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Instagram Server Migration via Federated GraphQL

Anirudh Padmarao, Chi Chan, Johnson Han, Deepak Singh, Kristina Kamendova

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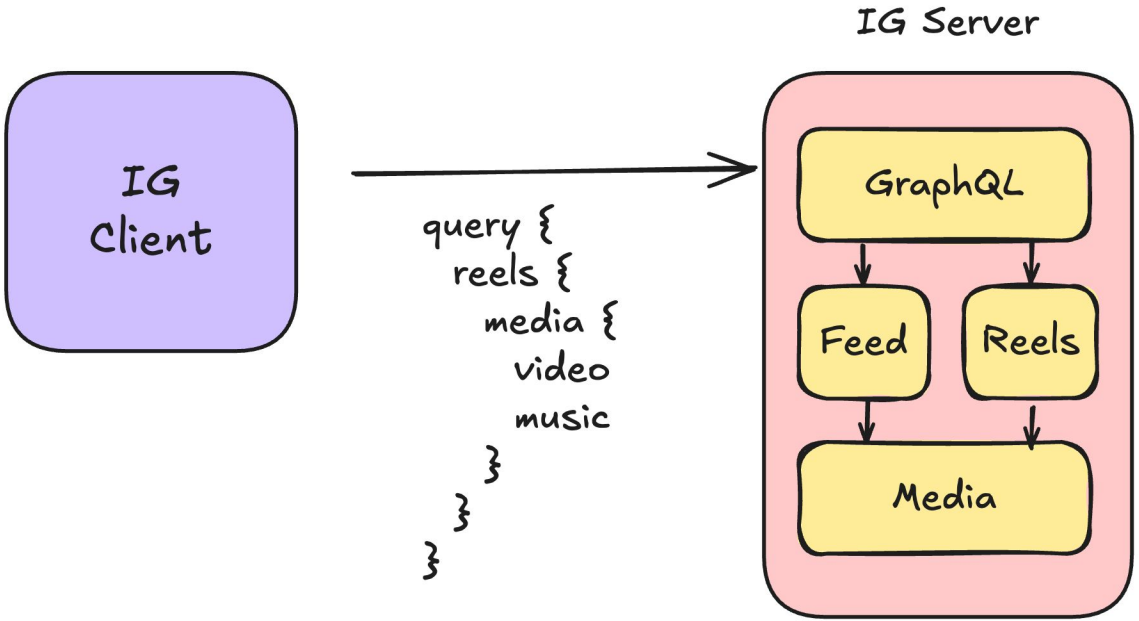
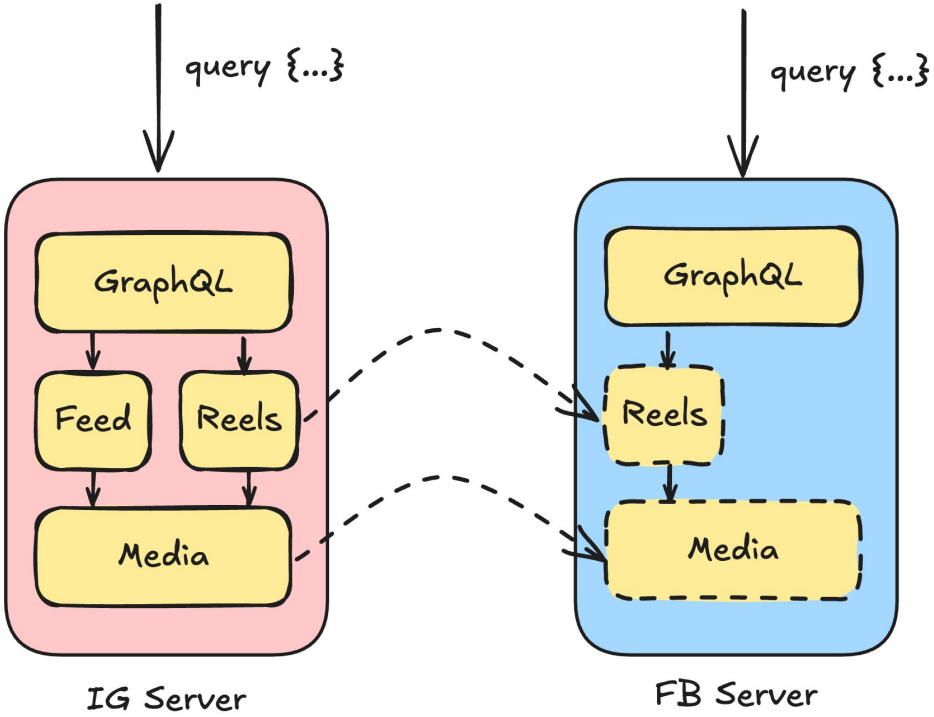
Architecture

