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Evaluating the Performance of Java Application Caches in EPOS GNSS Data and Products Portals

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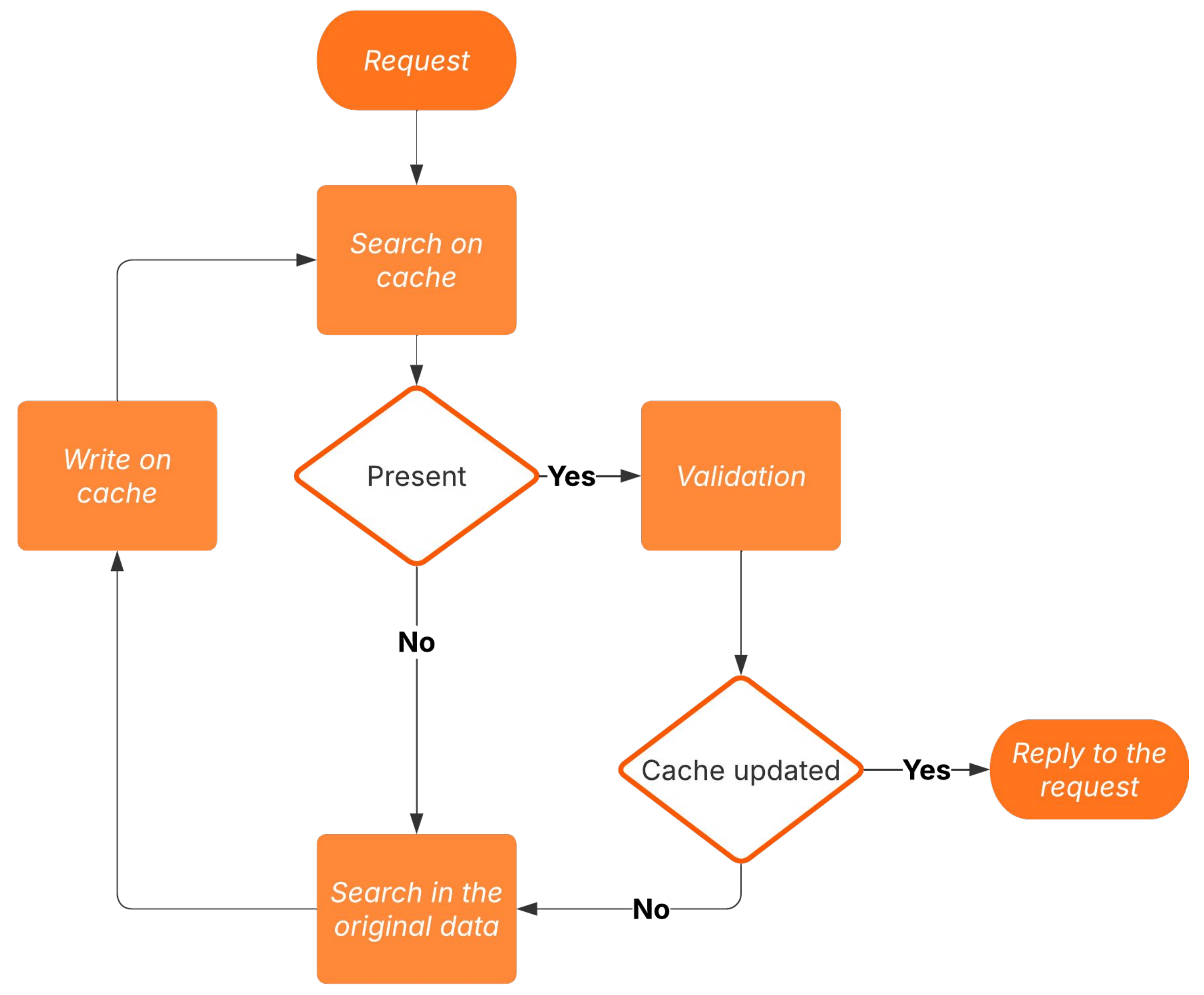
RESUME

Caching is a crucial component for enhancing the performance and scalability of web applications and database applications. This study investigates the performance characteristics of various caching solutions, including in-memory and distributed caches, within web and database environments. The primary objective is to identify optimal caching software and strategies, assess the impact of different caching frameworks on application responsiveness and throughput.

By combining benchmarking, profiling, and real-world scenario testing, this research aims to deliver valuable insights into the optimization of web application caches. The findings will contribute to improving applications performance, scalability, and user experience on EPOS GNSS Data and Products.

