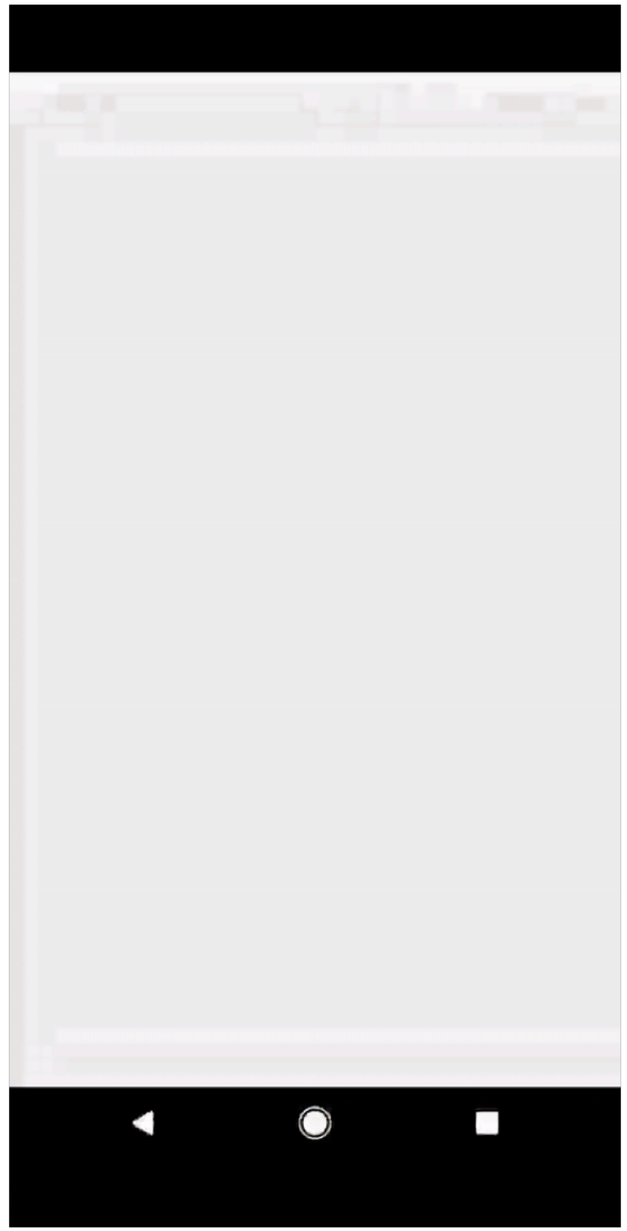
```
Query DroidConNYC{ slide(id: "1")
    {
     Title
     Authors
     Company
    }
}

{
  Title: "Intro to GraphQL on Android",
  Authors:  ["Brian Plummer","Mike Nakhimovich"],
  Company: "FriendlyRobot"
}
```

