UO-TECH

SKYTRAC Hack-a-thon

Presentation Date: April 1st , 2025

PROBLEM STATEMENT AND THE SOLUTION

Problem: Connecting to the aircraft while it is far from network towers or in a disaster zone where standard connectivity is unreliable

Solution: Build a linux-based networking service using the Iridium Certus 9770.

GLOSSARY

LCP: Link Control Protocol
PPP: Point-to-Point Protocol
AP: Authentication Protocol
NCP: Network Control Protocol
Systemd: System Deamon
LTE: Long Term Evolution
REST: Representative State Transfer
JSPR: JSON-based Serial Protocol for REST
LCR: Least Cost Rounting

CORE COMPONENTS OF THE SOFTWARE

Daemon Manager

- Handles logging, signal handling, and error recovery
- Uses system calls (fork, setsid) to detach from the terminal

Connection Handler

- Starts the PPP daemon (pppd) and monitors the connection.
- Ensures the interface is up and properly configured.
- Restarts the connection if it drops.
- Give PPP status
- Communicate with LCR

Serial Communication Handler

- Sends commands (ATD*99# to start a data session)
- Reads responses from the modem
- Manages timeouts and retries

Message Processor

- Handles data buffering and retries in case of failure.
- Encodes/decodes messages sent to and received from the modem.

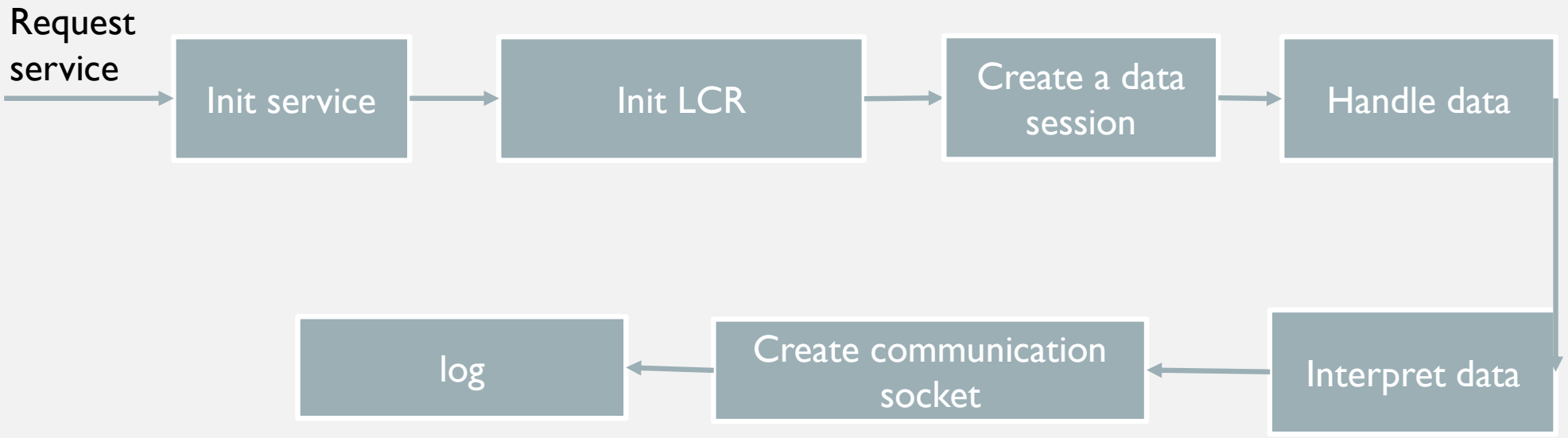
Network Request Handler

- Handles data transmission
- Reads responses and processes them
- Uses sockets for network communication