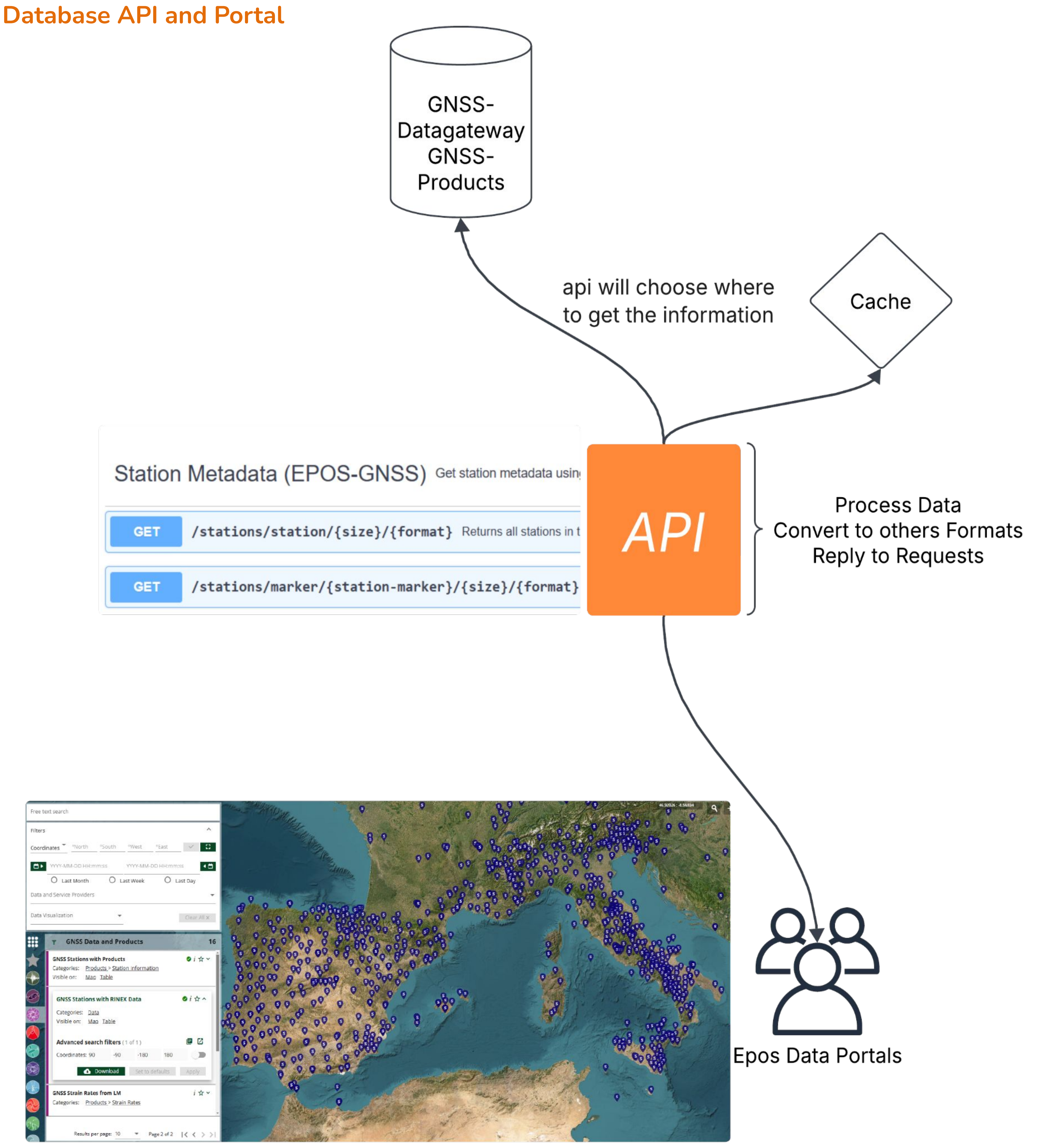
Cache Fundamentals



Cache is a type of fast, temporary storage designed to boost system performance by keeping copies of frequently accessed data in a location that's quicker and more efficient than the original source. This helps prevent repeated searches in slower or more costly sources.

🌟 Benefits	⚠ Limitations
✅ **Faster response times** – Data loads quickly by avoiding repeated and costly queries.	❌ **Outdated data** – Cached data may become stale, leading to inconsistencies.
✅ **Reduced system load** – Fewer queries to databases or remote services improve efficiency.	❌ **Complex configuration** – Balancing cache size, expiration policies, and update frequency can be challenging.
✅ **Optimized resource usage** – Less processing and data transport reduce costs.	❌ **Potential performance issues** – Poor cache management can lead to excessive memory and CPU usage, harming performance.

