intralox®

Introduction to GraphQL

Krishna Regmi

Before we start!!

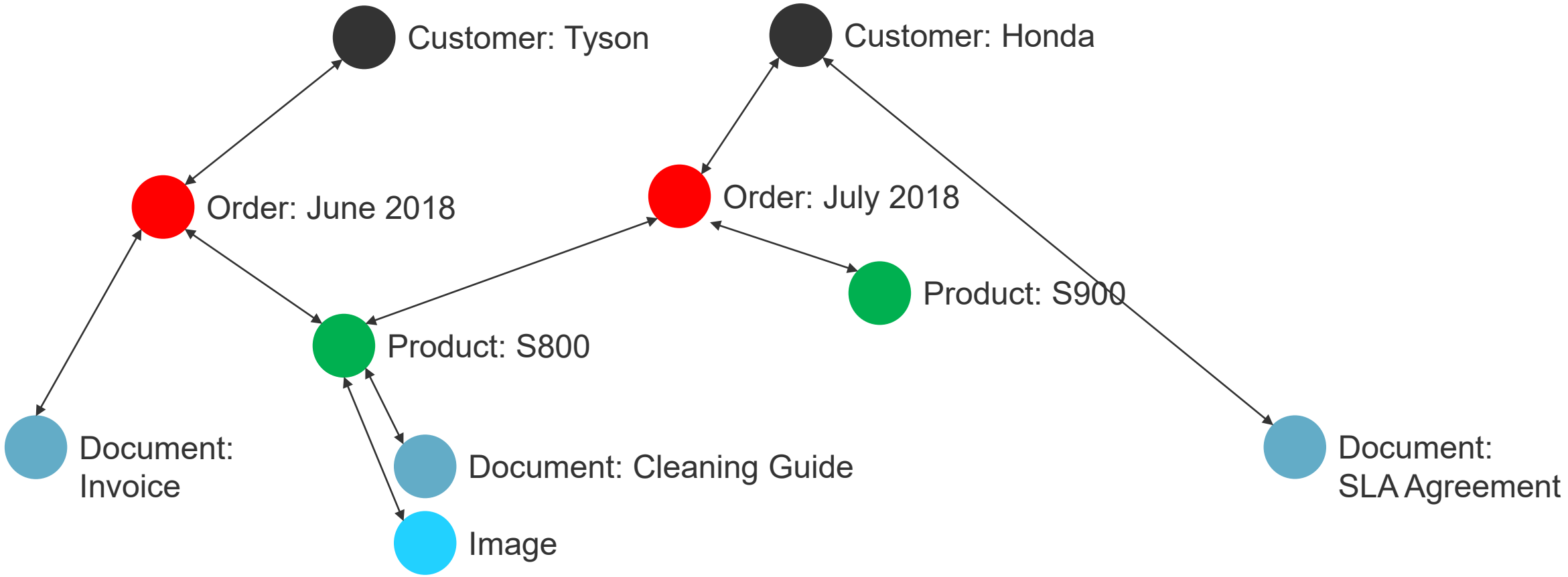
- First and foremost, it’s an abstraction.
  - You can do everything with or without GraphQL, but having GraphQL saves you time and effort.
  - On top of code abstraction, GraphQL also gives you a thinking model that enables better collaboration with other developers.
- GraphQL ultimately makes it easier to build and maintain web applications.
- There are applications where GraphQL is not the correct tool for the job.

What's in the Name?