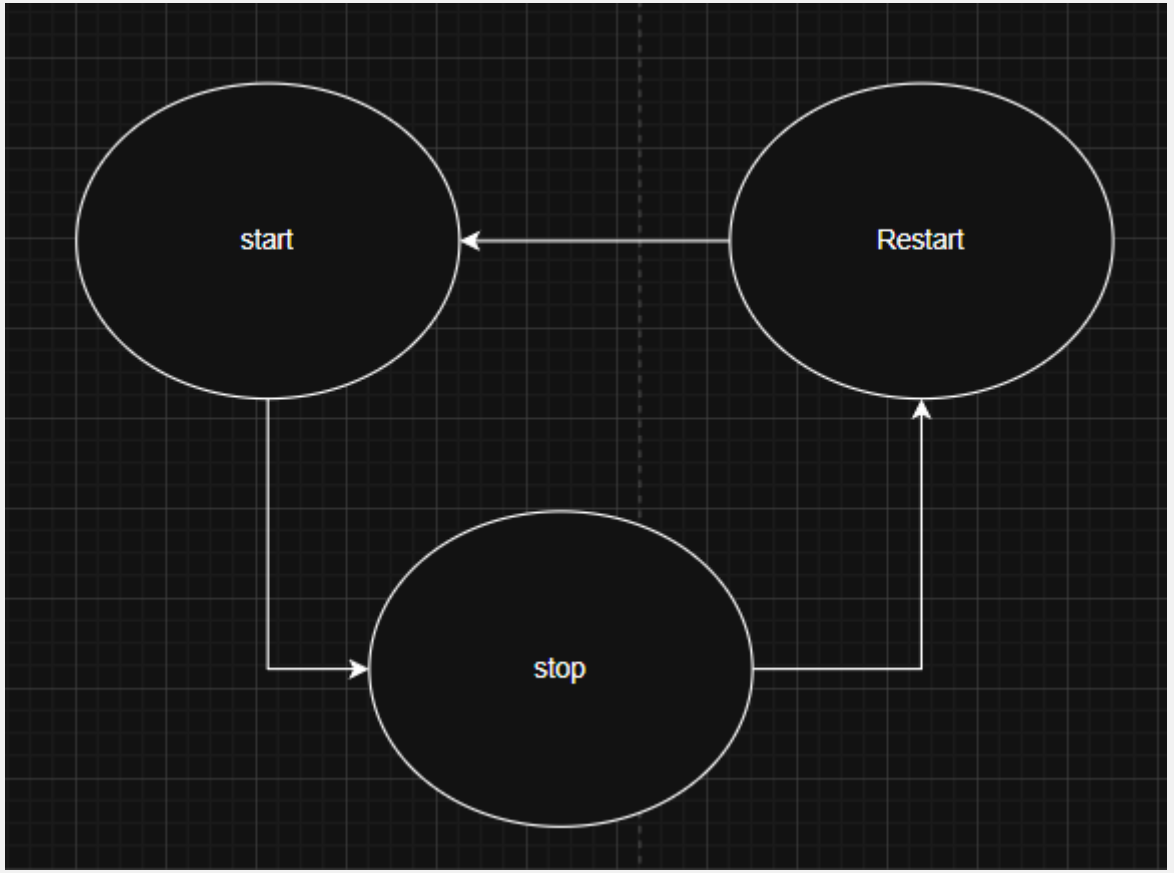
Logging & Monitoring

- Saves connection status, errors, and data events to a log file

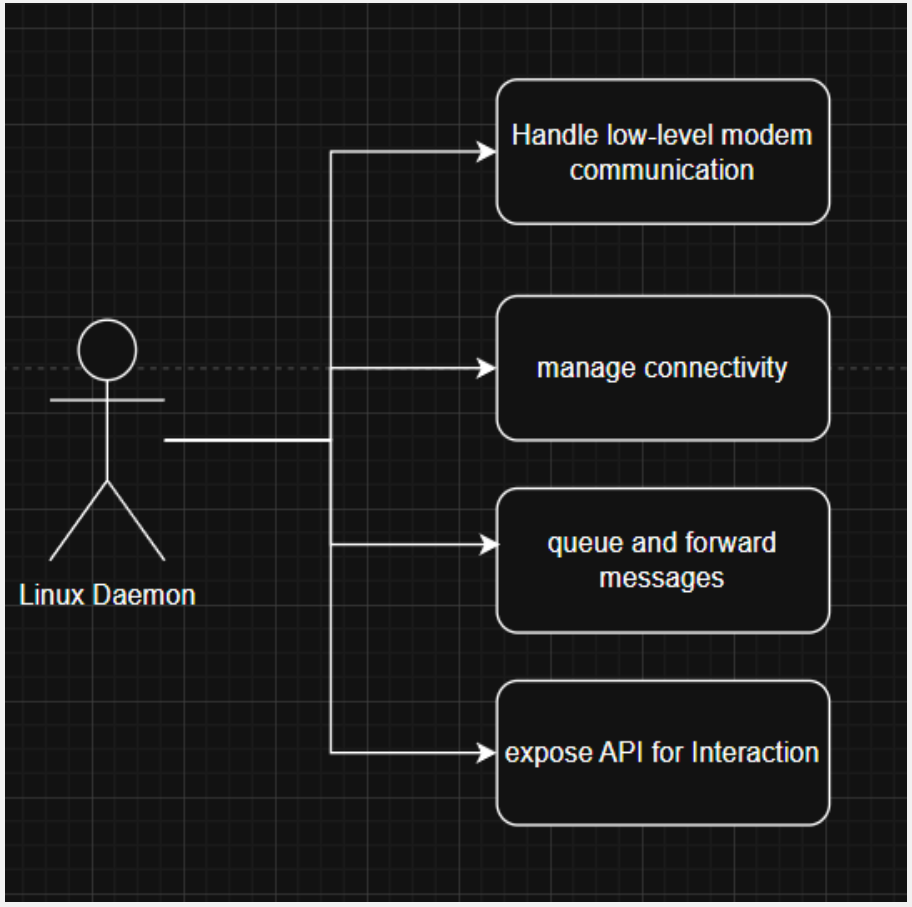
CORE COMPONENTS ACTION SEQUENCE

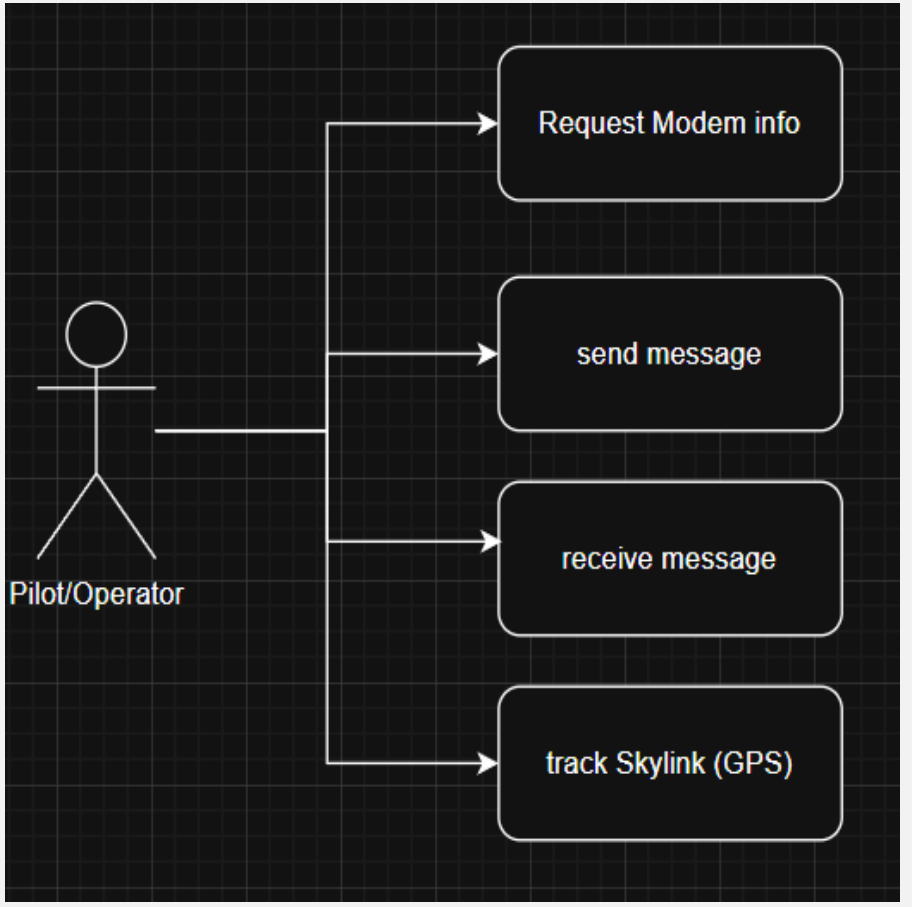