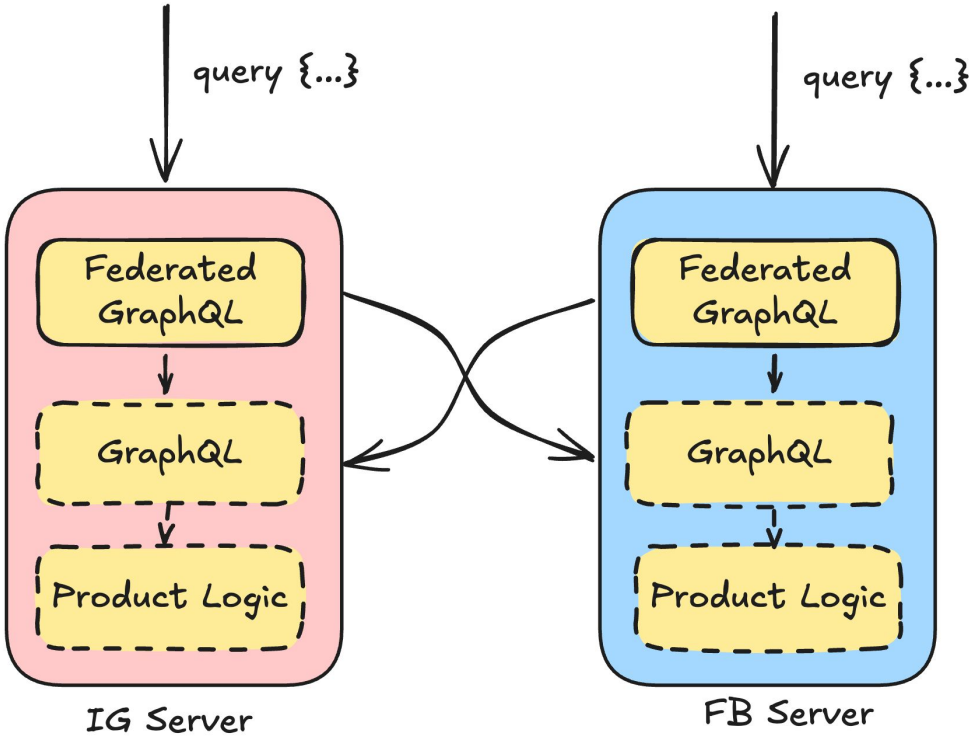
Instagram Architecture



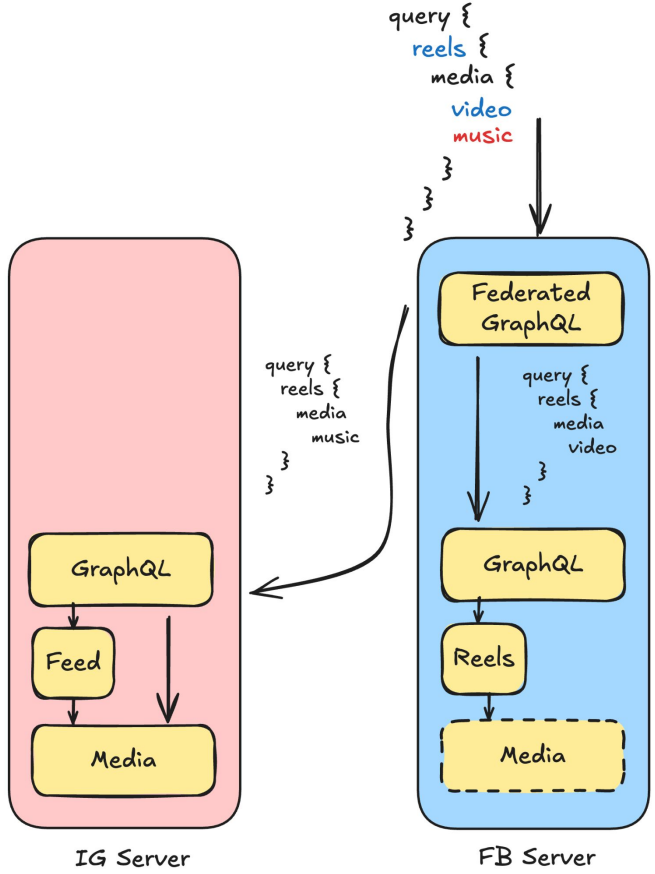
Meta Architecture



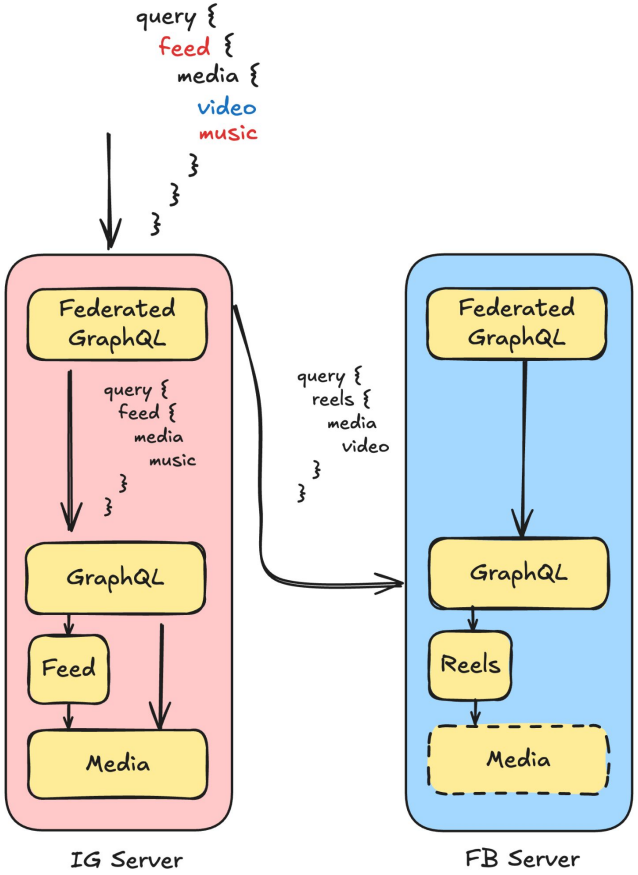
Federation Architecture



Federation Architecture: FB Server



Federation Architecture: IG Server



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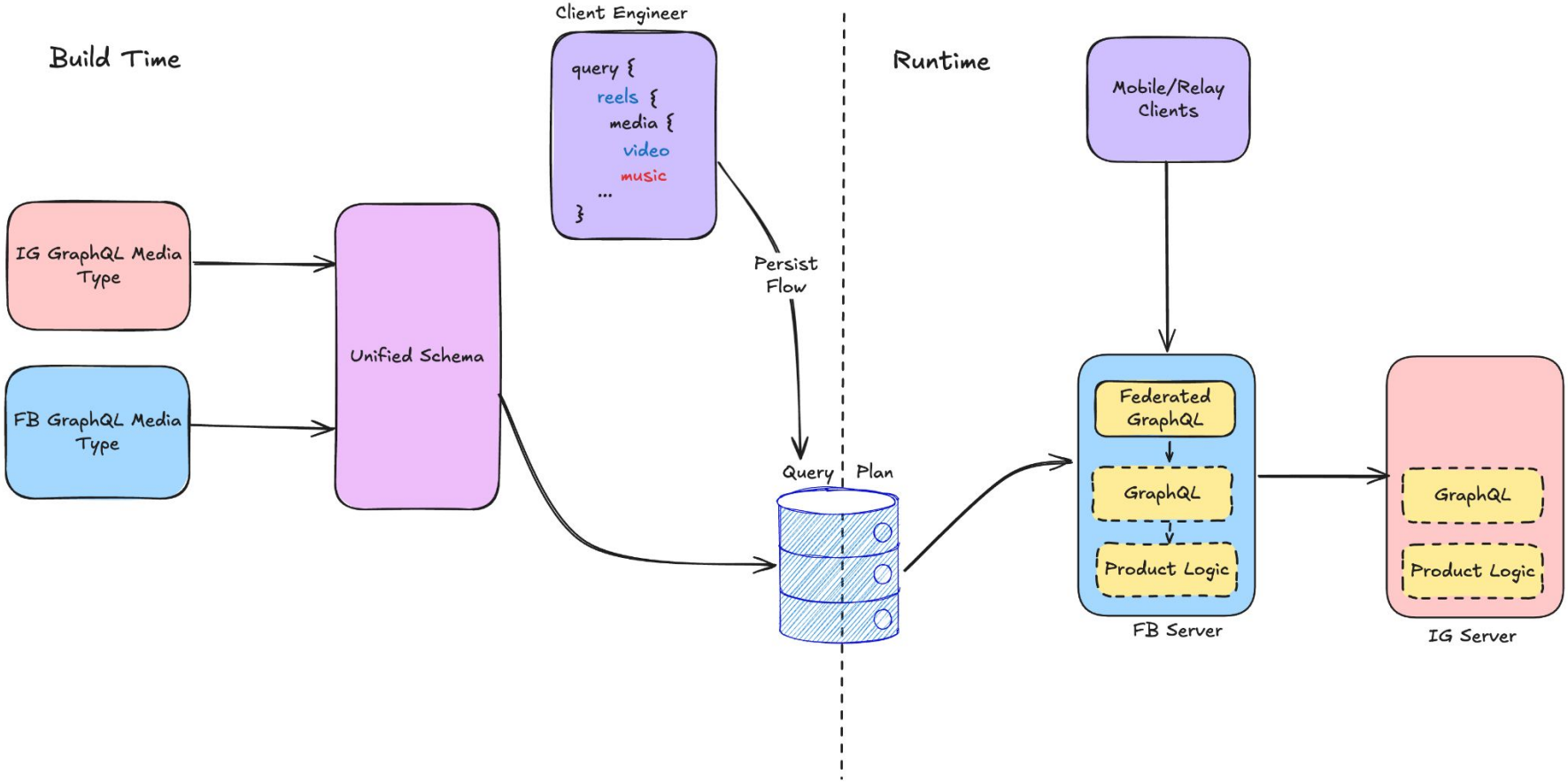
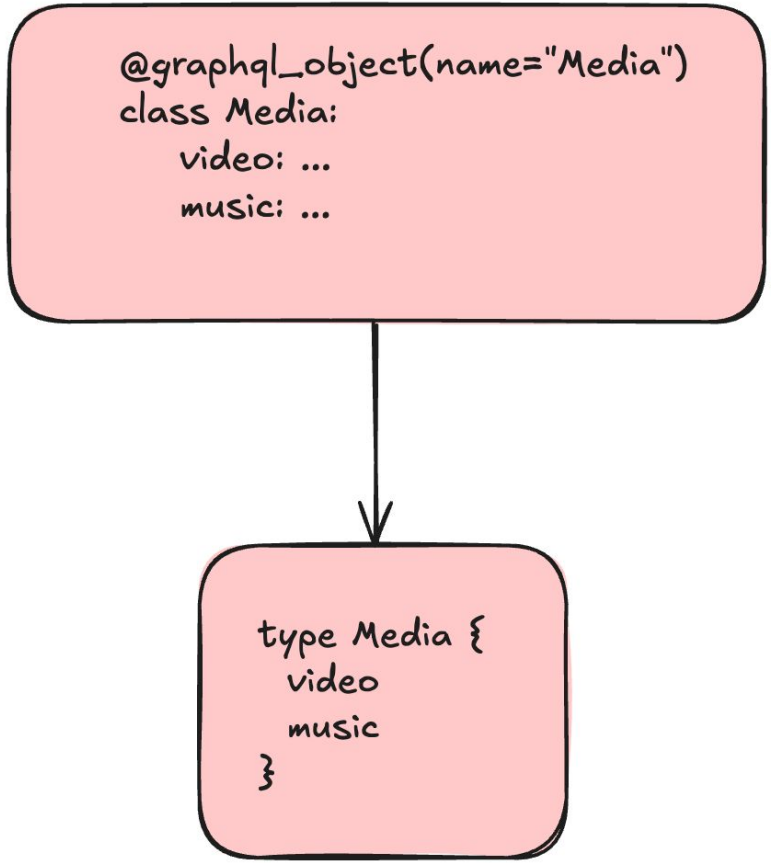
Federation