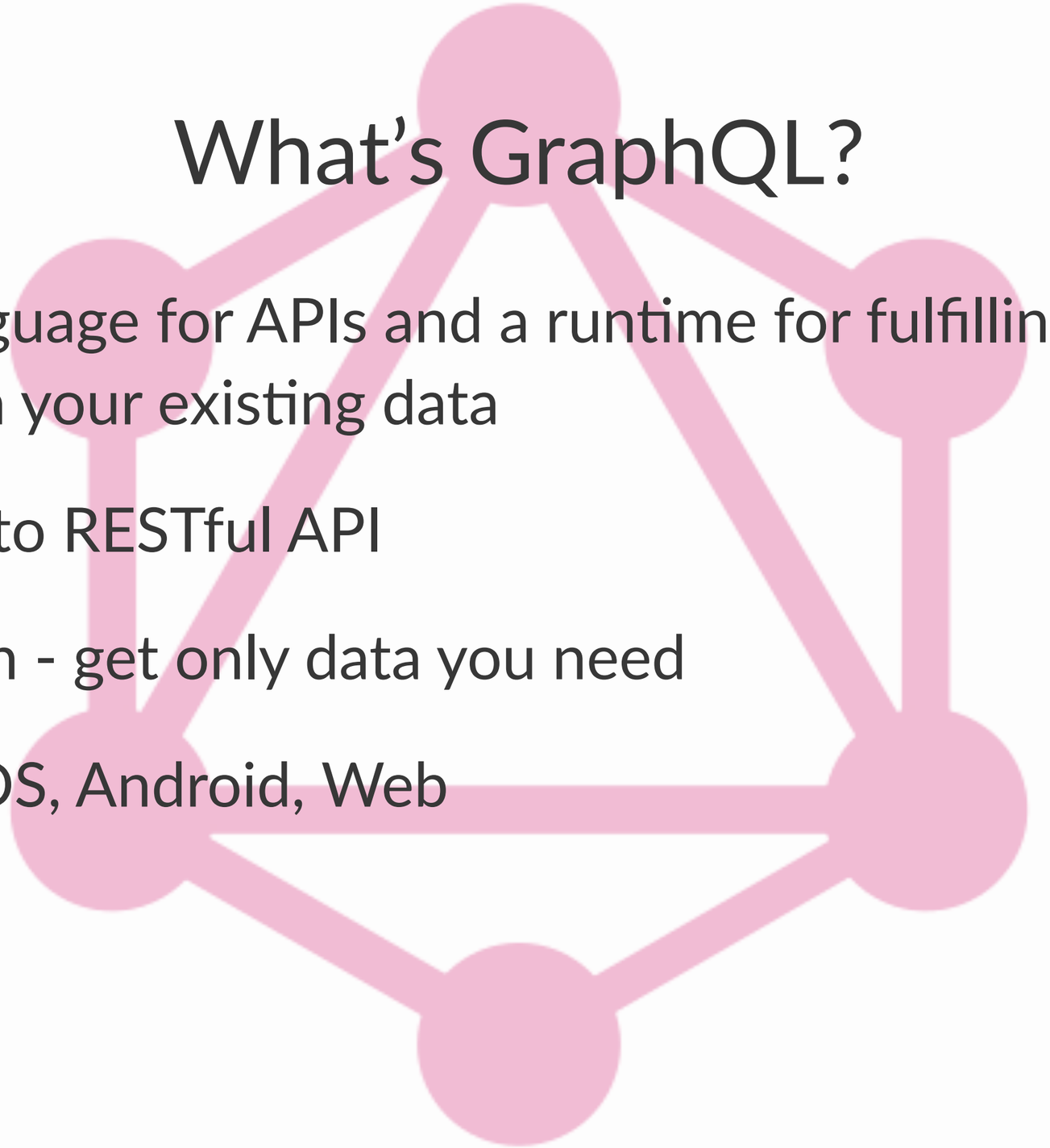
We were working at The New York Times

We were doing ***a lot*** of data loading



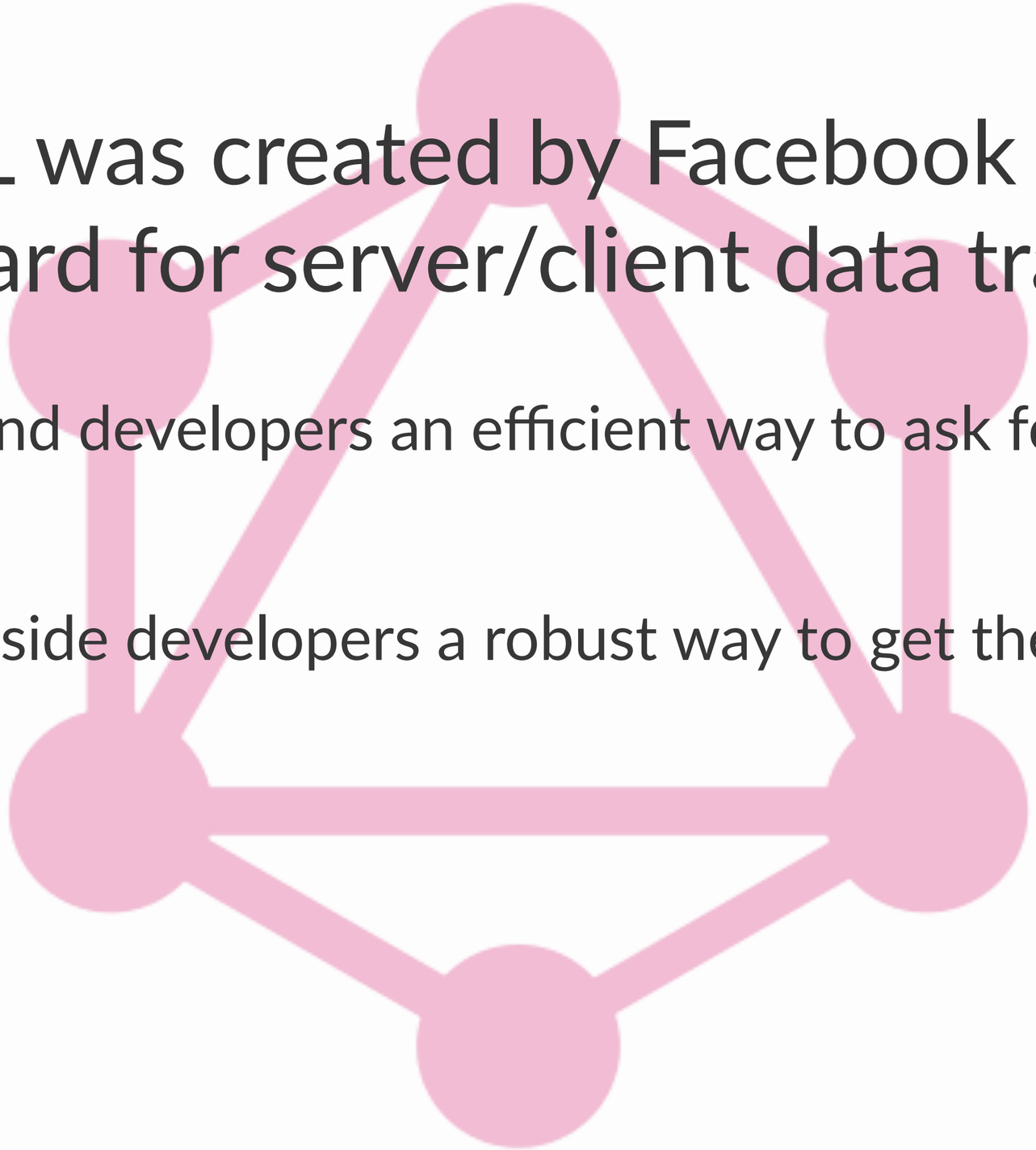
The team moved from using RESTful APIs to GraphQL for our data loading architecture

What’s GraphQL?