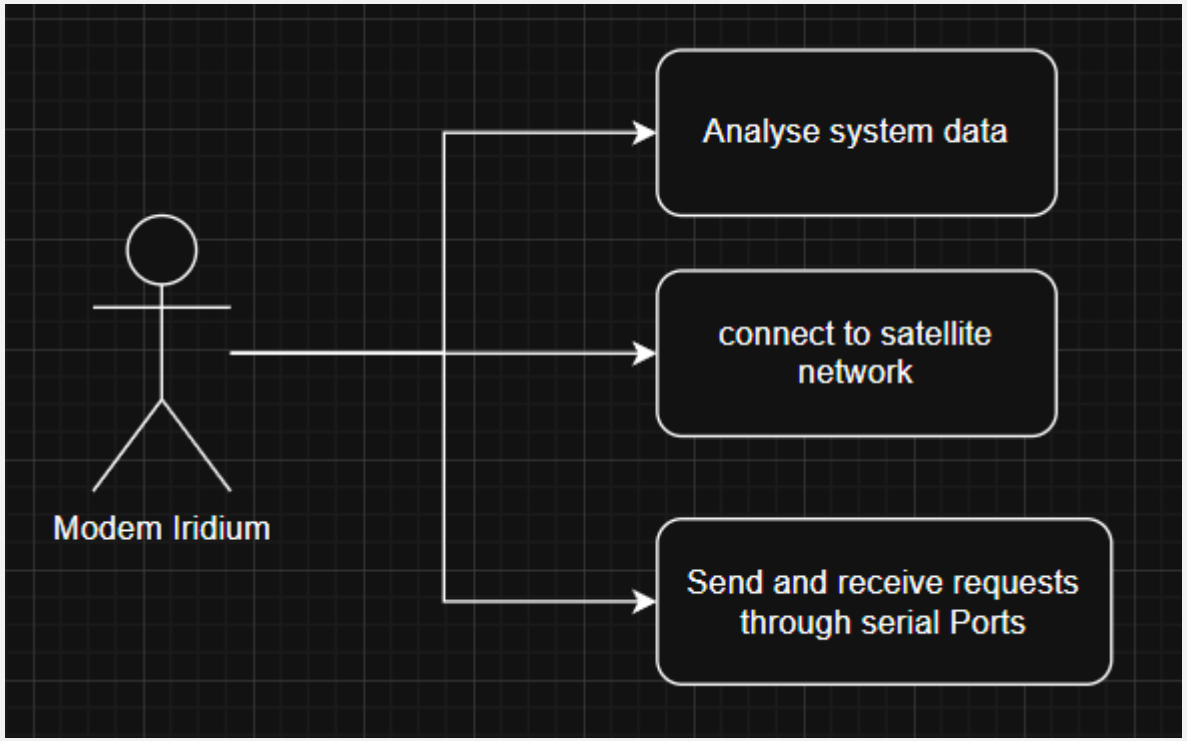
SERVICE LIFECYCLE



USE CASES

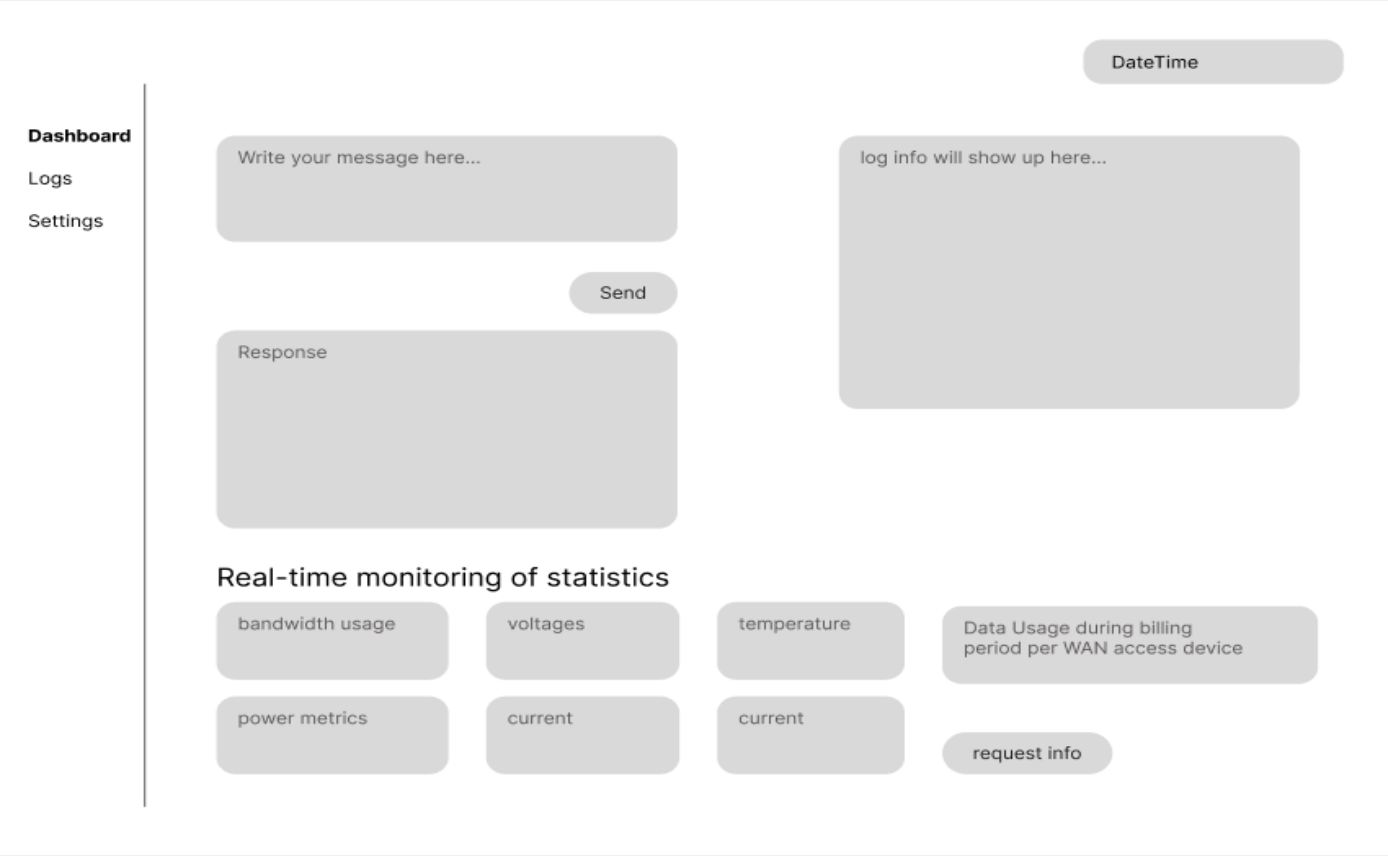

Handle low-level modem communication
manage connectivity
queue and forward messages
expose API for Interaction
Linux Daemon


Request Modem info
send message
receive message
track Skylink (GPS)
Pilot/Operator


Analyse system data
connect to satellite network
Send and receive requests through serial Ports
Modem Iridium