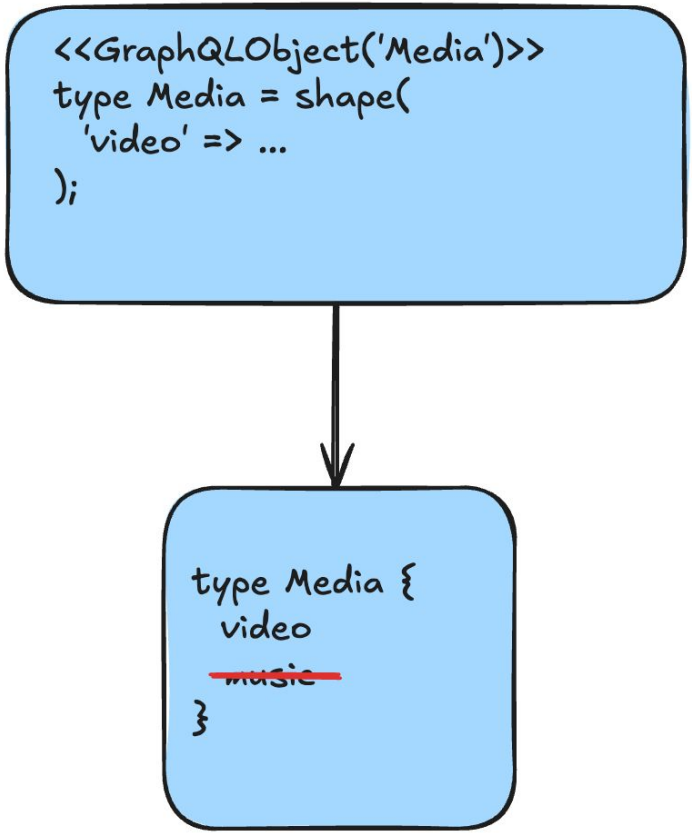
Federation Overview



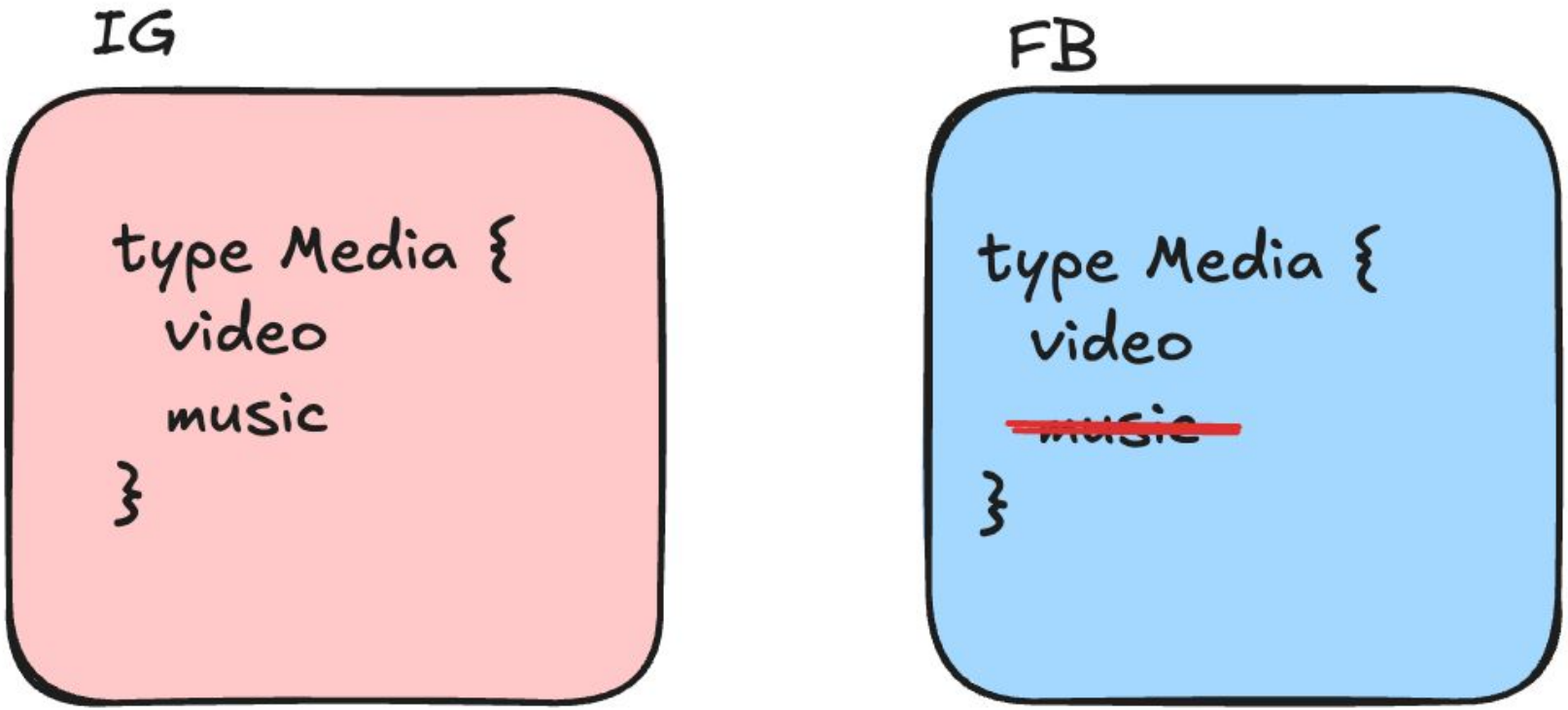
IG Media Server Definition



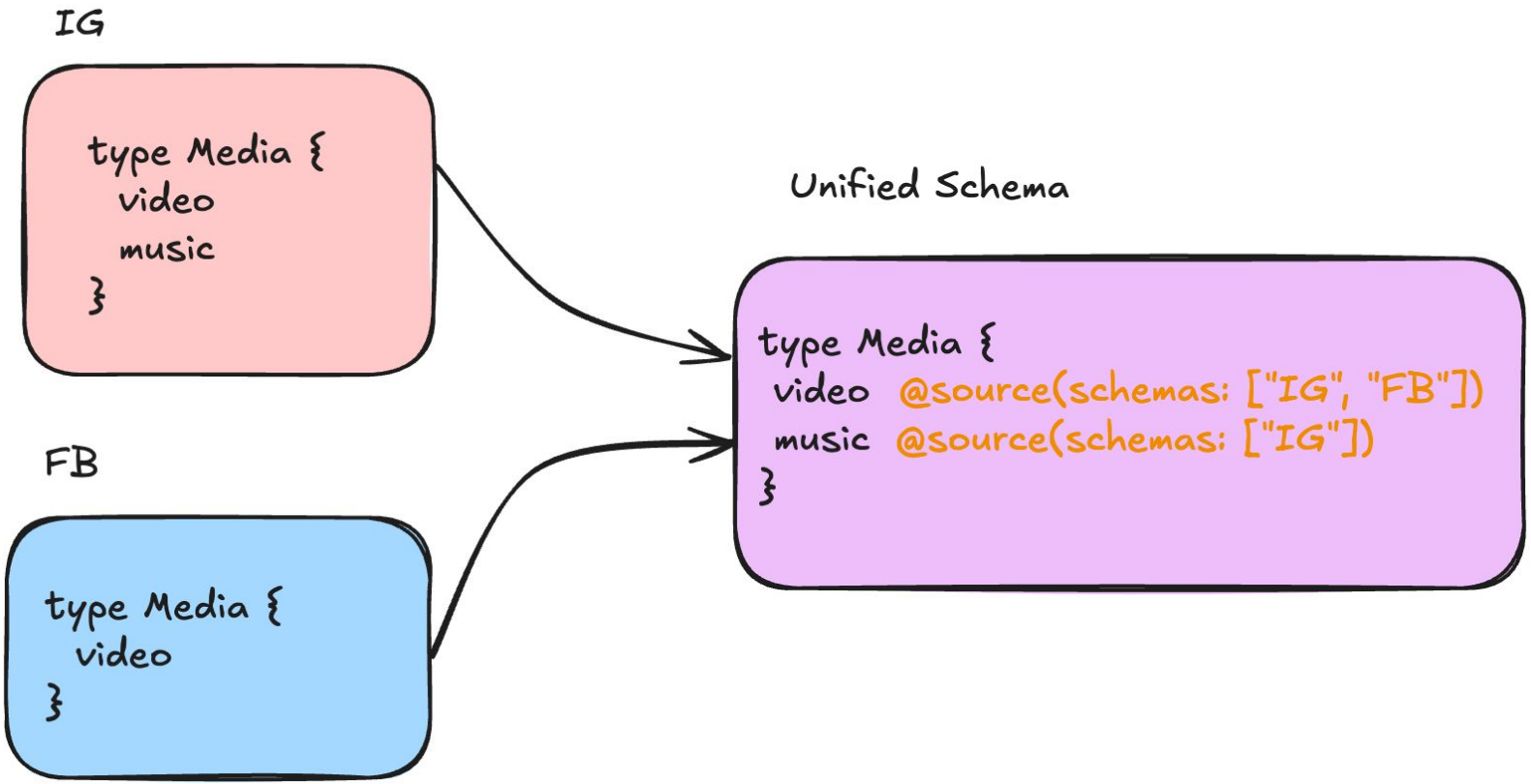
FB Server Media Definition



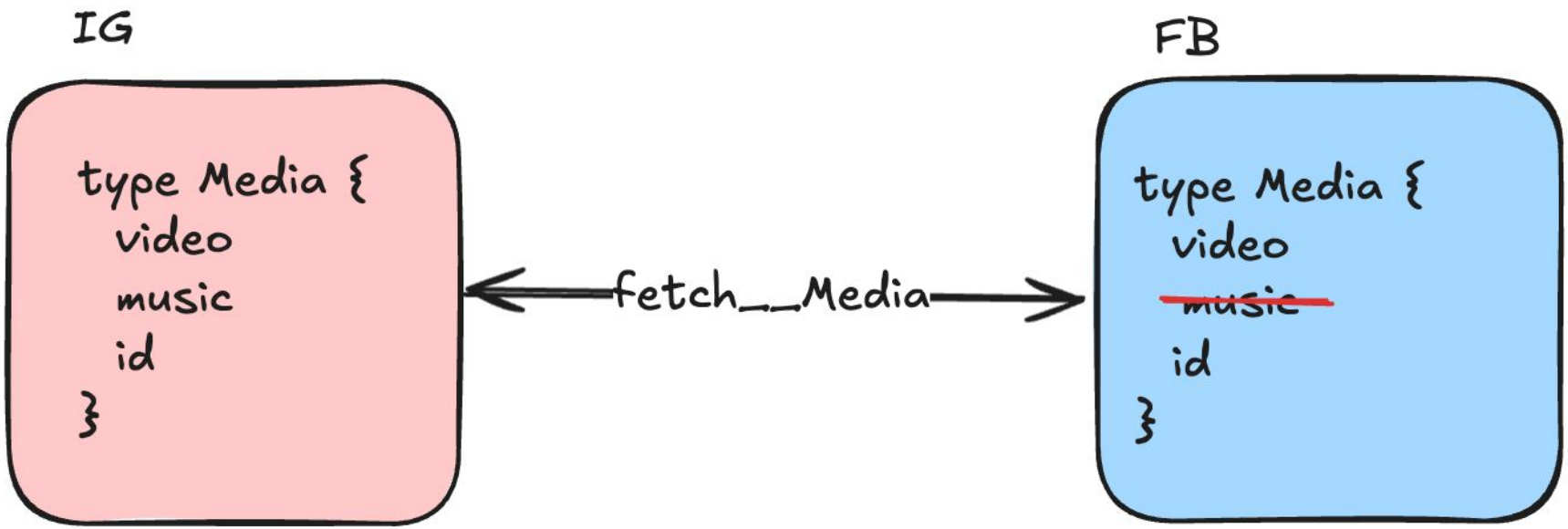
Two Medias, No Connection



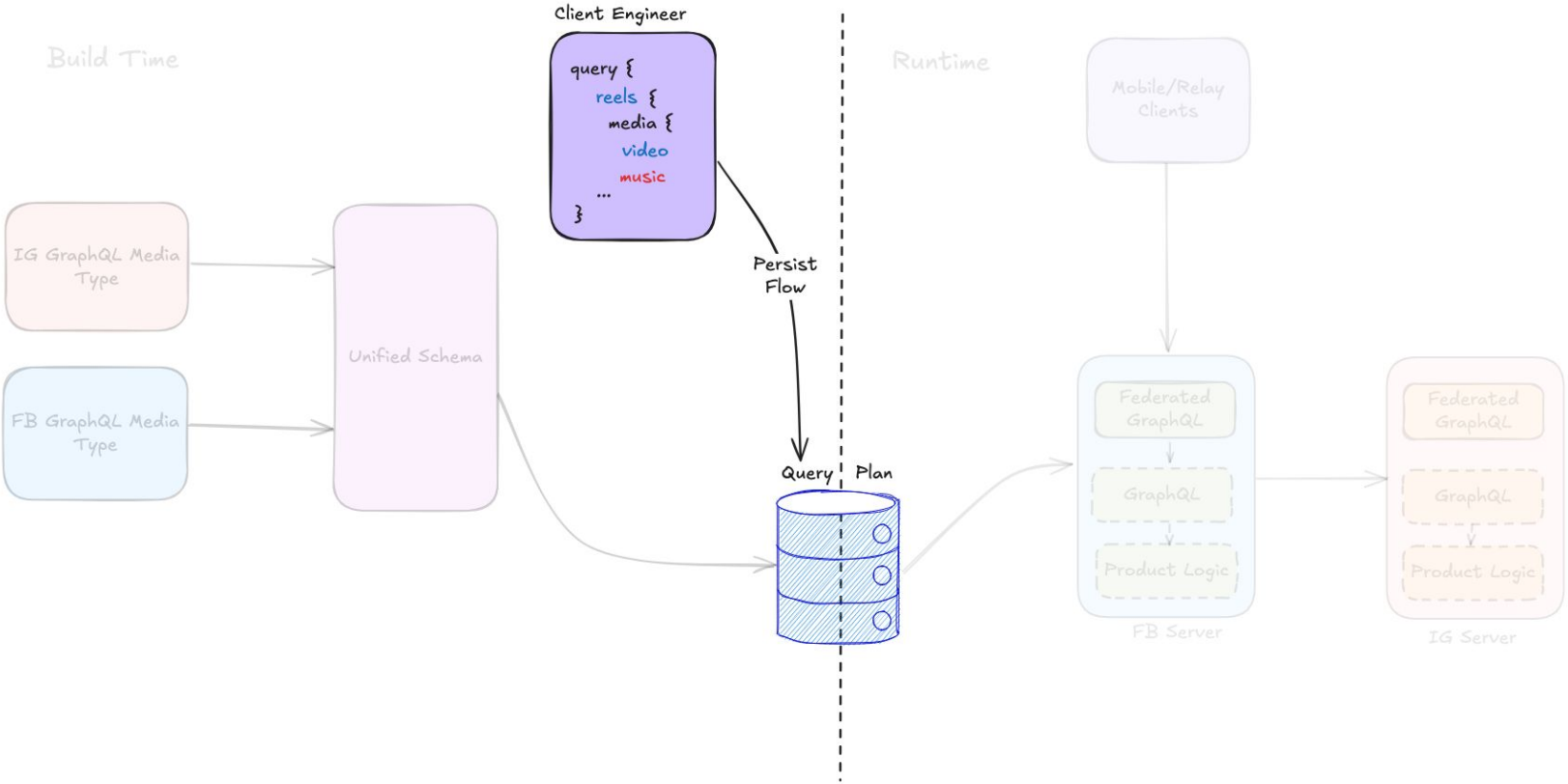
Unified SDL


IG
type Media {
video
music
}
FB
type Media {
video
}
Unified Schema
type Media {
video @source(schemas: ["IG", "FB"])
music @source(schemas: ["IG"])
}