Database API and Portal

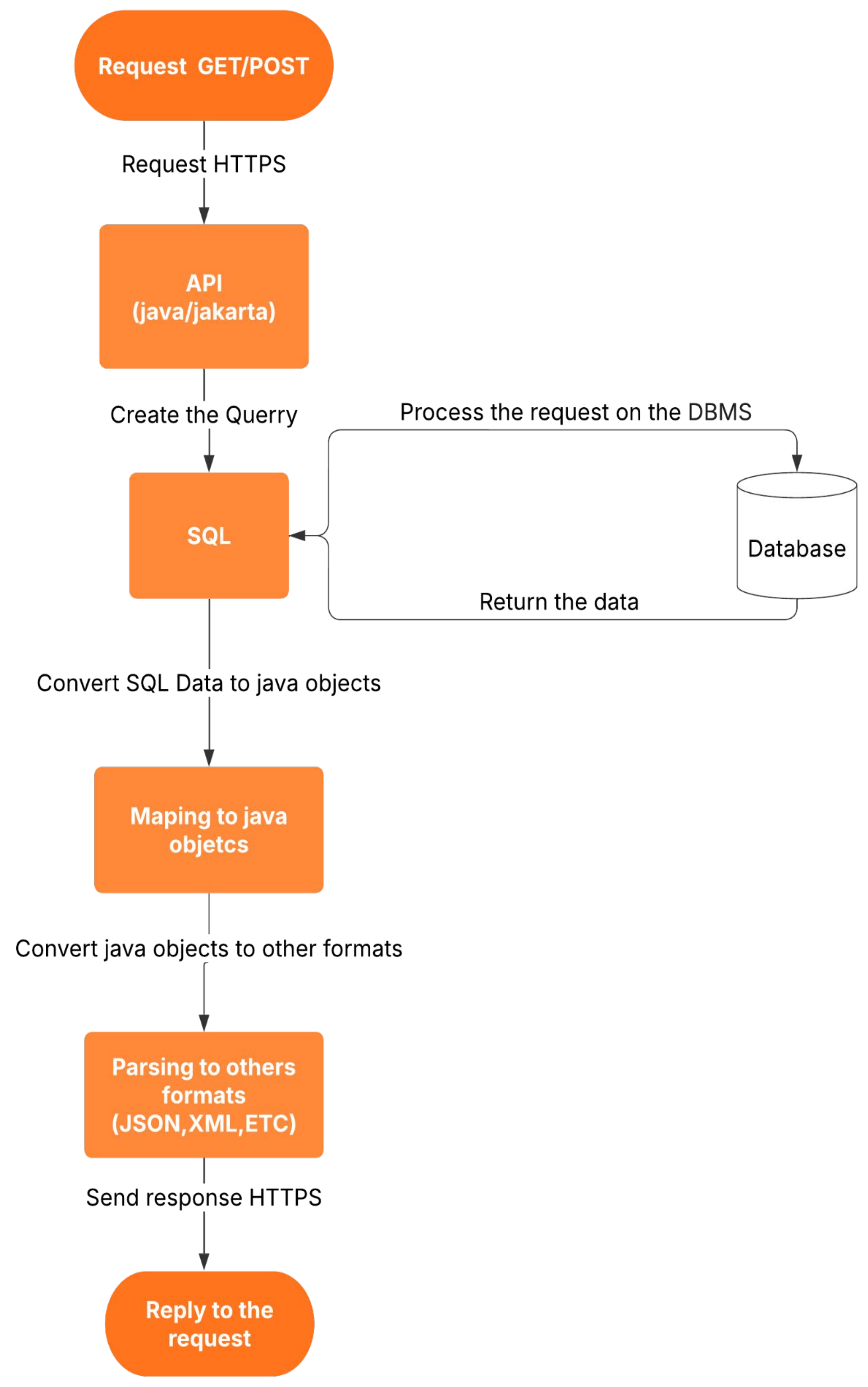

GNSS-Datagateway GNSS-Products
api will choose where to get the information
Cache
API
Process Data
Convert to others Formats
Reply to Requests
Epos Data Portals