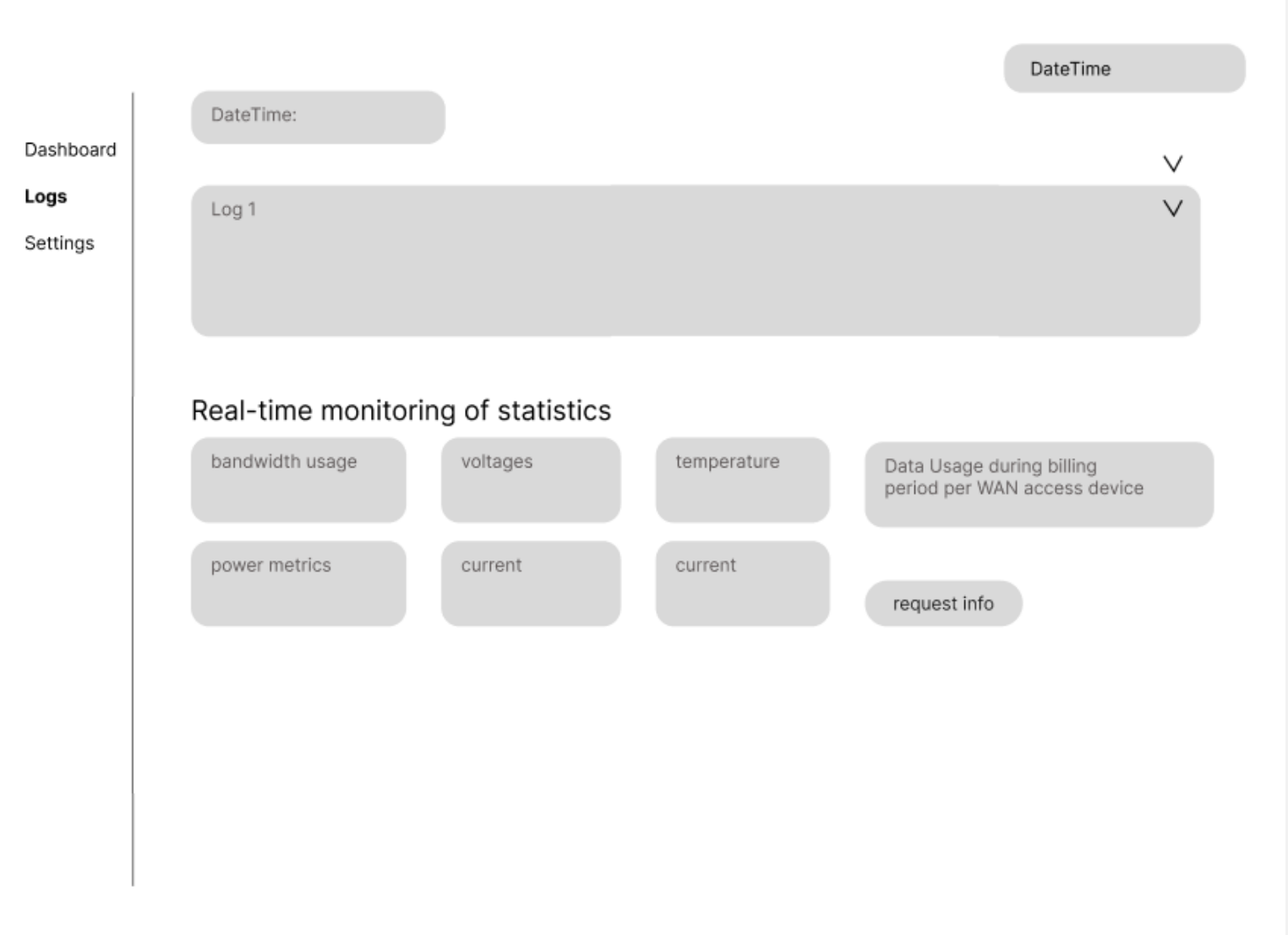
WEB UI

Dashboard Page

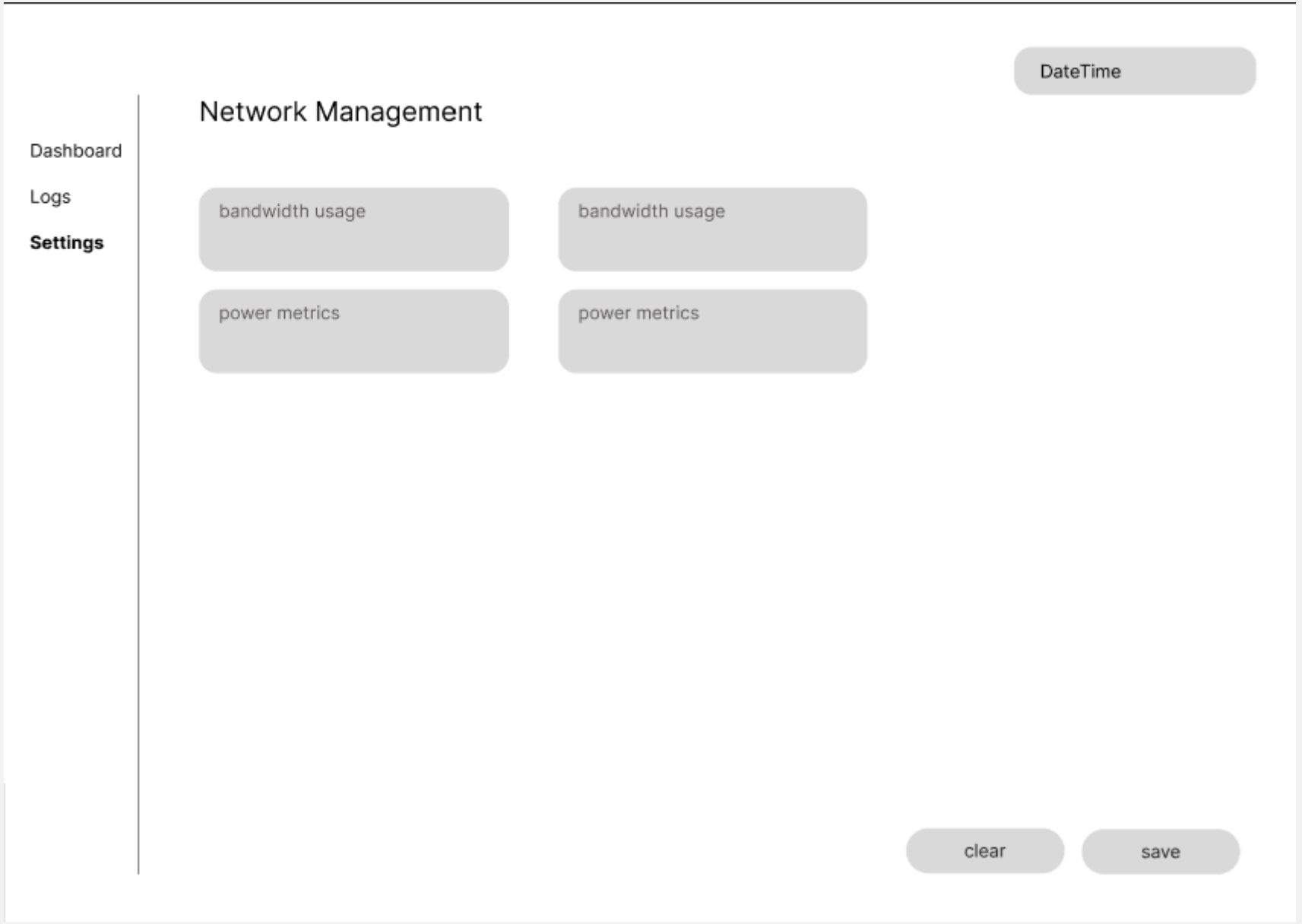


Designed using Figma - [link]

Logs Page


DateTime
DateTime:
Dashboard
Logs
Settings
Log 1
Real-time monitoring of statistics
bandwidth usage
voltages
temperature
Data Usage during billing period per WAN access device
power metrics
current
current
request info

Settings Page

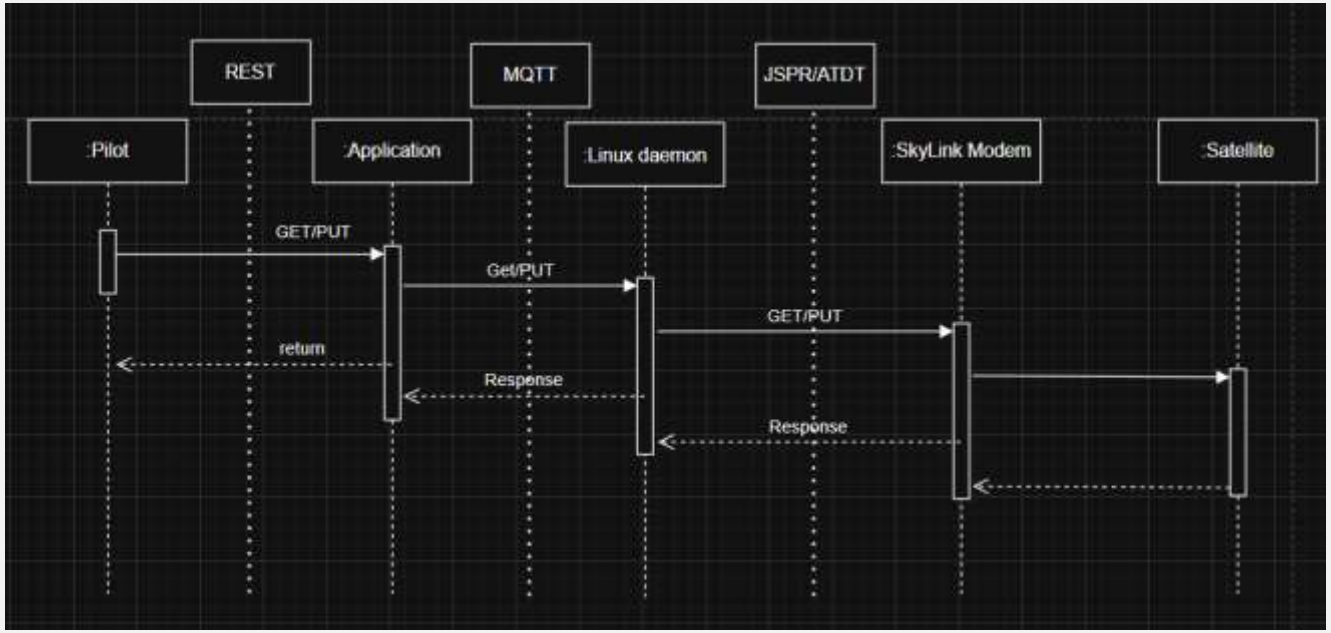


STACKS AND TECHNOLOGIES

Documentation manager

ADR- Architectural Decision Records - link

Communication



Website

Front-end

React

Back-end

NextJS

Software

C++

Linux image

Yocto-Based linux system (poky)

LCR (LEAST COST ROUTING) SOLUTION

Network Monitoring & Metrics Collection

- Monitor signal strength, latency, bandwidth, and cost per MB for each available network.
- Use MQTT-based status reporting for real-time data collection.

Decision-Making Algorithm

- Searches to find the cheapest network
- Implement a dynamic scoring system that weighs:
  - Cost per MB
  - Signal strength
  - Bandwidth availability
  - Network priority (set by admin)

Seamless Handover

- Implement failover/fallback mechanisms: If a primary network degrades, auto-switch to the best alternative.
- Minimize disruptions when switching between networks.
- Utilize "Modem Manager (MM)" to switch LTE networks.