One Media, Two Servers



Federated Query Persistence

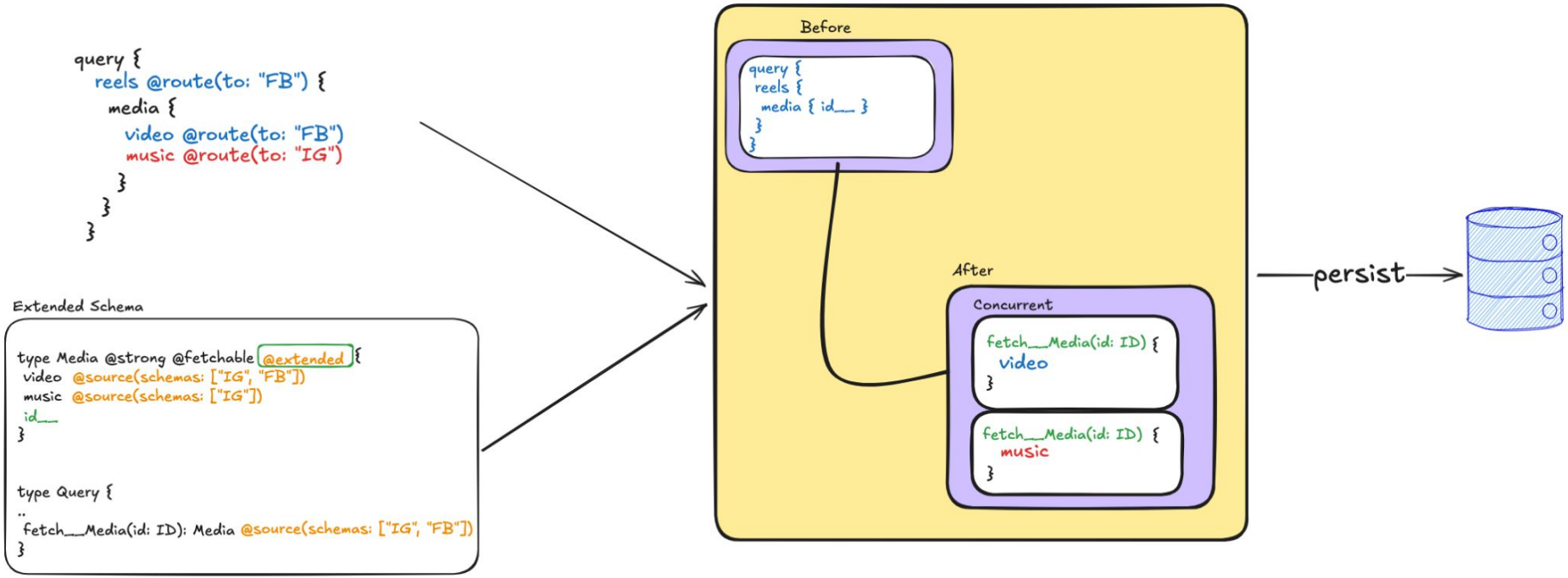


Federated Query Persistence: Routing

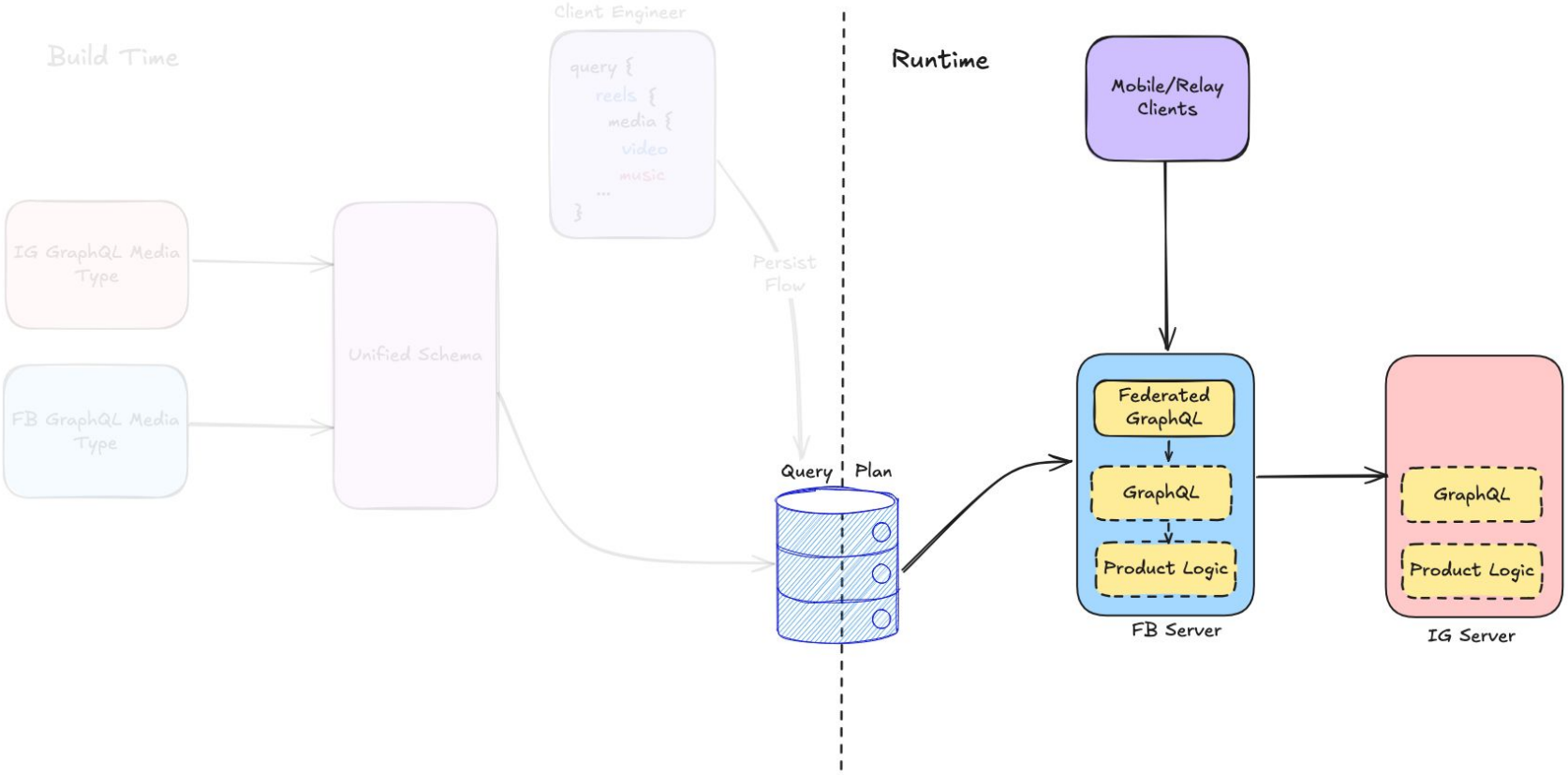
```
query {
  reels {
    media {
      video
      music
    }
  }
}
```

```
query {
  reels @route(to: "FB") {
    media {
      video @route(to: "FB")
      music @route(to: "IG")
    }
  }
}
```