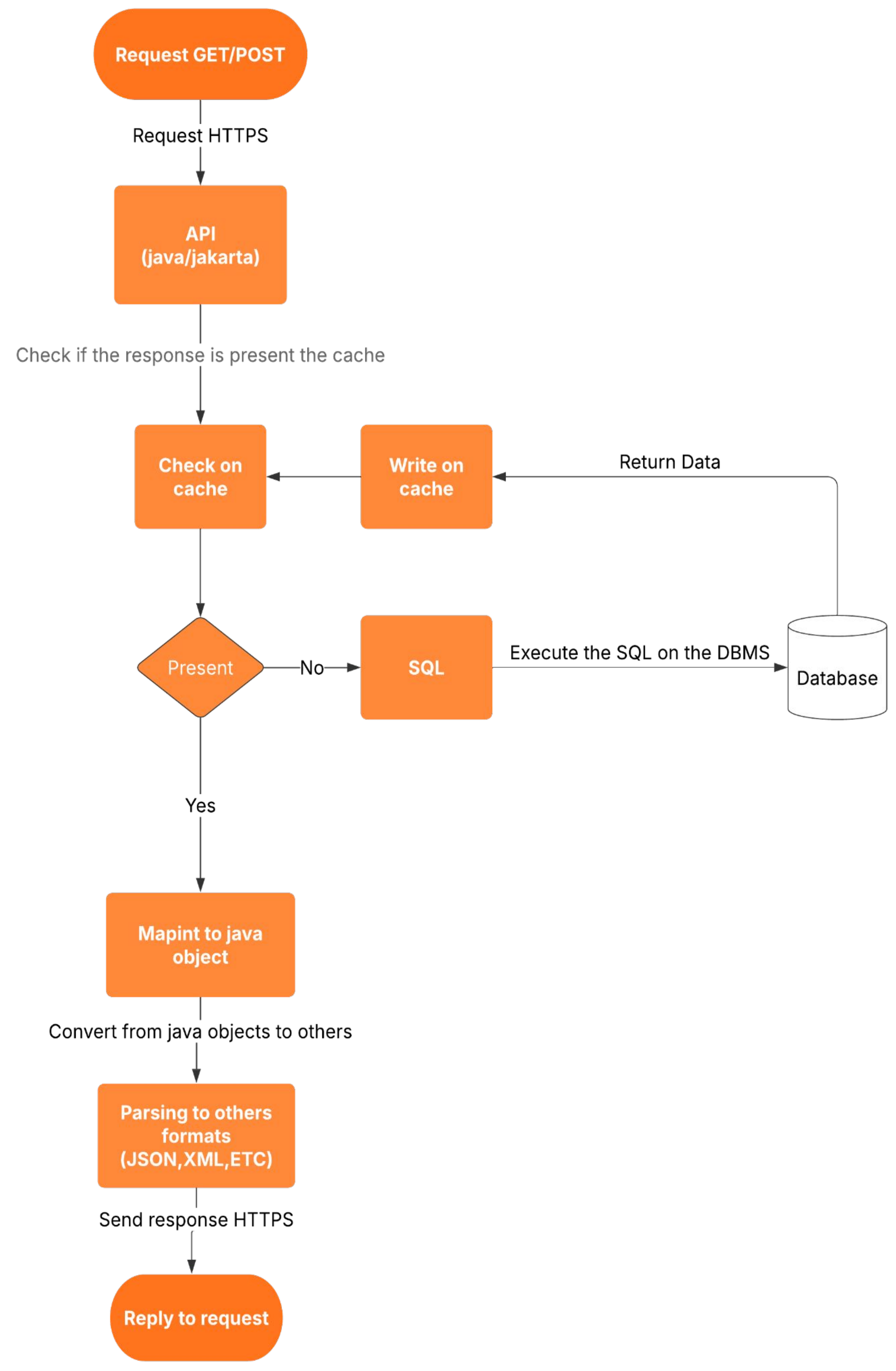
Station Metadata (EPOS-GNSS) Get station metadata usin

GET /stations/station/{size}/{format} Returns all stations in t

GET /stations/marker/{station-marker}/{size}/{format}

Flow of Data inside the API without and with cache implementation





Some frameworks on study

Apache Ignite

Advantages	Disadvantages
✅ Distributed caching with persistence	❌ Complex setup and configuration
✅ High availability and fault tolerance	❌ Requires significant system resources

Guava Cache

Advantages	Disadvantages
✅ Fast and lightweight	❌ No persistence
✅ Easy to integrate into Java	❌ Not scalable for large data

Ehcache

Advantages	Disadvantages
✅ Flexible storage options (heap, off-heap, disk)	❌ Requires tuning for performance
✅ Good integration with Java frameworks	❌ Off-heap and disk may add latency

Cache4j

Advantages	Disadvantages
✅ Simple and fast API	❌ No updates in 18 years
✅ Supports multithreading	❌ Lacks modern features

Caffeine

Advantages	Disadvantages
✅ High-performance with low latency	❌ Memory-only storage
✅ Advanced eviction algorithms	❌ More complex than Guava

References

Products Portal: https://gnssproducts.epos.ubi.pt **DGW:** https://gnssdata-epos.oca.eu **EPOS GNSS/TCS Page**: https://gnss-epos.eu

CONTACT

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