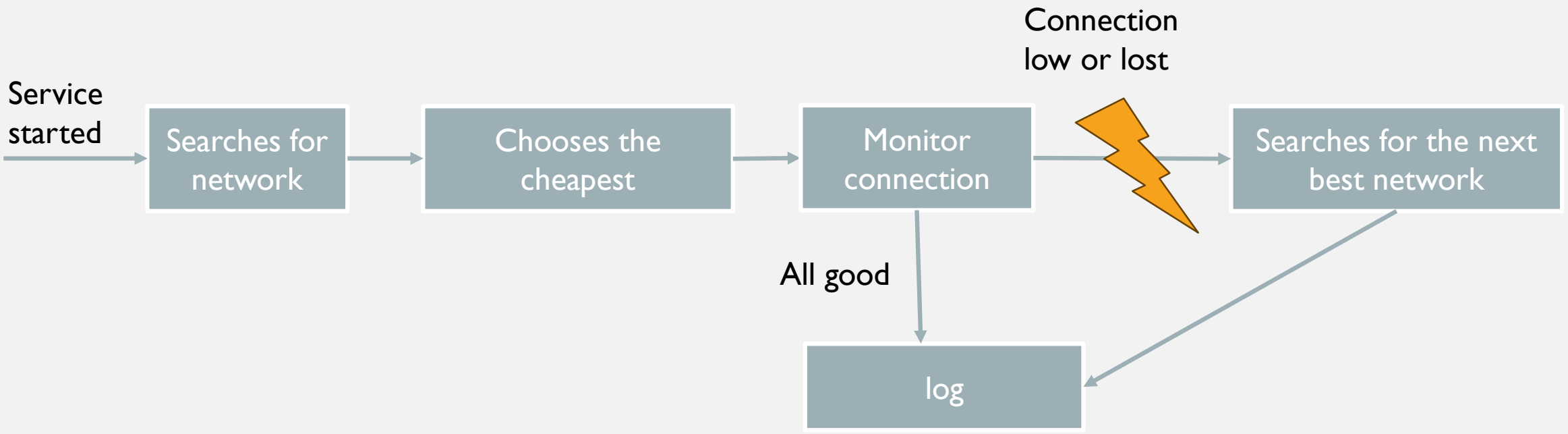
Configuration & UI

- Expose network priority and cost settings in the UI
- Allow users to define cost threshold for switching
- Allow SSID and PassKey configuration in the UI for wi-fi local connectivity

Security & Efficiency

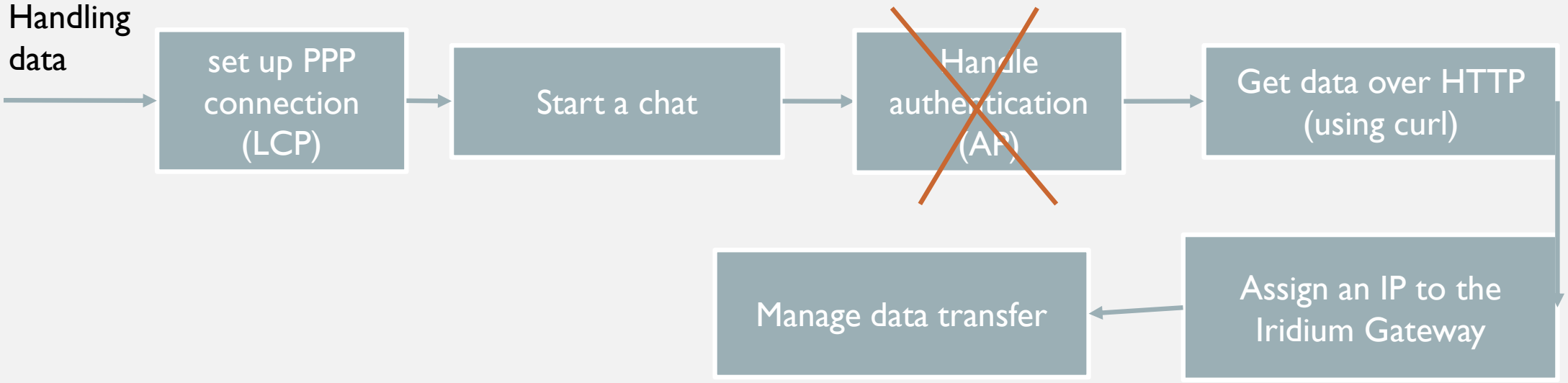
- Secure network transitions to prevent unauthorized access or tampering.
- Optimize CPU/memory usage since it's running on ARM hardware.