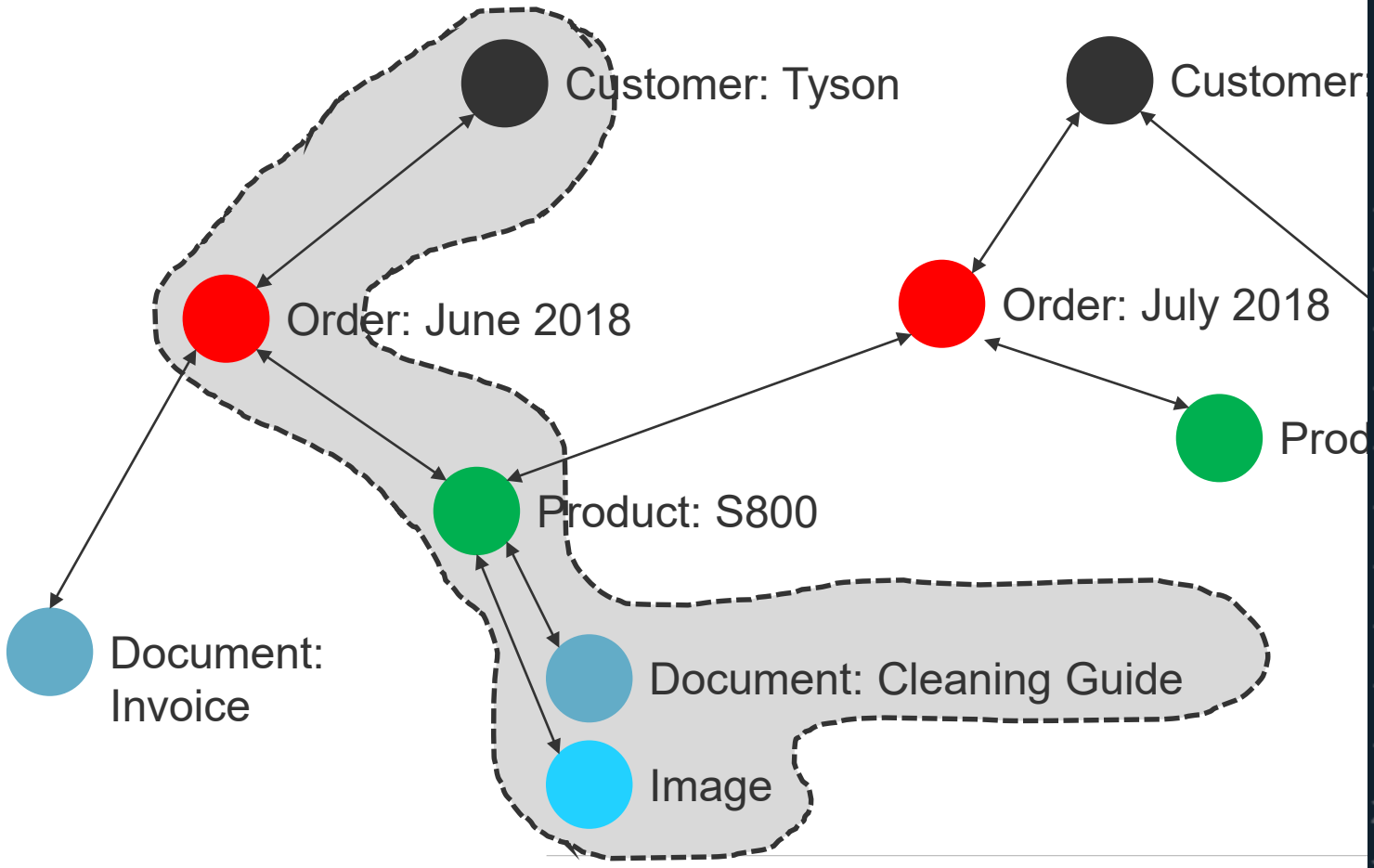
Graph + QL

Graph

Consider your application data as a graph of nodes that are connected.