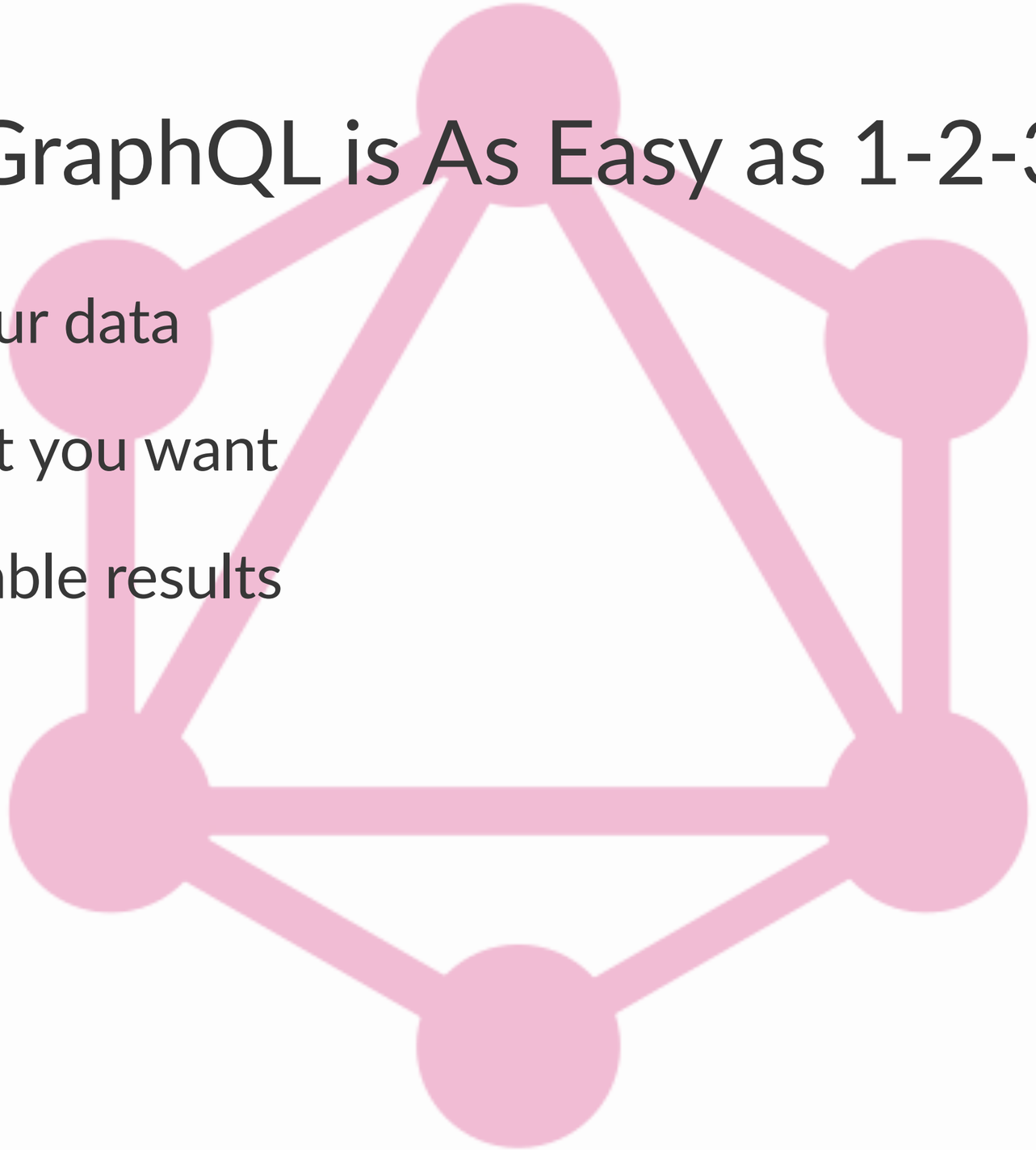
- A query language for APIs and a runtime for fulfilling those queries with your existing data
- Alternative to RESTful API
- Client driven - get only data you need
- Works on iOS, Android, Web

GraphQL was created by Facebook as a new standard for server/client data transfer



- Give front end developers an efficient way to ask for minimal data
- Give server-side developers a robust way to get their data out to their users

GraphQL is As Easy as 1-2-3



- Describe your data
- Ask for what you want
- Get predictable results

Describe Your Data in a Schema

```
type Character {
  name: String!
  appearsIn: [Episode]!
}
```

Describe Your Data in a Schema

```
type Character {
  name: String!
  appearsIn: [Episode]!
}
```

Character is a GraphQL Object Type, meaning it's a type with some fields. Most of the types in your schema will be object types.

Describe Your Data in a Schema

```
type Character {
  name: String!
  appearsIn: [Episode]!
}
```

name and **appearsIn** are fields on the Character type. That means that name and appearsIn are the only fields that can appear in any part of a GraphQL query that operates on the Character type.

Describe Your Data in a Schema

```
type Character {
  name: String!
  appearsIn: [Episode]!
}
```

String is one of the built-in scalar types. These are types that resolve to a single scalar object and can't have sub-selections in the query.

GraphQL Example Schema

```
type Character {
  name: String!
  appearsIn: [Episode]!
}
```

String! means that the field is non-nullable, meaning that the GraphQL service promises to always give you a value when you query this field.

GraphQL Example Schema

```
type Character {
  name: String!
  appearsIn: [Episode]!
}
```

[Episode]! represents an array of Episode objects. Since it is also non-nullable, you can always expect an array (with zero or more items) when you query the appearsIn field.

Ask for what you need

get predictable results

Combine Resources into One Request

```
{
  hero {
    name
    # Queries can have comments
    friends {
      name
    }
  }
}
```

Combine Resources into One Request

```
{
  hero {
    name
    # Queries can have comments
    friends {
      name
    }
  }
}
```

```
{
  "data": {
    "hero": {
      "name": "R2-D2",
      "friends": [
        {
          "name": "Luke Skywalker"
        },
        {
          "name": "Han Solo"
        },
        {
          "name": "Leia Organa"
        }
      ]
    }
  }
}
```

Reuse Fields in a Fragment

```
{
  leftColumn: hero(episode: EMPIRE) {
    ...comparisonFields
  }
  rightColumn: hero(episode: JEDI) {
    ...comparisonFields
  }
}

fragment comparisonFields on Character {
  name
  appearsIn
}
```

Reuse Fields in a Fragment

```
{
  leftColumn: hero(episode: EMPIRE) {
    ...comparisonFields
  }
  rightColumn: hero(episode: JEDI) {
    ...comparisonFields
  }
}

fragment comparisonFields on Character {
  name
  appearsIn
}
```

```
{
  "data": {
    "leftColumn": {
      "name": "Luke Skywalker",
      "appearsIn": [
        "NEWHOPE",
        "EMPIRE",
        "JEDI"
      ]
    },
    "rightColumn": {
      "name": "R2-D2",
      "appearsIn": [
        "NEWHOPE",
        "EMPIRE",
        "JEDI"
      ]
    }
  }
}
```

Example:

Loading Data from Github Using REST vs GraphQL

On any platform, data loading consists of these steps:

1. Model Data
2. Network
3. Transform
4. Persist

How does REST look on Android?