LCR ACTION SEQUENCE

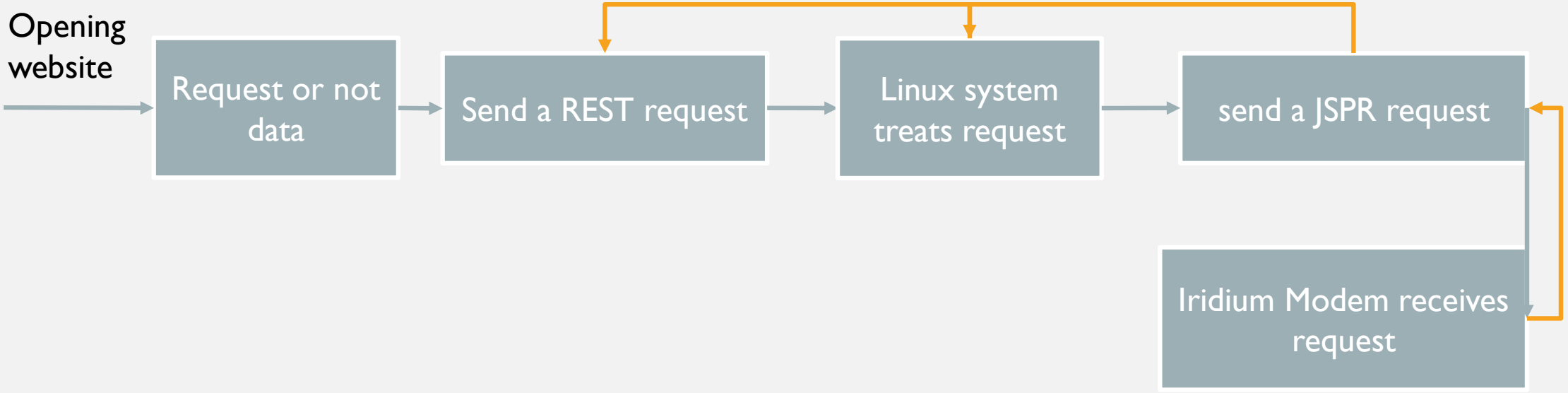


PPPD (PPP DAEMON) MANAGEMENT

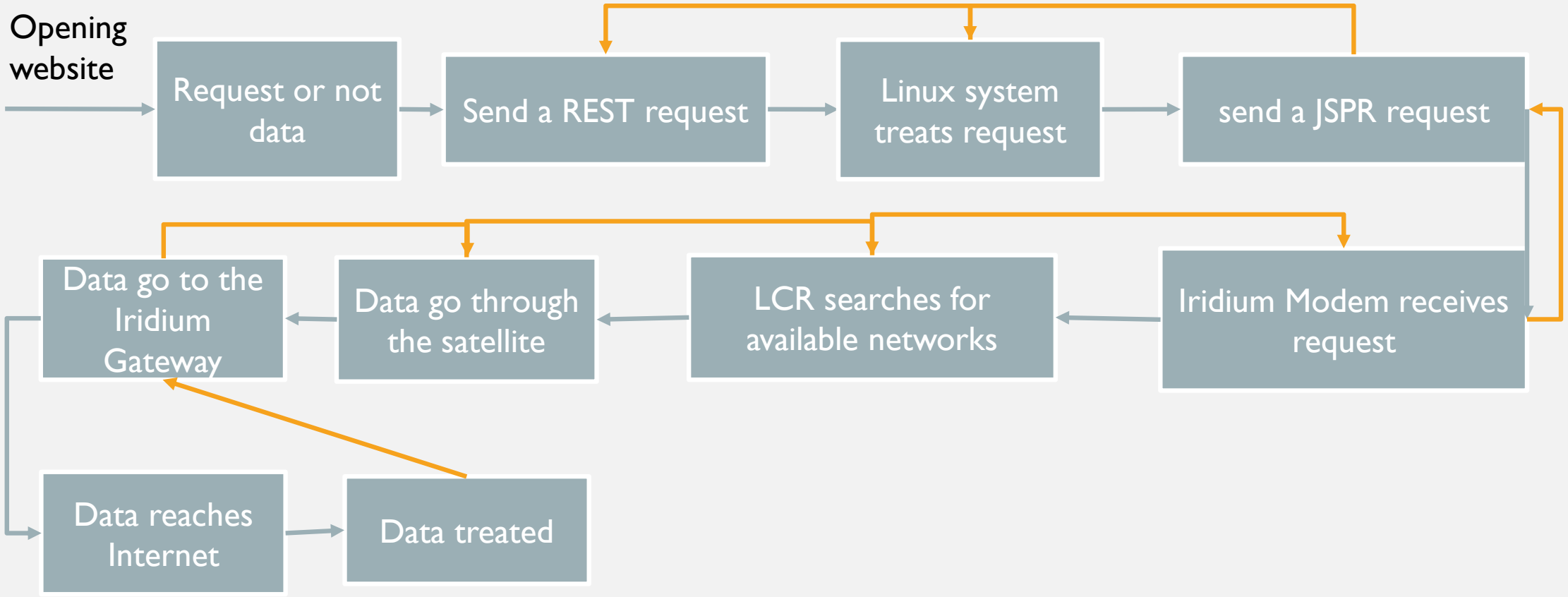
To handle dial-up network connections for cellular modems and satellite links



USE CASE IMPL. FOR DATA REQUEST



USE CASE IMPL. FOR SENDING DATA THROUGH GATEWAY



V1 CHECKLIST

- Full-stack website
- Linux daemon
- Communication set up between the website and the daemon
- Linux-based system embedded into Iridium through Ethernet
- System works independently

V2 CHECKLIST

VoIP (voice over IP)

GPS

Thank you!

uO-tech Team members:

Anas Hammou
Hamzo Bouzoubaa
Hiba Tantawi
Ichrak El Hatimi