📘 CHAPTER 11: Memory Budget Report — Per Device ID

A compact technical brief suitable for your fleet analytics documentation.

1. Column Group Breakdown (Optimized Data Types)

This table now includes:

- Old Type
- Old Bytes per Cell
- Suggested Type
- New Bytes per Cell

So you can directly compare category-level savings.

📄 Notion-Ready Table – Attribute Groups

Column Group	Example Attributes	Old Type	Old Bytes/Cell	Suggested Type	New Bytes/Cell	Notes
Cell Voltages	Pack_cellVoltage_1–576	REAL	8 bytes	DECIMAL(4,3)	**4 bytes**	0–4.999 ' exact; av float erro
Temperature Sensors	Pack_Temperature*, CellMaxTemperature, MotorTemp	REAL/DOUBLE	8 bytes	SMALLINT	**2 bytes**	Range −4 215 fits si int16
VIN Digits	vin_digit_1–17	REAL/BIGINT	8 bytes	TINYINT	**1 byte**	0–255
Lifesignal Counters	BMSlifesignal, AirpumpDCACLifesignal	REAL/BIGINT	8 bytes	TINYINT	**1 byte**	Roll-over counters
Status Flags	IgnitionStatus, Gun_Connection_Status	REAL/SMALLINT	8 bytes	BOOLEAN/TINYINT	**1 byte**	Only 0/1
State Variables	vehicle_operation_mode, Pre_Charge_status	REAL	8 bytes	TINYINT	**1 byte**	Enum val 7 or 0–15
Alarms & Fault Codes	Temperaturedifferencealarm, BMS_Fault_Code, EVCC_ERROR	REAL	8 bytes	TINYINT	**1 byte**	All <255
SOC / SOH	bat_soc, soh	REAL	8 bytes	DECIMAL(4,1)	**4 bytes**	Supports 100.0
Battery Current	total_battery_current	REAL	8 bytes	DECIMAL(6,1)	**4 bytes**	−3200.0 3200.0
Battery Voltage	bat_voltage	REAL	8 bytes	DECIMAL(5,1)	**4 bytes**	e.g. 662.5
DC Link Voltages	DCDCbusvoltage	REAL	8 bytes	SMALLINT	**2 bytes**	Up to 100
Distance / Range	DistancetoEmpty	REAL	8 bytes	DECIMAL(6,3)	**4 bytes**	0–999.99
Odometer	OdoMeterReading	REAL	8 bytes	DECIMAL(12,3)	**8 bytes**	Up to 5,000,00 km
Pedal Inputs	AccelarationPedal, BrakePedalPos	REAL	8 bytes	DECIMAL(6,3)	**4 bytes**	0–120.00
Speed	vehicle_speed_vcu	REAL	8 bytes	DECIMAL(6,3)	**4 bytes**	0–120.00 km/h
Pressure Sensors	Front/Rear_Air_Pressure	REAL	8 bytes	SMALLINT	**2 bytes**	Range 0–

Column Group	Example Attributes	Old Type	Old Bytes/Cell	Suggested Type	New Bytes/Cell	Notes
RPM Signals	Motor_RPM, Steering_Pump_RPM	REAL	8 bytes	SMALLINT	**2 bytes**	0–5000 r
Metadata / Versions	VCUversionInformation	REAL	8 bytes	DECIMAL(6,3)	**4 bytes**	e.g. 12.34
Timestamps	timestamp, insert_timestamp	TIMESTAMP	8 bytes	TIMESTAMP	**8 bytes**	No chang

2. Memory Consumption — Per Row

Per-row bytes (after type optimization):

- Cell voltages ＝ **2304 bytes**
- Temperatures ＝ **216 bytes**
- TINYINT signals ＝ **150 bytes**
- DECIMAL values ＝ **80 bytes**
- RPM + Pressure ＝ **20 bytes**
- Timestamps ＝ **16 bytes**
- Misc metadata ＝ **40 bytes**

Total ≈ 2826 bytes per row → ~3.0 KB/row

3. Per-Day Memory — One Device-ID

Assuming 1-second data rate:

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86400 rows × 3 KB ≈ 253 MB per device per day
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≈ 250 MB/day per device (post-optimization)

vs

~800–1200 MB/day originally

≈ 70–80% reduction in storage footprint

4. Summary (Notion-Ready)

- Optimized schema reduces memory from **1.0 GB/day → 0.25 GB/day per ID**
- DECIMAL choices ensure precision for SOC, SOH, currents, voltages, speeds
- SMALLINT/TINYINT dramatically reduce temperature / VIN / alarm footprint
- All values now safely fit actual DBC-derived ranges
- Parquet + predicate pushdown will further reduce read-time memory pressure