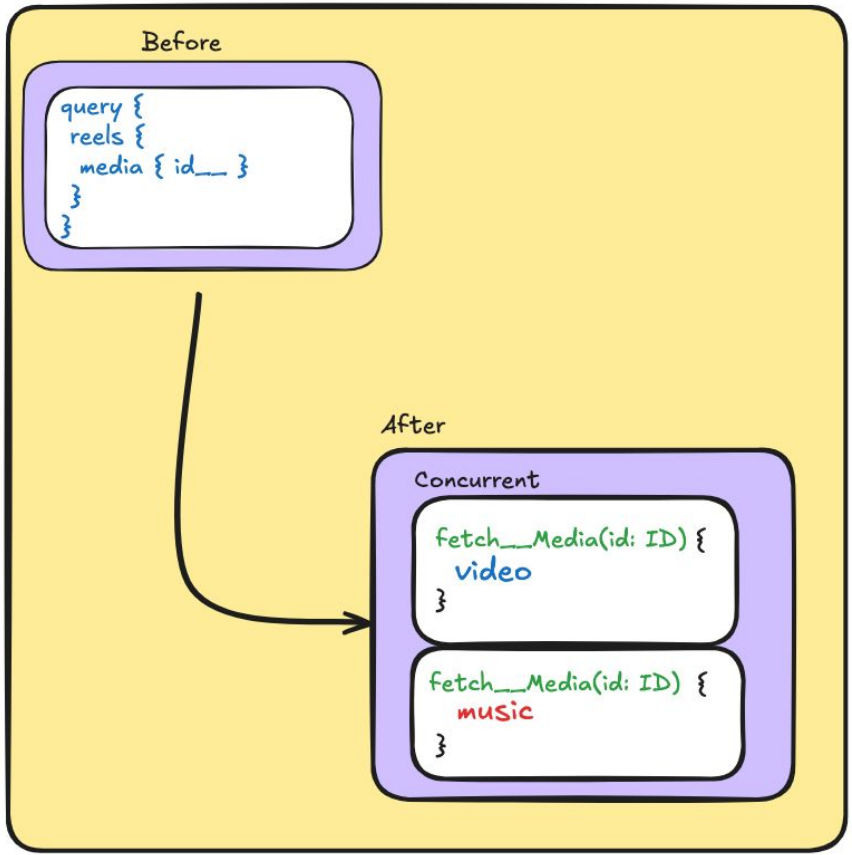
Federated Query Persistence: Building

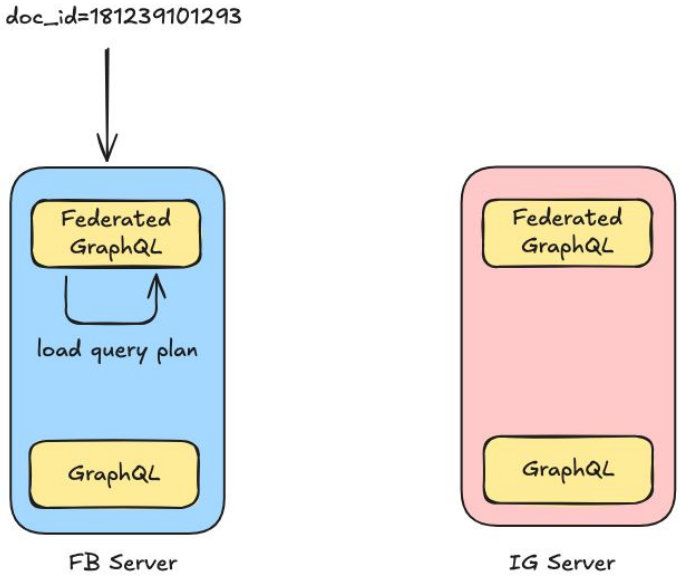


Federated Query Execution

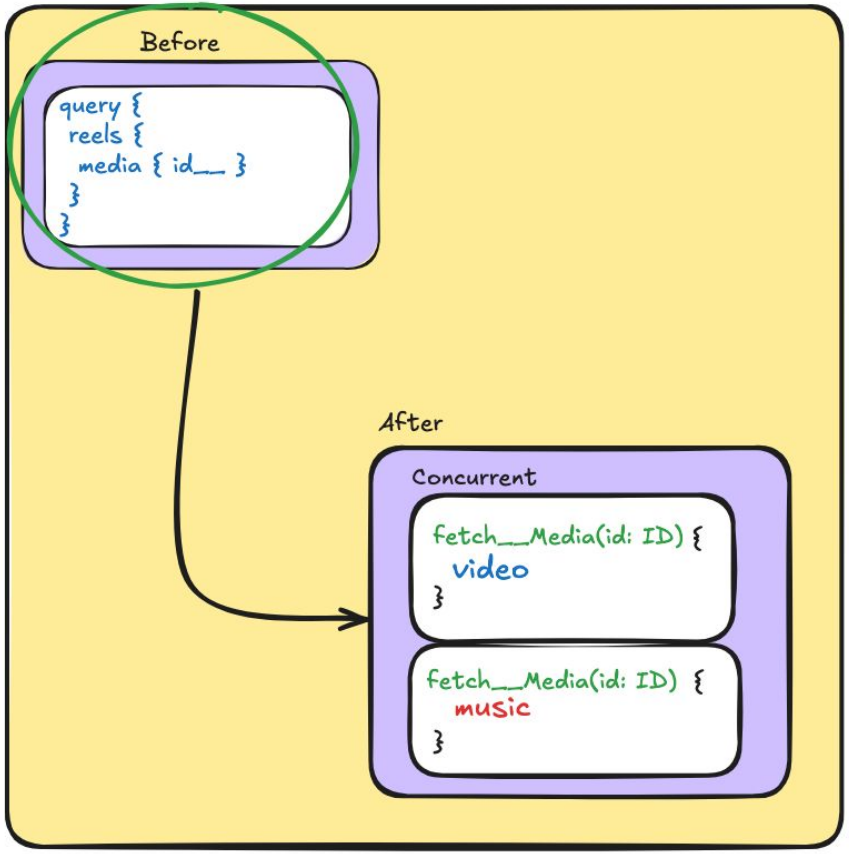


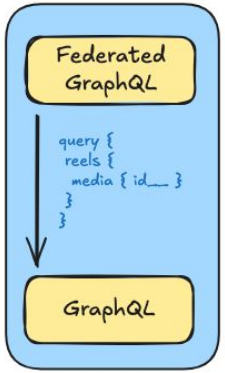
Federated Query Execution

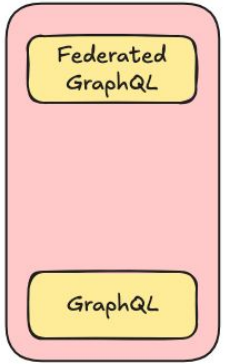




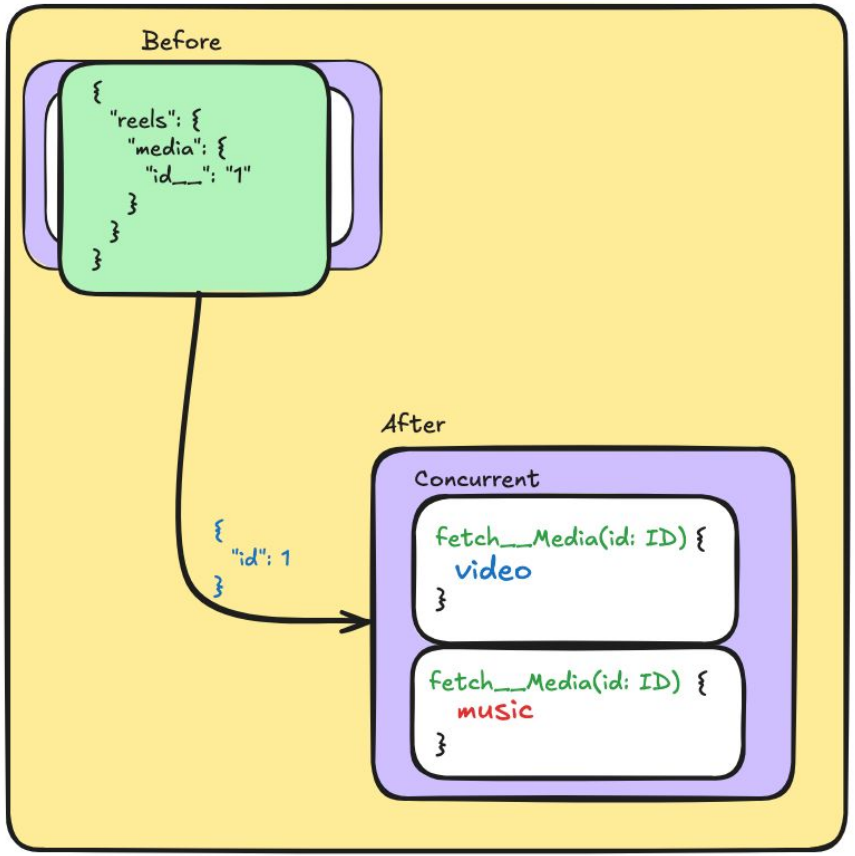
Federated Query Execution: Before

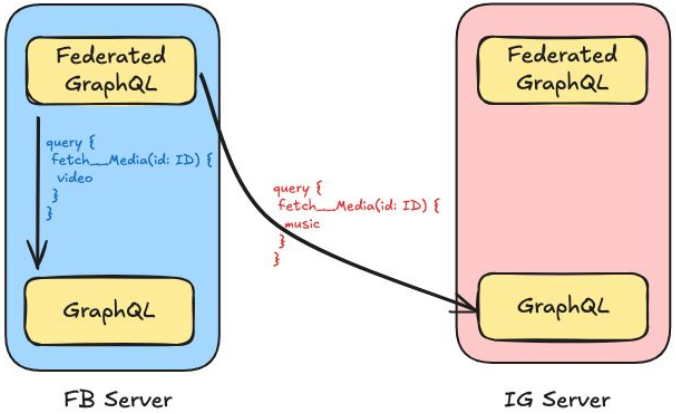




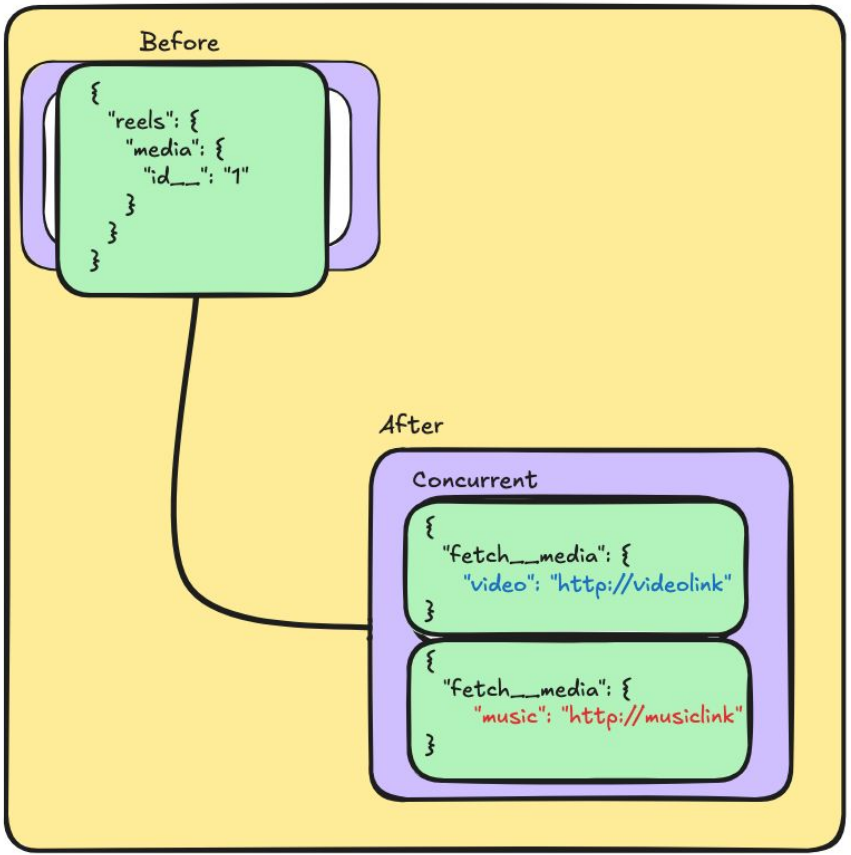


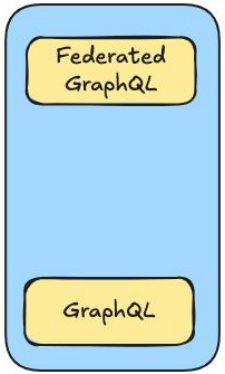
Federated Query Execution: After

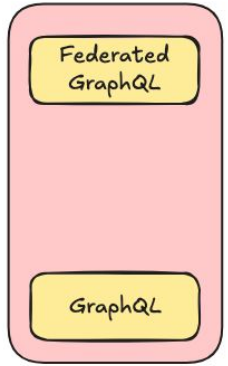




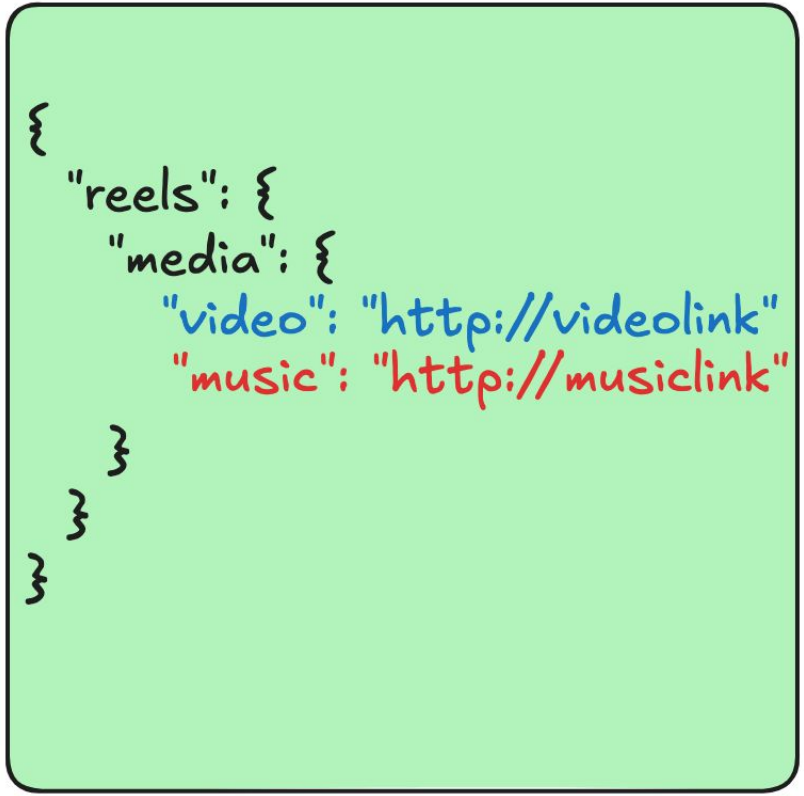
Federated Query Execution: Merging







Federated Query Execution: Response