...It Looks Like a lot of Dependencies

Data Modeling	Networking	Storage	Transform
Immutables	OKhttp	Store	Moshi
Curl	Retrofit	SqlDelight	RxJava

Yes, those are all needed 😂

```
},
{
  "url": "https://api.github.com/repos/vmg/redcarpet/issues/607",
  "repository_url": "https://api.github.com/repos/vmg/redcarpet",
  "labels_url": "https://api.github.com/repos/vmg/redcarpet/issues/607/labels{/name}",
  "comments_url": "https://api.github.com/repos/vmg/redcarpet/issues/607/comments",
  "events_url": "https://api.github.com/repos/vmg/redcarpet/issues/607/events",
  "html_url": "https://github.com/vmg/redcarpet/issues/607",
  "id": 211546203,
  "number": 607,
  "title": "Low Level Rendering `entity`: what now when?",
  "user": {
    "login": "dgsan",
    "id": 313910,
    "avatar_url": "https://avatars2.githubusercontent.com/u/313910?v=4",
    "gravatar_id": "",
    "url": "https://api.github.com/users/dgsan",
    "html_url": "https://github.com/dgsan",
    "followers_url": "https://api.github.com/users/dgsan/followers",
    "following_url": "https://api.github.com/users/dgsan/following{/other_user}",
    "gists_url": "https://api.github.com/users/dgsan/gists{/gist_id}",
    "starred_url": "https://api.github.com/users/dgsan/starred{/owner}{/repo}",
    "subscriptions_url": "https://api.github.com/users/dgsan/subscriptions",
    "organizations_url": "https://api.github.com/users/dgsan/orgs",
    "repos_url": "https://api.github.com/users/dgsan/repos",
    "events_url": "https://api.github.com/users/dgsan/events{/privacy}",
    "received_events_url": "https://api.github.com/users/dgsan/received_events",
    "type": "User",
    "site_admin": false
  },
```


Start with Inspection

curl -i "https://api.github.com/repos/vmg/redcarpet/issues?state=closed"

Model Your Data

```
interface Issue {
    User user();
    String url();


    interface User {
        long id();
        String name();
    }
}
```

Error prone even with code generation

Data Modeling with Immutables

```
@Value.Immutable
interface Issue {
    User user();
    String url();

    @Value.Immutable
    interface User {
        long id();
        String name();
    }
}
```

Error Prone even with Code Generation

Data Parsing with Gson

```
@Gson.TypeAdapters
@Value.Immutable
interface Issue {
    User user();
    String url();

    @Value.Immutable
    interface User {
        long id();
        String name();
    }
}
```

Networking

```
open fun provideRetrofit(gson: Gson, okHttpClient: OkHttpClient): GithubApi {
        return Retrofit.Builder()
                .client(okHttpClient)
                .baseUrl(BuildConfig.BASE_URL)
                .addConverterFactory(GsonConverterFactory.create(gson))
                .addCallAdapterFactory(RxJavaCallAdapterFactory.create())
                .build()
                .create(GithubApi::class.java!!)}
```

Storage

```
CREATE TABLE issue (
    _id LONG  PRIMARY KEY AUTOINCREMENT,
    id LONG NOT NULL,
    url STRING,
    title STRING,
    comments INT NOT NULL
}
```

Storage

```
public abstract class Issue implements IssueModel {
    public static final Mapper<Issue> MAPPER =
            new Mapper<>((Mapper.Creator<Issue>)
            ImmutableIssue::of);

    public static final class Marshal extends IssueMarshal {
    }
}
```

Storage

```
long insertIssue(Issue issue) {
        if (recordExists(Issue.TABLE_NAME, Issue.ID, String.valueOf(issue.id()))) {
            return 0;
        }

        return db.insert(Issue.TABLE_NAME, new Issue.Marshal()
                .url(issue.url())
                .id(issue.id()));
}
```

