devices.
- ▶ Use assertion statements liberally in your code.



Practical tip: Implement a circular buffer for logs to avoid filling up storage while still capturing recent events.

7. Security Implementation

Security is often overlooked but is crucial. Practical steps include:

- ▶ Using secure boot mechanisms to prevent firmware tampering.
- ▶ Implementing secure storage for sensitive data (e.g., using ARM's TrustZone).
- ▶ Using strong, unique default passwords for each device.
- ▶ Implementing certificate-based authentication for cloud communication.

8. Power Supply Design

Reliable power supply is critical for IoT devices:

- ▶ Use LDOs with low quiescent current for battery-powered devices.
- ▶ Implement brown-out detection and safe shutdown procedures.
- ▶ Consider adding a small supercapacitor for handling power spikes.
- ▶ For AC-powered devices, ensure your power supply can handle wide input ranges.



Use Case:

An industrial IoT sensor manufacturer faced frequent device resets due to power fluctuations. By redesigning the power supply with a supercapacitor and brown-out detection, they eliminated unexpected resets, improving system reliability.

9. Certification and Compliance

Certification is often underestimated but is crucial for product launch:

- ▶ Start EMC/EMI design considerations early in the development process.
- ▶ Use pre-certified modules when possible to simplify certification.
- ▶ Budget time and resources for certification testing and potential redesigns.
- ▶ Familiarize yourself with regulations in all target markets (FCC, CE, etc.).



Practical tip: Conduct pre-compliance testing using tools like Tekbox's TBTC2 TEM cell to identify potential EMC issues early.

Use Case:

A new startup rushed their product to market without considering EMC compliance, leading to costly



redesigns. By incorporating pre-certified modules in their redesign, they quickly passed certification and avoided further delays.

10. Enclosure Selection

Selecting the right enclosure is crucial for durability and functionality:

- ▶ **Plastic Mold:** Suitable for lightweight and cost-effective solutions.
- ▶ **3D Printing:** Ideal for rapid prototyping or low-volume production.
- ▶ **Metal Sheet:** Provides robustness and durability for industrial environments.
- ▶ **Off the Shelf:** Cost-effective and time-saving for standard requirements.



Practical tip: If opting for an off-the-shelf enclosure, choose the enclosure first and design the PCB accordingly to fit within the available space.

Remember, IoT product development is an iterative process. Be prepared to go through several prototype iterations, and always test your device in real-world conditions as early and as often as possible.