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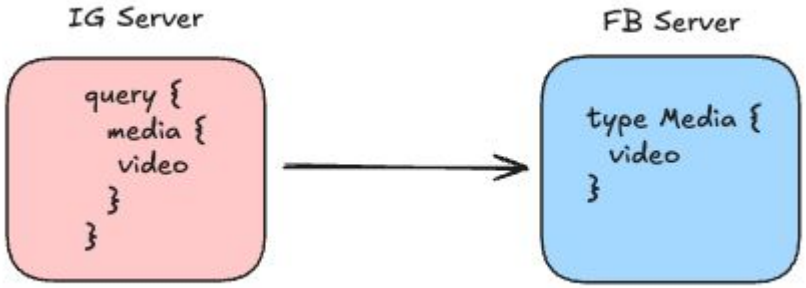
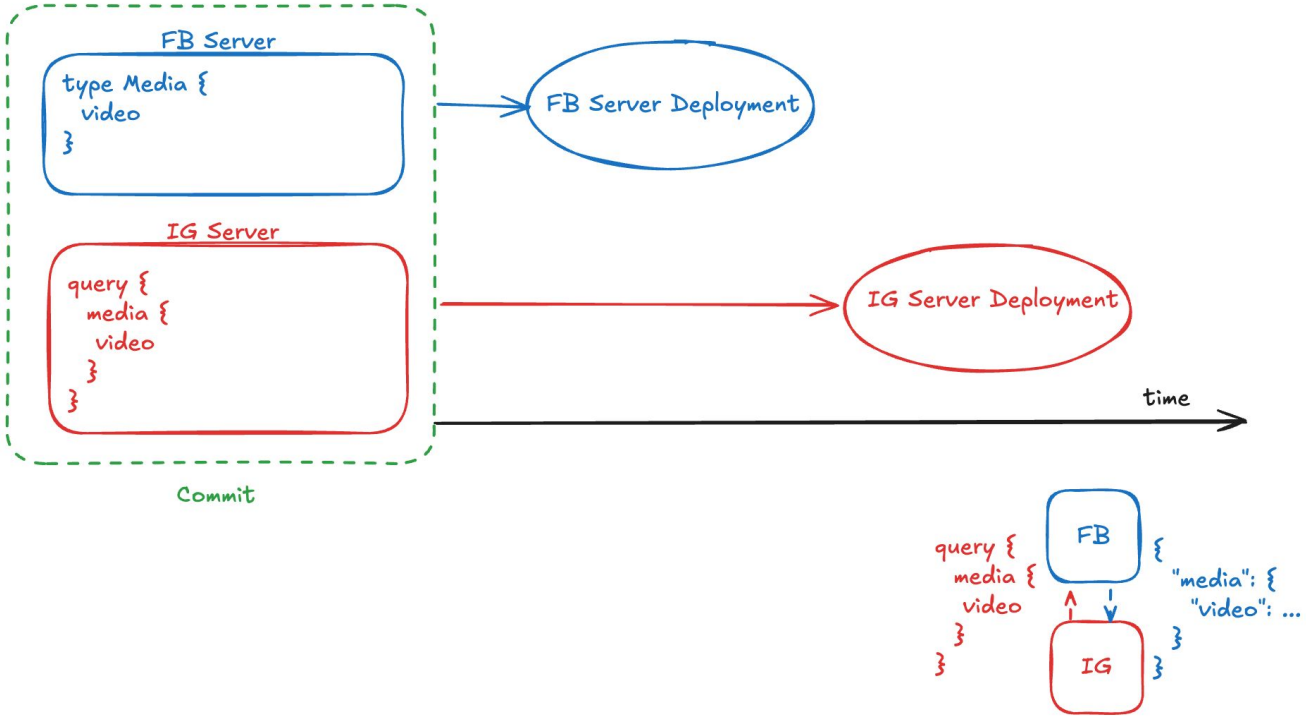
Push Safety & Performance

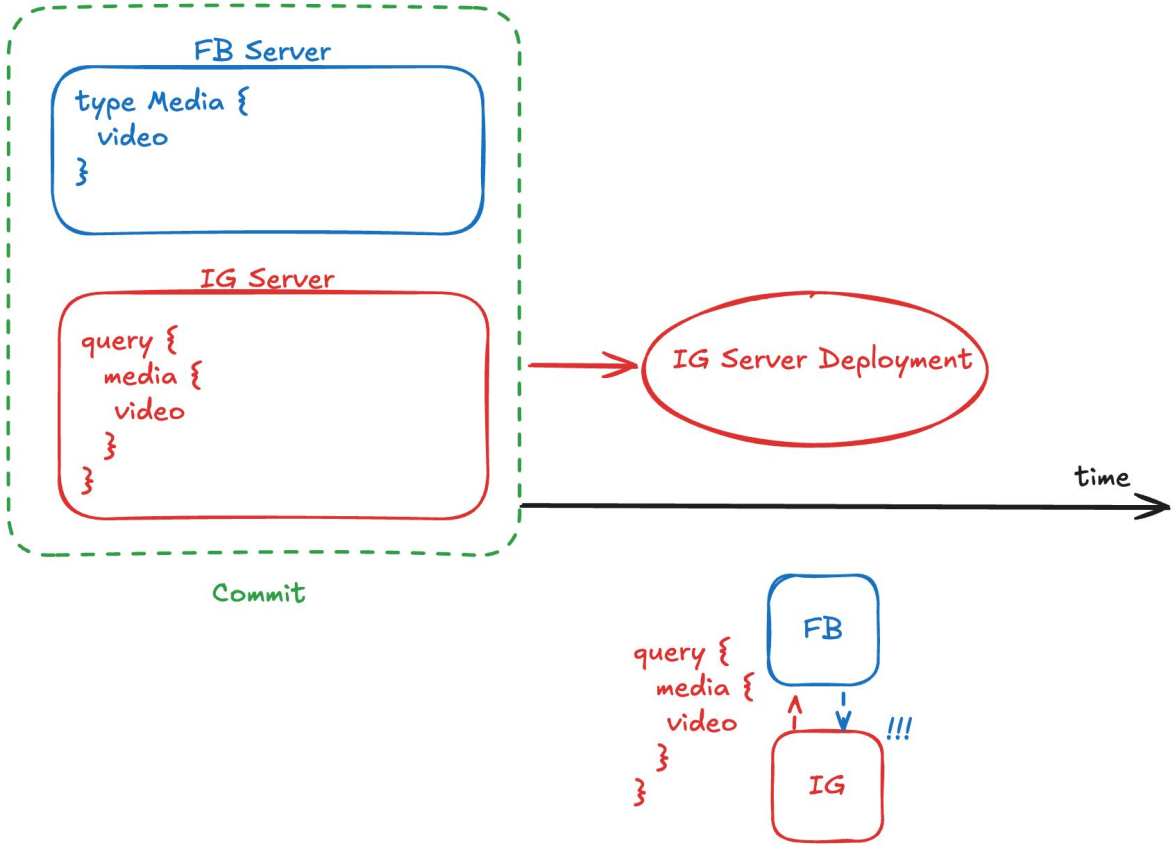
Cross Client-Server Change & Push Safety



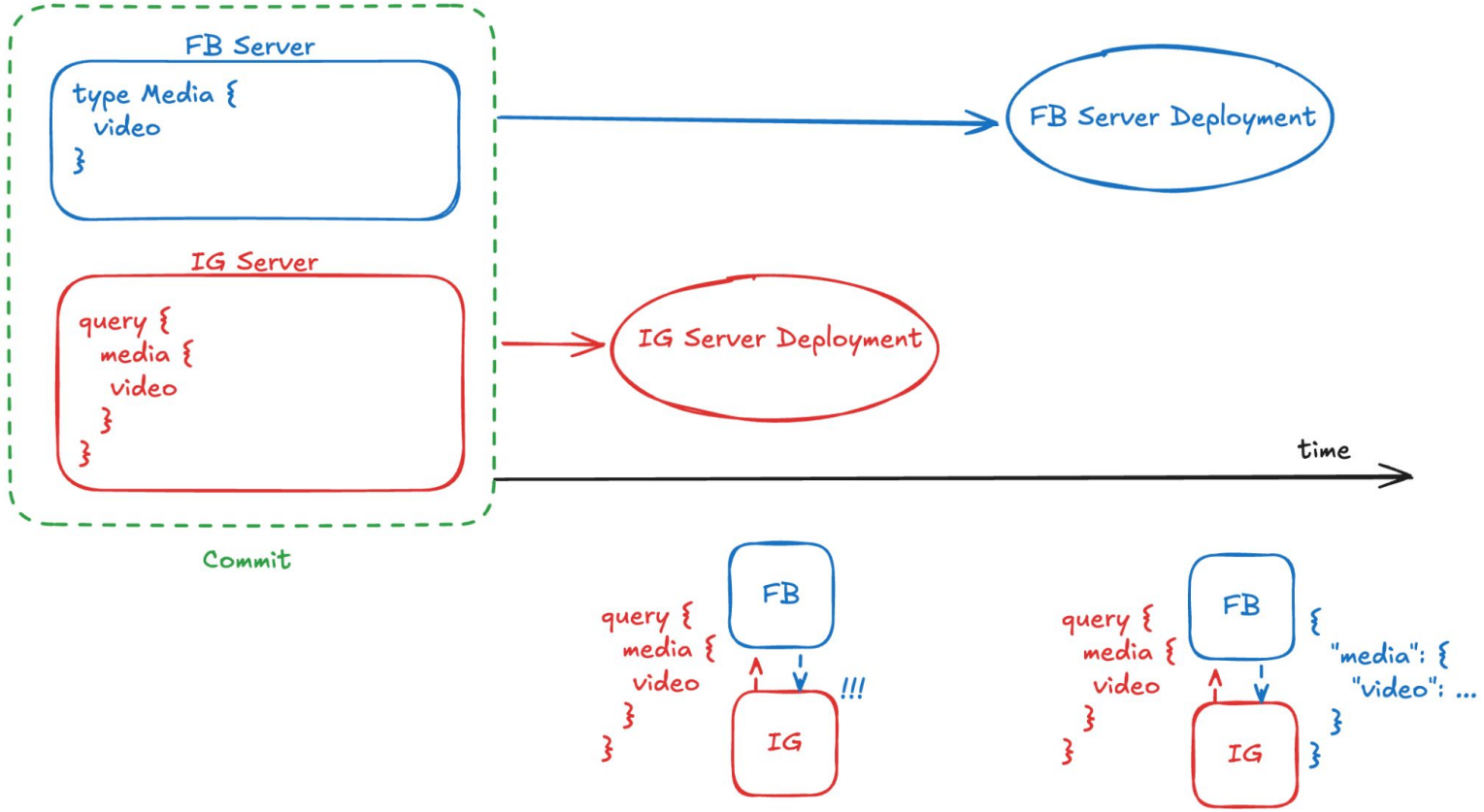
Cross Client-Server Change & Push Safety



Cross Client-Server Change & Push Safety



Cross Client-Server Change & Push Safety

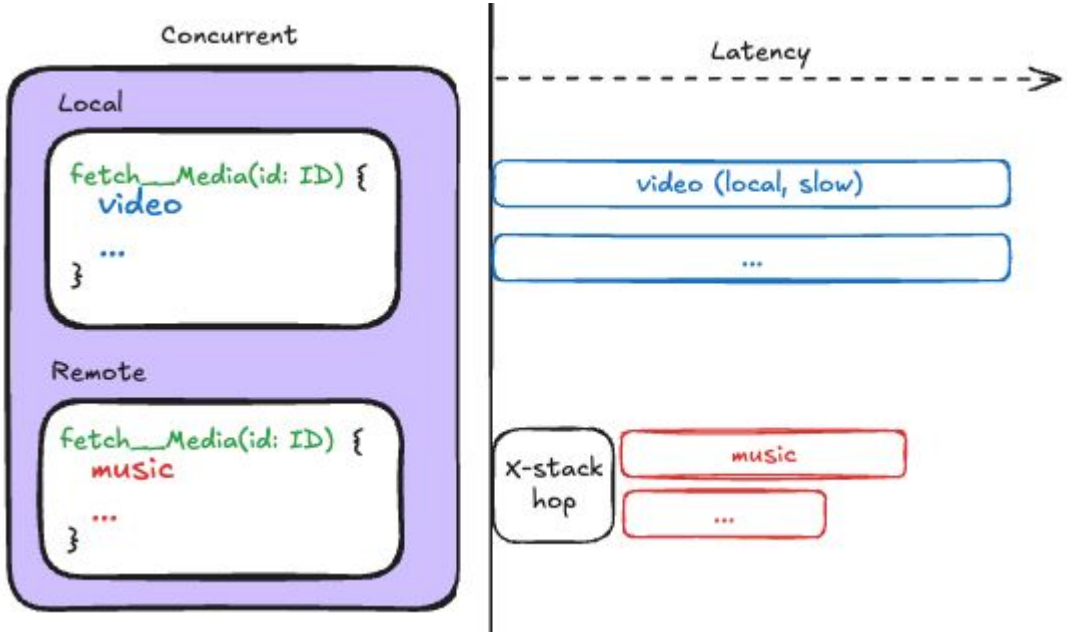


Cross Client-Server Change & Push Safety

What GraphQL Gives Us

- ✓ New nullable field → safe (old server returns null, client already handles it)
- ✗ New non-nullable field → unsafe (old server can't produce it)