Storage - Memory

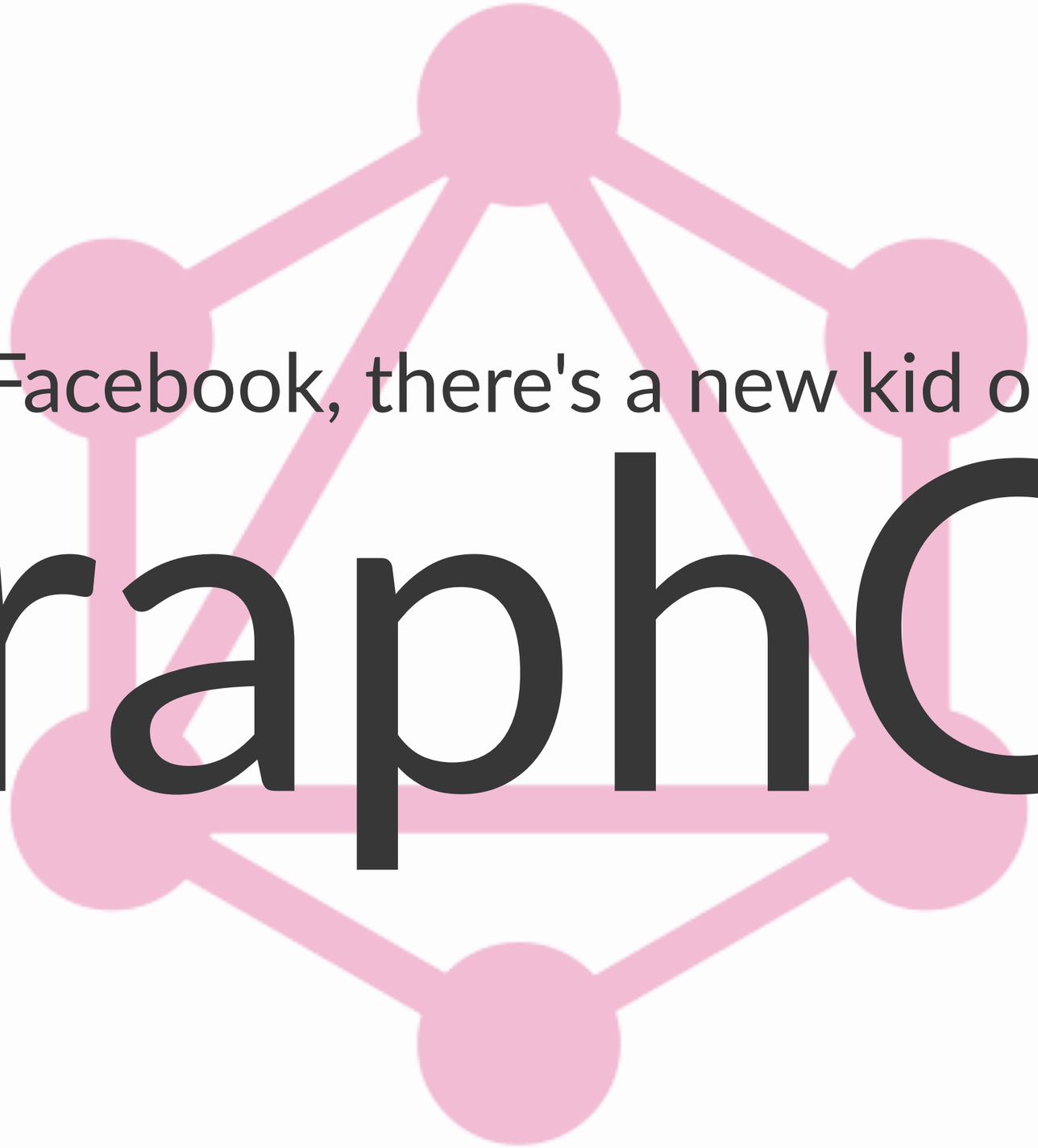
```
StoreBuilder.parsedWithKey<GitHubOrgId, BufferedSource, Issues>()
                .fetcher(fetcher)
                .persister(persister)
                .parser(parser)
                .memoryPolicy(MemoryPolicy
                        .builder()
                        .setMemorySize(11L)
                        .setExpireAfterWrite(TimeUnit.HOURS.toSeconds(24))
                        .setExpireAfterTimeUnit(TimeUnit.SECONDS)
                        .build())
                .networkBeforeStale()
                .open()
```

That's a Good Architecture

It's also not something we can expect a beginner to know

REST Feels Like Legacy Tech

Well-established and with great tools, but cumbersome to work with



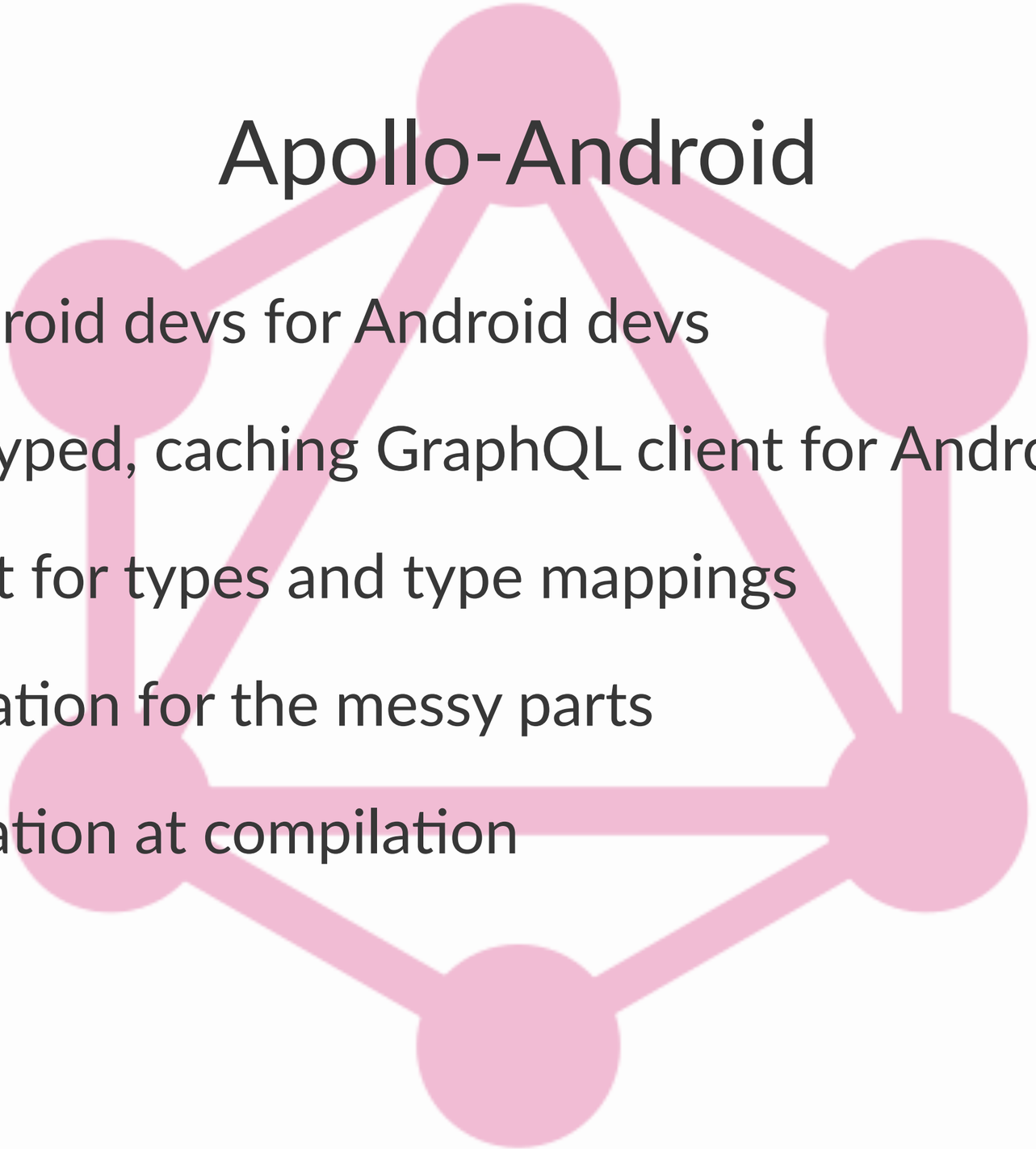
Thanks to Facebook, there's a new kid on the block