QL
Query Language

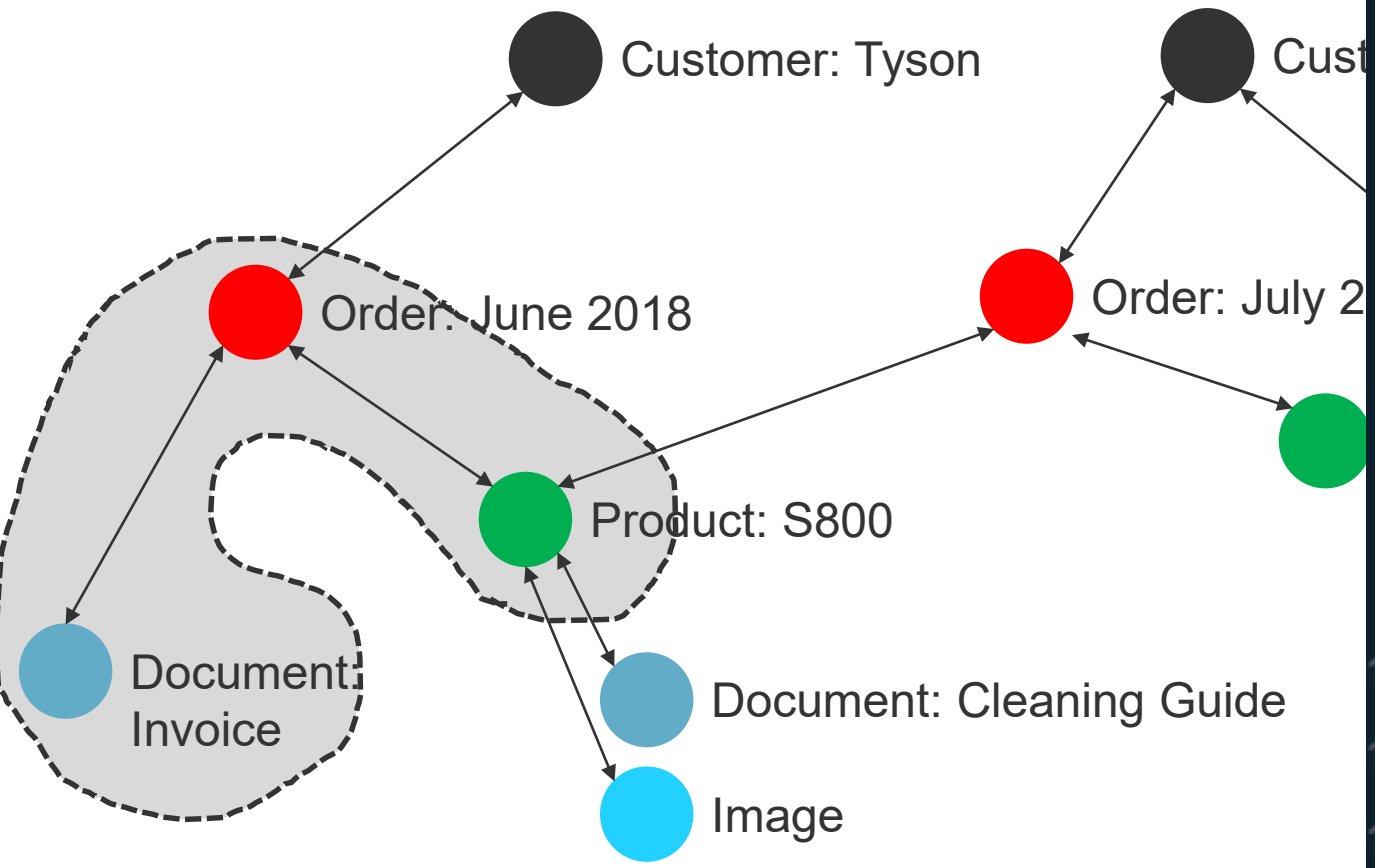



```
query {
  customer(id: 1) {
    id
    name
    contactLanguage
    orders {
      id
      date
      products {
        id
        name
        document {
          documentUrl
        }
        images {
          imageUrl
        }
      }
    }
  }
}
```

```graphql
query {
  customer(id: 1) {
    id
    name
    contactLanguage
    orders {
      id
      date
      products {
        id
        name
        document {
          documentUrl
        }
        images {
          imageUrl
        }
      }
    }
  }
}
```