Performance



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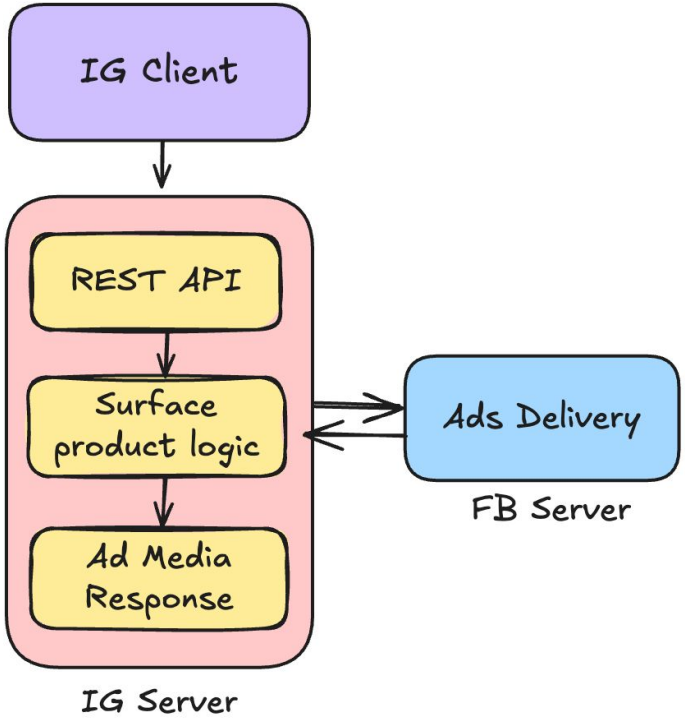
Case Study

IG Ads: Federated Schema Adoption

How It Started:

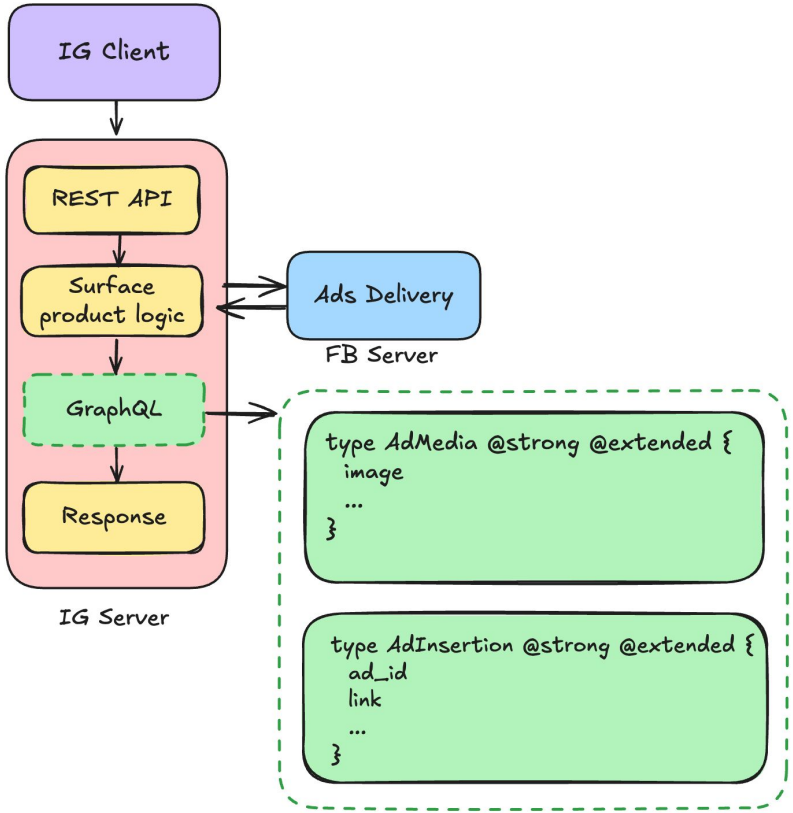
- IG Server serves as REST API entry point for ads – holds significant portion of business logic and computes 600+ ad media fields for the final client response.
- Fields logic tightly coupled and deeply intertwined.
- No GraphQL compatibility.



IG Ads: Federated Schema Adoption

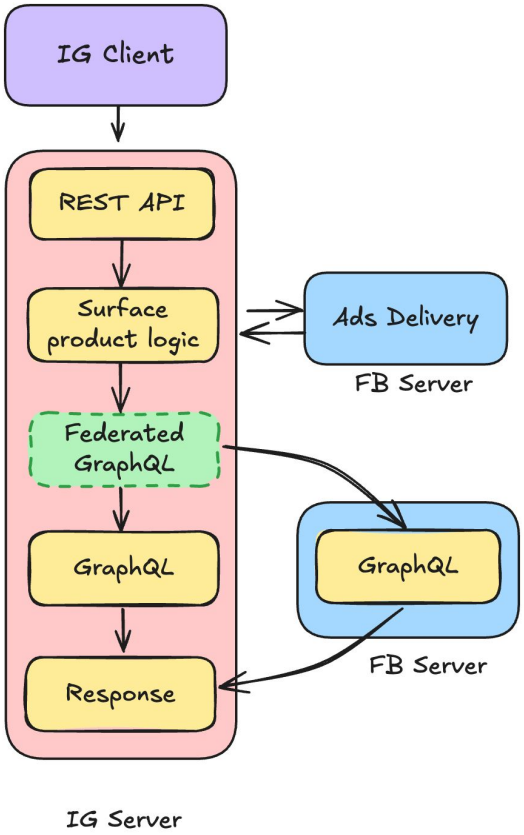
Switching to GraphQL Extended Types:

- Modular architecture — every field encapsulated as its own GraphQL function, decoupled from the monolithic rendering pipeline.
- Performance & efficiency gains — improved latency and capacity across all IG ad surfaces as ads rendering became independent, streamlined and more optimized.



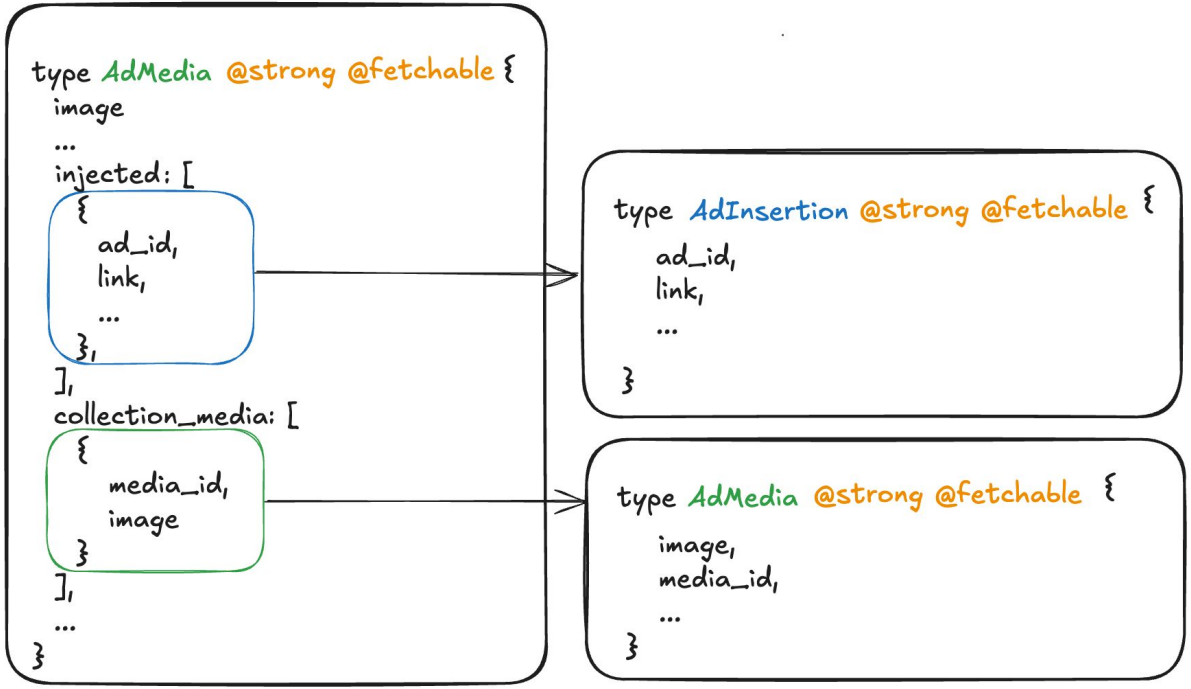
IG Ads: Federated Schema Adoption

- Federated Schema unblocked incremental ads fields migration to FB Server.
- New fields can be defined and implemented entirely in FB Server, zero IG Server code needed.