GraphQL

Introducing Apollo-Android GraphQL

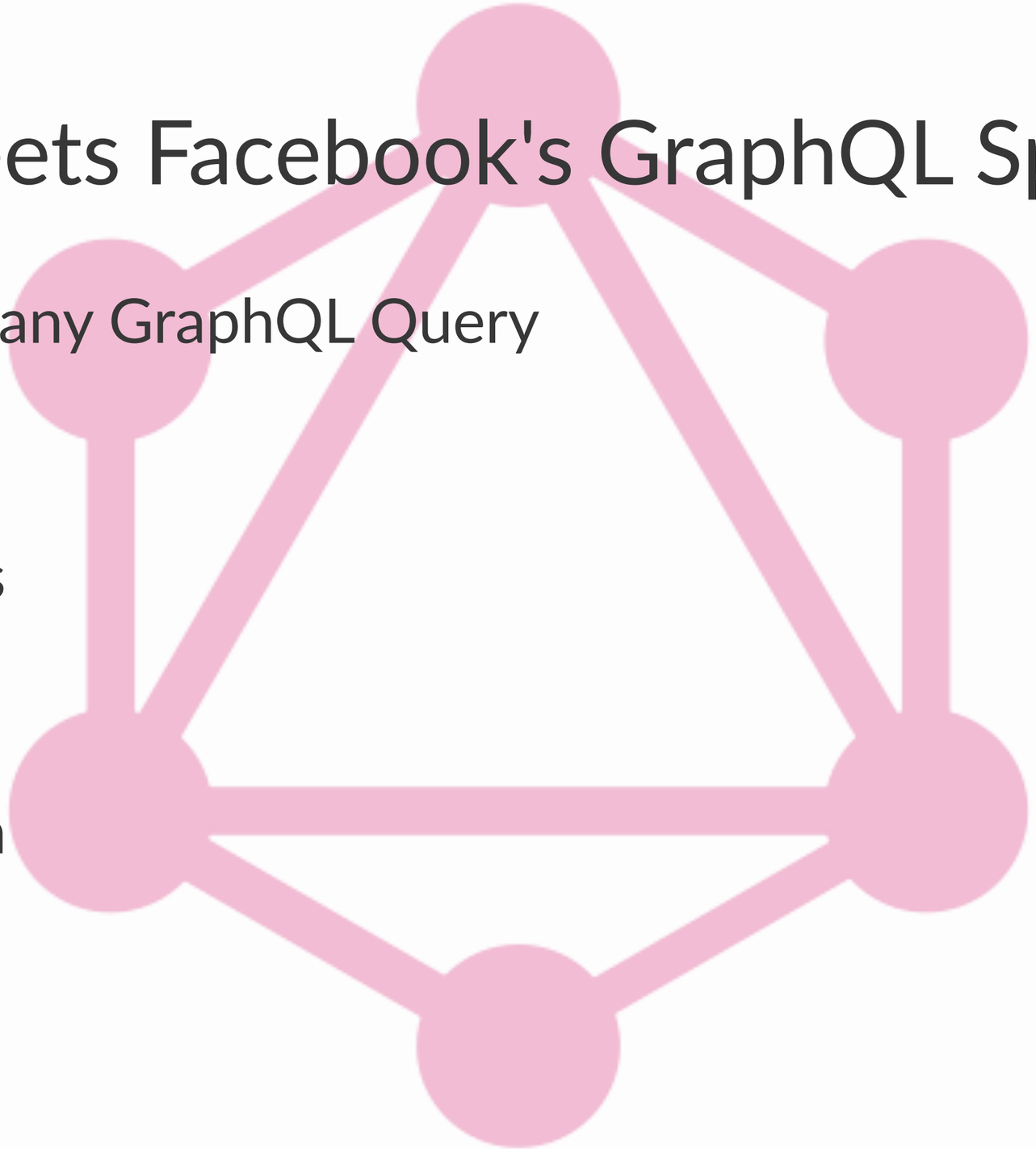
Apollo Android was developed by Shopify, New York Times, & AirBnb as an **Open Source** GraphQL solution.

Apollo-Android



- Built by Android devs for Android devs
- A strongly-typed, caching GraphQL client for Android
- Rich support for types and type mappings
- Code generation for the messy parts
- Query validation at compilation

Meets Facebook's GraphQL Spec



- Works with any GraphQL Query
- Fragments
- Union Types
- Nullability
- Deprecation

Apollo Reduces Setup to Work with a Backend

Data Modeling	Networking	Storage	Transform
Github Explorer	OKhttp	Apollo	RxJava
Apollo	Apollo	Apollo	Apollo

You Ain't Gonna Need It

~~***Retrofit***~~ | ~~***Immutables***~~| ~~***Gson***~~ | ~~***Guava***~~ | ~~***SqlDelight/Brite***~~ | ~~***Store***~~ | ~~***Curl***~~ | ~~***JsonViewer.hu***~~

Apollo-Android Has **2 Main Parts**

- **Gradle Plugin** Apollo code generation plugin
- **Runtime** Apollo client for executing operations

Using Apollo-Android

like a boss

Add Apollo Dependencies

```
build.gradle:
dependencies {
  classpath 'com.apollographql.apollo:apollo-gradle-plugin:0.5.0'
}

app/build.gradle:
apply plugin: 'com.apollographql.android'
.....
compile 'com.apollographql.apollo:apollo-runtime:0.5.0'
//optional RxSupport
compile 'com.apollographql.apollo:apollo-rx2-support:0.5.0'
```

Create a Standard GraphQL Query

Queries have params and define shape of response

```
organization(login:”nyTimes”){
    repositories(first:6) {
        Name
    }
}
```