GraphQL lets you start at any node in the graph

GraphQL lets you start at Any Node

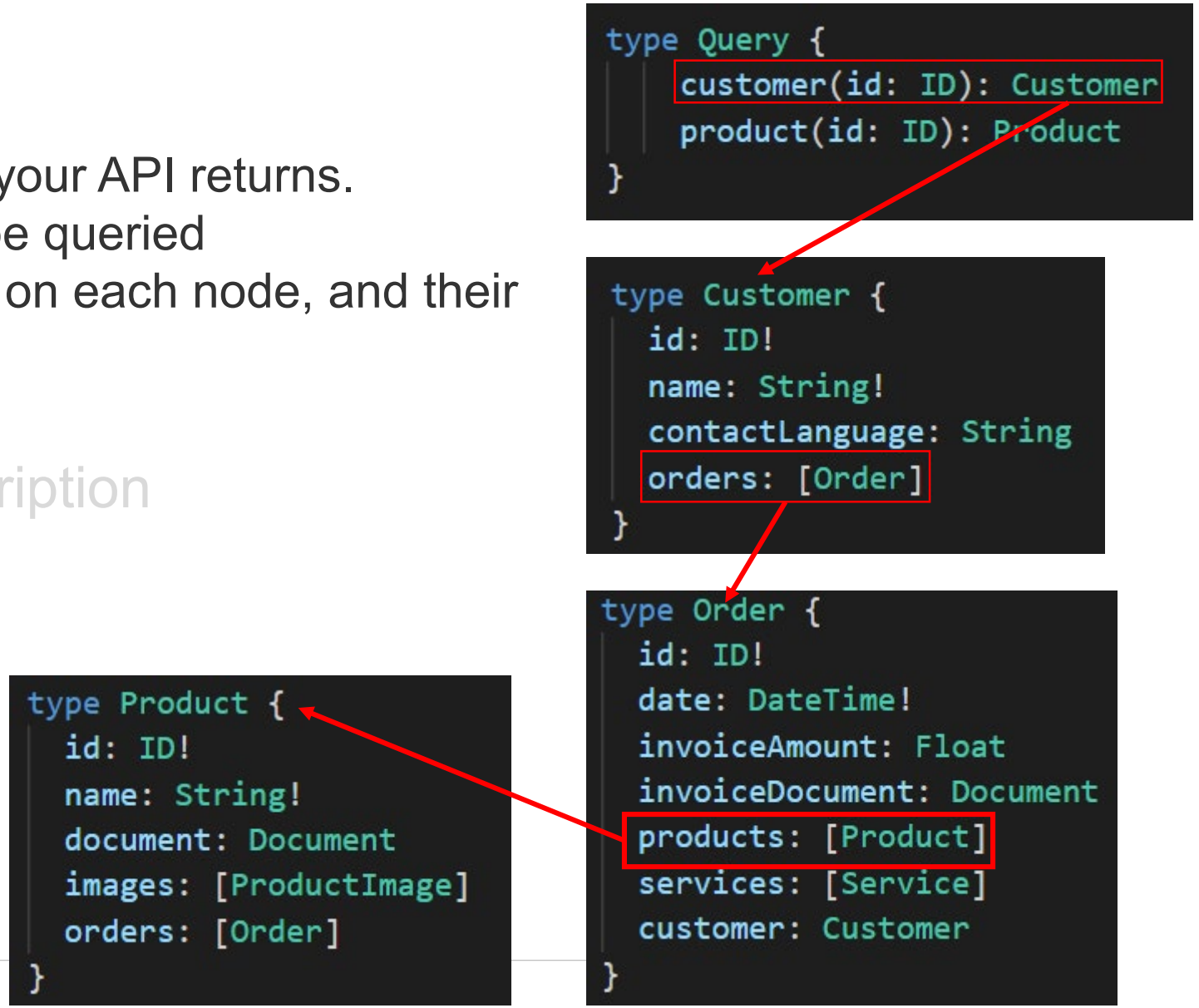



```
query {
  product (id: "S800") {
    id
    orders {
      id
      date
      invoiceDocument {
        documentUrl
      }
    }
  }
}
```

