🌍 What is a Smart City IoT System?

A **Smart City IoT (Internet of Things) system** uses interconnected devices and sensors deployed across the city to collect real-time data.
This data is used to monitor, manage, and optimize **urban infrastructure and services** like:

- 🚦 **Traffic Management** (reducing congestion, optimizing signals)
- 🌦️ **Weather & Environment Monitoring** (air quality, rainfall, noise)
- 💡 **Smart Lighting** (adjusting streetlights based on need)
- 🔋 **Energy Management** (power consumption, renewable usage)
- 🚗 **EV Charging Stations** (monitoring usage and efficiency)
- 🏙️ **Public Safety & Maintenance** (detecting anomalies, scheduling repairs)

In short, the goal is to make cities:
✔️ More efficient
✔️ More sustainable
✔️ Better for citizens' quality of life

🏗️ How Your Table Fits (Schema Explanation)

Your `smart_city_iot_data` table is a **raw staging table** (before normalization). It records **every reading/event** from an IoT device. Let's break it down:

1. Identifiers

- `record_id` → Unique row identifier (primary key).
- `device_id` → Unique ID of the IoT sensor/device.
- `device_type` → Type of device (Traffic Sensor, Weather Sensor, Smart Light, EV Charger, etc.).

👉 These fields help track **which device generated which data**.

2. Location

- `location_name` → Human-readable name (like "Location-208" or "Main Street").
- `latitude`, `longitude` → GPS coordinates for precise positioning.

👉 Useful for **mapping sensors on dashboards** or grouping readings by area.

3. Timestamp

- `timestamp` → When the reading was captured.

👉 Core for **time-series analysis** (trends, forecasting, anomalies).

4. Measurements (Sensor Data)

- `temperature`, `humidity`, `air_quality_index`, `noise_level`, `traffic_density`, `power_consumption`, `light_intensity`, `rainfall`, `wind_speed`.

👉 Each metric depends on **device_type**:

- Weather sensors → Temp, humidity, rainfall, wind speed.
- Traffic sensors → Vehicle counts, noise.
- Smart lights → Light intensity, power consumption.
- EV chargers → Power consumption, uptime.

5. Device & System Health

- `system_status` → Active / Inactive / Maintenance.
- `battery_level` → Important for remote sensors.
- `connectivity` → 4G, 5G, WiFi, LoRaWAN (IoT protocols).
- `firmware_version` → Software version on the device.

👉 Ensures devices are working properly and helps with **predictive maintenance**.

6. Maintenance & Quality

- `last_maintenance_date` → When the device was last serviced.
- `remarks` → Notes from maintenance logs.
- `anomaly_detected` → Flag for abnormal behavior.

👉 Useful for **device lifecycle management** and **fault detection**.

📊 Why This Data is Valuable

With this dataset, cities can:

- **Monitor air quality & noise** → Public health impact.
- **Optimize energy use** → Smart lights & EV charging.
- **Reduce congestion** → Real-time traffic monitoring.
- **Detect anomalies** → Broken sensors, cyberattacks, unexpected patterns.
- **Schedule maintenance** → Based on actual device performance.

📦 Next Steps (Data Processing)

1. **Normalization**: Split into Dimensions (Devices, Locations, Maintenance) + Fact Table (Measurements).
2. **Load into Power BI**: Build dashboards for traffic, energy, weather, maintenance KPIs.
3. **Analytics**:
    - Average AQI per area
    - Energy consumption trends
    - Traffic congestion heatmaps
    - Predictive maintenance alerts