Leave Your CURL at Home

Most GraphQL Servers have a GUI (Graph**i**QL)

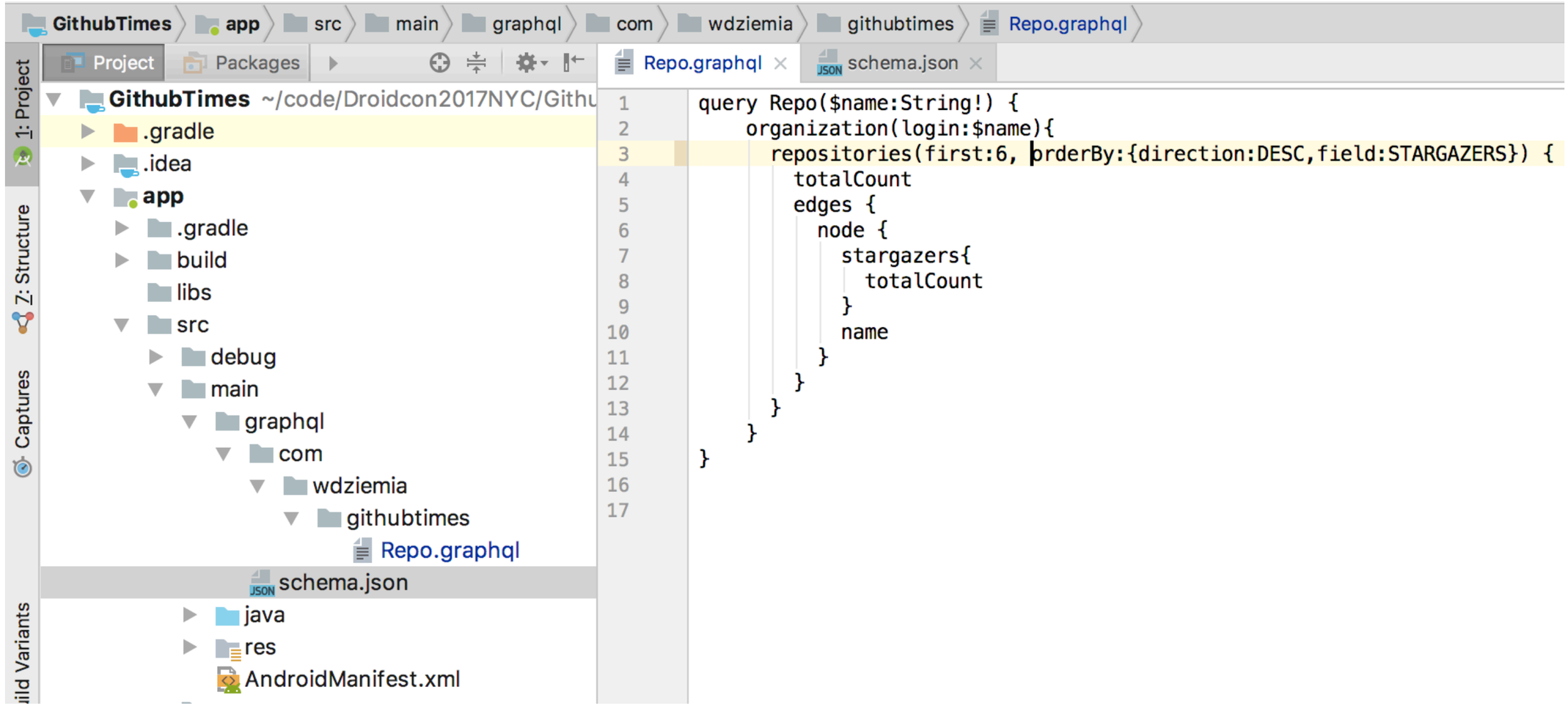
https://developer.github.com/v4/explorer/

GraphiQL: Explore Schema and Build Queries

- Shape of Response
- Nullability Rules
- Enum values
- Types

GraphiQL is easy!

Add Schema & RepoQuery.graphql to project & compile



Apollo Writes Code So You Don't Have To

```
private fun CodeGenerationIR.writeJavaFiles(context: CodeGenerationContext, outputDir: File,
    outputPackageName: String?) {
  fragments.forEach {
    val typeSpec = it.toTypeSpec(context.copy())
    JavaFile.builder(context.fragmentsPackage, typeSpec).build().writeTo(outputDir)
  }

  typesUsed.supportedTypeDeclarations().forEach {
    val typeSpec = it.toTypeSpec(context.copy())
    JavaFile.builder(context.typesPackage, typeSpec).build().writeTo(outputDir)
  }

  if (context.customTypeMap.isNotEmpty()) {
    val typeSpec = CustomEnumTypeSpecBuilder(context.copy()).build()
    JavaFile.builder(context.typesPackage, typeSpec).build().writeTo(outputDir)
  }

  operations.map { OperationTypeSpecBuilder(it, fragments, context.useSemanticNaming) }
      .forEach {
        val packageName = outputPackageName ?: it.operation.filePath.formatPackageName()
        val typeSpec = it.toTypeSpec(context.copy())
        JavaFile.builder(packageName, typeSpec).build().writeTo(outputDir)
      }
}
```

Actually Ivan(sav007) Does (He's Awesome)

Builder - For Creating Your Request Instance

```
///api
val query = RepoQuery.builder.name("nytimes").build()

//Generated Code
public static final class Builder {
    private @Nonnull String name;

    Builder() {
    }

    public Builder name(@Nonnull String name) {
      this.name = name;
      return this;
    }

    public RepoQuery build() {
      if (name == null) throw new IllegalStateException("name can't be null");
      return new RepoQuery(name);
    }
  }
```

Notice How Our Request Param name is Validated

```
///api
val query = RepoQuery.builder.name("nytimes").build()

//Generated Code
public static final class Builder {
    private @Nonnull String name;

    Builder() {
    }

    public Builder name(@Nonnull String name) {
      this.name = name;
      return this;
    }

    public RepoQuery build() {
      if (name == null) throw new IllegalStateException("name can't be null");
      return new RepoQuery(name);
    }
  }
```