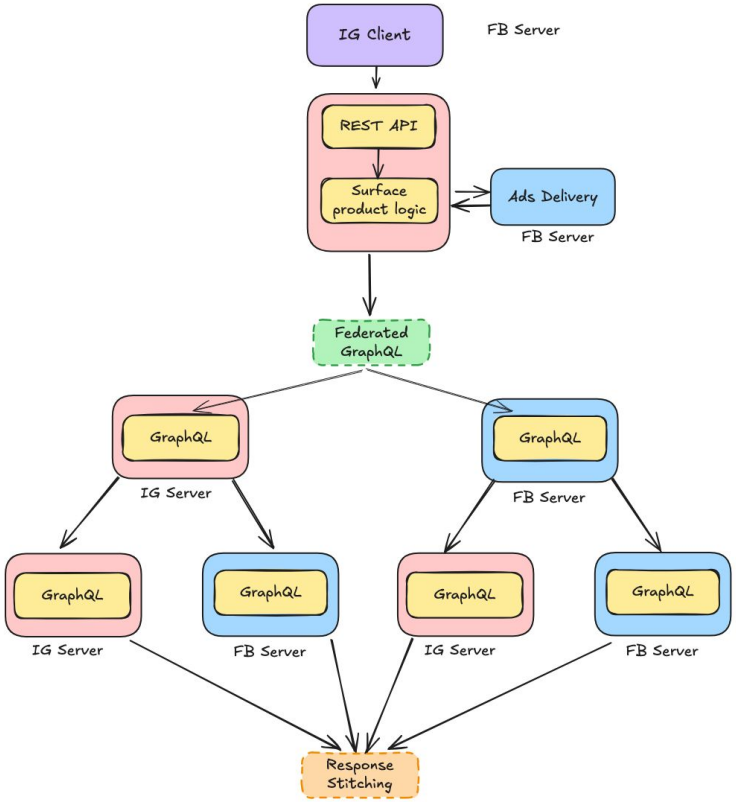
IG Ads: Federated Schema Adoption

Ads responses have multiple layers of extended types nested inside each other:



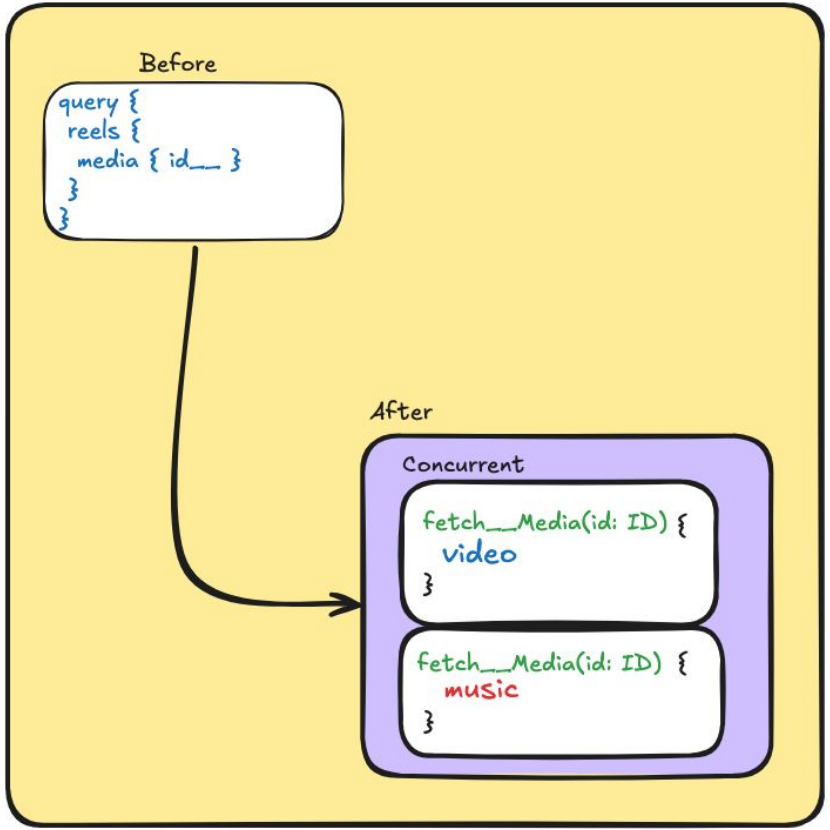
IG Ads: Federated Schema Adoption

- Separate cross-stack call for each nested type boundary.
- Each call = serialization + network hop + deserialization overhead.



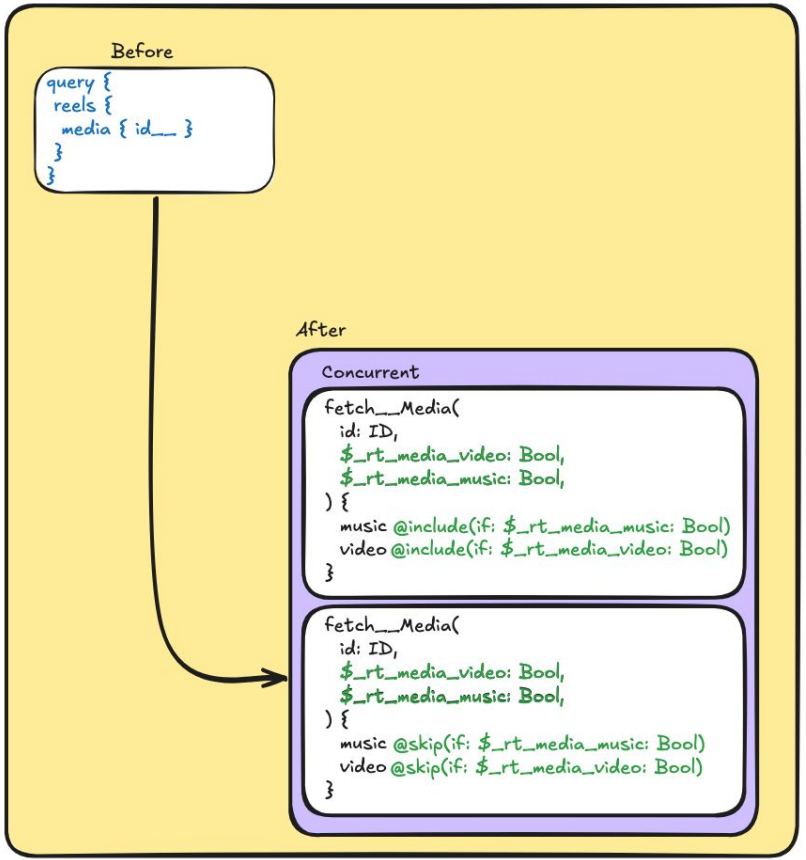
Evolving Routing: Static Query Plan

- Initial Design
- Encodes routing in the query plan itself.
- **Limitation**: Routing changes require rebuilding and repersisting the query itself.

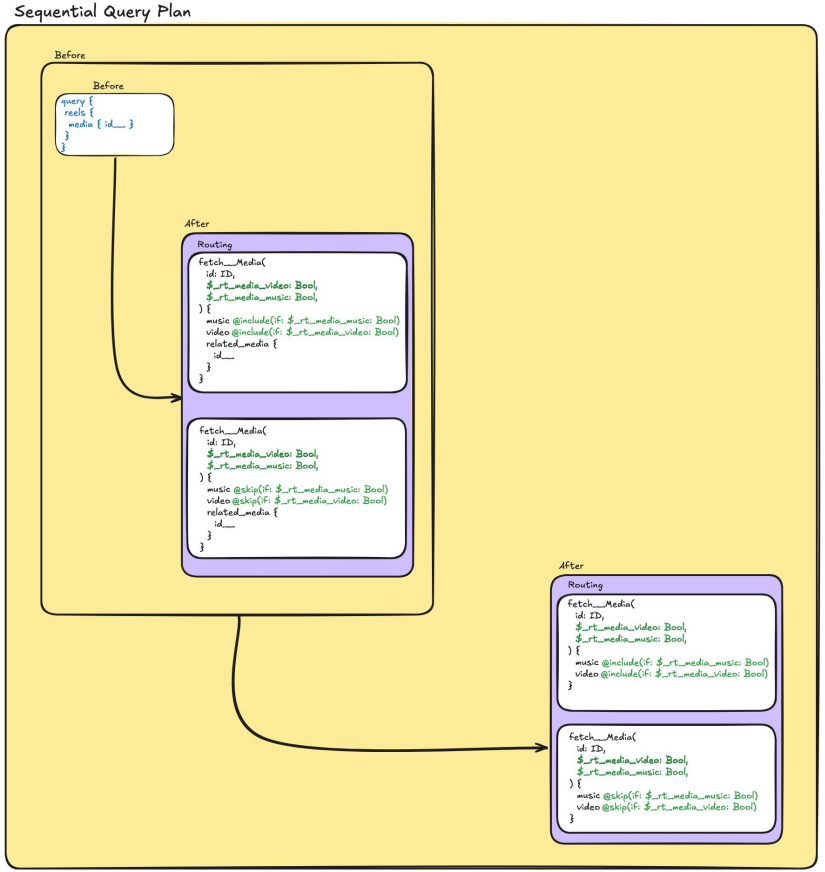


Evolving Routing: Dynamic Query Plan

- Enables dynamic routing
- `@skip` and `@include` directives allow dynamic routing.
- Routing is computed at execution time.
- **Limitation:** Nested Extended Types lead to deeply nested query plans.

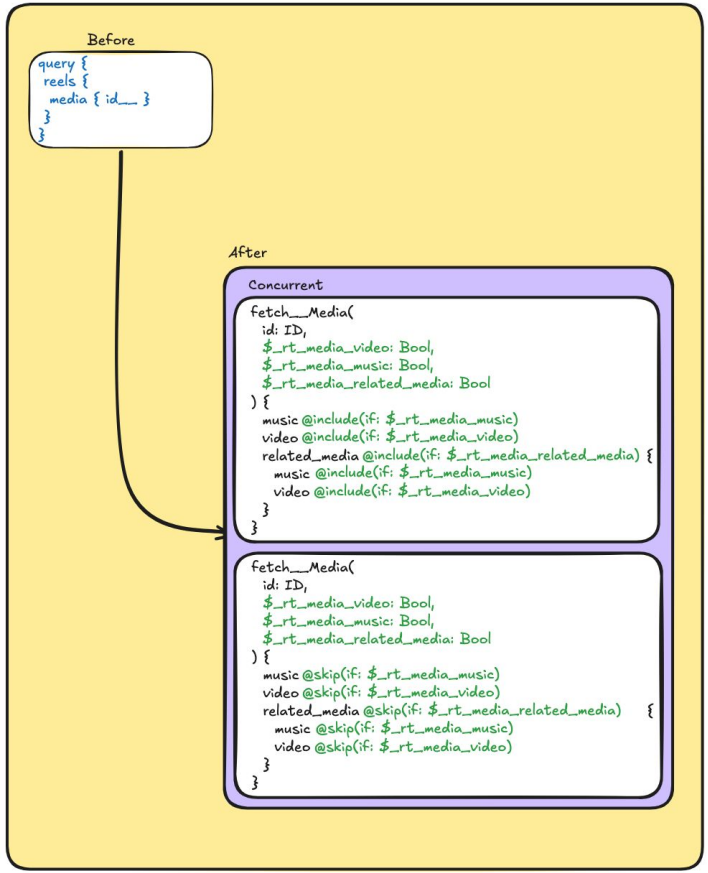


Evolving Routing: Dynamic Query Plan (cont)



Evolving Routing: Dynamic Query Plan V2

- Flattens the nestedness of Routing Query Plans.
- **Pros**
  - Simpler structure.
  - Eliminates latency overhead from V1.
- **Limitations:**
  - Higher CPU cost to re-execute paths in both stacks.



IG Ads - GraphQL & Monoschema Adoption

Product Correctness & Testing:

- DMS not supported in test environments — persisted query IDs don't exist in test tier.
- Cross-stack calls fail silently, tests fall back to hardcoded mocks.
- More fields migrated to WWW = less real test coverage (migration progress inversely correlated with testing confidence).
- Resolved with cross-stack testing framework — a framework that spins up a real WWW test server alongside Distillery, integration tests can make actual DMS calls E2E.

IG Ads - GraphQL & Monoschema Adoption

Key Learnings:

- Understand your type graph before migration, not after. A flat schema splits cleanly across servers. But the moment you have nested types, each boundary multiplies your cross-stack overhead. RQP is essential but requires planning upfront.
- Invest in cross-stack testing early. Don't let your testing infrastructure lag behind your migration.
- Budget before you bridge — splitting queries across servers costs real latency; earn that margin upfront so the migration is a trade-off, not a regression.

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Conclusion

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