Response Models

```
public static class Repositories {
   final @Nonnull String __typename;
   final int totalCount;
   final @Nullable List<Edge> edges;
   private volatile String $toString;
   private volatile int $hashCode;
   private volatile boolean $hashCodeMemoized;

   public @Nonnull String __typename() { return this.__typename; }

   //Identifies the total count of items in the connection.
   public int totalCount() {return this.totalCount;}

   //A list of edges.
   public @Nullable List<Edge> edges() {return this.edges;}

   @Override
   public String toString() {...}

   @Override
   public boolean equals(Object o) {  ... }

   @Override
   public int hashCode() {...}
```

Mapper - Reflection-Free Parser

```
public static final class Mapper implements ResponseFieldMapper<Repositories> {
     final Edge.Mapper edgeFieldMapper = new Edge.Mapper();

     @Override
     public Repositories map(ResponseReader reader) {
       final String __typename = reader.readString($responseFields[0]);
       final int totalCount = reader.readInt($responseFields[1]);
       final List<Edge> edges = reader.readList($responseFields[2], new ResponseReader.ListReader<Edge>() {
         @Override
         public Edge read(ResponseReader.ListItemReader reader) {
           return reader.readObject(new ResponseReader.ObjectReader<Edge>() {
             @Override
             public Edge read(ResponseReader reader) {
               return edgeFieldMapper.map(reader);
             }
           });
         }
       });
       return new Repositories(__typename, totalCount, edges);
     }}
```

Can parse 20MB Response w/o OOM

Querying Github's API With Apollo Client

Building an Apollo Client

```
ApolloClient.builder()
                    .serverUrl("https://api.github.com/graphql)
                    .okHttpClient(okhttp)
                    .build();
```

Querying a Backend

```
query = RepoQuery.builder().name("nytimes").build()
```

Querying a Backend

```
query = RepoQuery.builder().name("nytimes").build()

ApolloQueryCall githubCall = apolloClient.query(query);
```

Querying a Backend

```
query = RepoQuery.builder().name("nytimes").build()

ApolloQueryCall githubCall = apolloClient.query(query);

githubCall.enqueue(new ApolloCall.Callback<>() {
    @Override
    public void onResponse(@Nonnull Response<> response) {
        handleResponse(response);
    }

    @Override
    public void onFailure(@Nonnull ApolloException e) {
        handleFailure(e);
    }
});
```

Apollo also Handles Storage

Storage with Apollo is done through Caches

- HTTP
- Normalized

HTTP Caching

- Similar to OKHTTP Cache (LRU)
- Streams response to cache same time as parsing
- Can Set Max Cache Size
- Useful for background updating to prefill cache
- Prefetching
  apolloClient.prefetch(new RepoQuery("nytimes"));

HTTP Caching - as well as you can do in REST

Apollo Introduces a Normalized Cache

Apollo Store

Apollo Store

- Allows multiple queries to share same cached values
- Great for things like master/detail
- Caching is done post-parsing
- Each field is cached individually
- Apollo ships with both an in memory and a disk implementation of an Apollo Store
- You can even use both at same time

How Does Apollo Store Work?

- Each Object in Response will have its own record with ID
- All Scalars/Members will be merged together as fields
- When we are reading from Apollo, it will seamlessly read from Apollo Store or network

Setup Bi-Level Caching with Apollo Store

```
//Create DB
ApolloSqlHelper apolloSqlHelper = ApolloSqlHelper.create(context, "db_name");
//Create NormalizedCacheFactory
NormalizedCacheFactory normalizedCacheFactory = new LruNormalizedCacheFactory(EvictionPolicy.NO_EVICTION)
                                                    .chain(new SqlNormalizedCacheFactory(apolloSqlHelper));
```

Create a Cache Key Resolver

```
//Create the cache key resolver
 CacheKeyResolver cacheKeyResolver = new CacheKeyResolver() {
      @Nonnull @Override
      public CacheKey fromFieldRecordSet(@Nonnull ResponseField field, @Nonnull Map<String, Object> recordSet) {
        String typeName = (String) recordSet.get("__typename");
          if (recordSet.containsKey("id")) {
          String typeNameAndIDKey = recordSet.get("__typename") + "." + recordSet.get("id");
          return CacheKey.from(typeNameAndIDKey);
        }
        return CacheKey.NO_KEY;
      }

      @Nonnull @Override
      public CacheKey fromFieldArguments(@Nonnull ResponseField field, @Nonnull Operation.Variables variables) {
        return CacheKey.NO_KEY;
      }
    };
```

Init Apollo Client With a Cache

```
//Build the Apollo Client
ApolloClient apolloClient = ApolloClient.builder()
                                        .serverUrl("/")
                                        .normalizedCache(cacheFactory, resolver)
                                        .okHttpClient(okHttpClient)
                                        .build();
```

Don't Like Our Cache? BYO Cache

```
public abstract class NormalizedCache {

@Nullable public abstract Record loadRecord(@Nonnull String key, @Nonnull CacheHeaders cacheHeaders)

@Nonnull public Collection<Record> loadRecords(@Nonnull Collection<String> keys, @Nonnull CacheHeaders cacheHeaders)

@Nonnull public abstract Set<String> merge(@Nonnull Record record, @Nonnull CacheHeaders cacheHeaders)

public abstract void clearAll()

public abstract boolean remove(@Nonnull CacheKey cacheKey)
```

Bonus: Includes RxJava Bindings

```
RxApollo.from(apolloClient.query(RepoQuery.builder().name("nytimes").build()))
        .map(dataResponse -> dataResponse
        .data()
        .organization()
        .repositories())
        .subscribe(view::showRepositories, view::showError)
```

RxApollo response can be transformed into LiveData

Version 1.0 ships soon!

- 550 commits
- 1000s of tests
- 41 contributors including devs from Shopify, Airbnb, NY Times
- Come join us at https://github.com/apollographql/apollo-android