Components of GraphQL API

Components of GraphQL API

- Schema
  - Schema defines the data your API returns.
  - Declare what nodes can be queried
  - Declare what values exist on each node, and their types
- Resolvers
- Query / Mutation / Subscription



Components of GraphQL API

- Schema
- Resolvers
  - Resolver is a function that gets the data requested
  - GraphQL runtime only runs resolvers necessary
  - Permissions can be applied on each resolver function
- Query / Mutation / Subscription

Components of GraphQL API

```
type Order {
  id: ID!
  date: DateTime!
  invoiceAmount: Float
  invoiceDocument: Document
  products: [Product]
  services: [Service]
}
```

Resolver 1

Resolver 2

Resolver 3

```
const resolvers = {
  Query: {
    customer: async (_, {id}, ctx) => {
      return data.customers.find(cust => cust.id == id)
    },
    product: async (_, {id}, ctx) => {
      return data.products.find(p => p.id == id)
    },
    order: async (_, {id}, ctx) => {
      return data.orders.find(ord => ord.id == id)
    }
  },
```

Root Resolver

```
Order: {
  products: async (parentOrder, _, ctx) => {
    return data.products.filter(prd => parentOrder.products.includes
    ( parseInt(prd.id) ))
  },
  services: async (parentOrder, _, ctx) => {
    if(ctx.user.role !==  "vp"){
      throw Error("You are not allowed to access information about
      services")
    }
    return []
  }
},
```

Components of GraphQL API

```
query {
  order(id:1) {
    id
    invoiceAmount
  }
}
```

```
type Order {
  id: ID!
  date: DateTime!
  invoiceAmount: Float
  invoiceDocument: Document
  products: [Product]
  services: [Service]
}
```

```
const resolvers = {
  Query: {
    customer: async (_, {id}, ctx) => {
      return data.customers.find(cust => cust.id == id)
    },
    product: async (_, {id}, ctx) => {
      return data.products.find(p => p.id == id)
    },
    order: async (_, {id}, ctx) => {
      return data.orders.find(ord => ord.id == id)
    }
  },
```

```
Order: {
  products: async (parentOrder, _, ctx) => {
    return data.products.filter(prd => parentOrder.products.includes
    ( parseInt(prd.id) ))
  },
  services: async (parentOrder, _, ctx) => {
    if(ctx.user.role !==  "vp"){
      throw Error("You are not allowed to access information about
      services")
    }
    return []
  }
},
```

Components of GraphQL API

```
query {
  order(id:1) {
    id
    invoiceAmount
    products {
      name
    }
  }
}
```

```
type Order {
  id: ID!
  date: DateTime!
  invoiceAmount: Float
  invoiceDocument: Document
  products: [Product]
  services: [Service]
}
```

```
const resolvers = {
  Query: {
    customer: async (_, {id}, ctx) => {
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    },
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      return data.products.find(p => p.id == id)
    },
    order: async (_, {id}, ctx) => {
      return data.orders.find(ord => ord.id == id)
    }
  },
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Order: {
  products: async (parentOrder, _, ctx) => {
    return data.products.filter(prd => parentOrder.products.includes
    ( parseInt(prd.id) ))
  },
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    if(ctx.user.role !==  "vp"){
      throw Error("You are not allowed to access information about
      services")
    }
    return []
  }
},
```

Components of GraphQL API

```
query {
  order(id:1) {
    id
    invoiceAmount
    products {
      name
    }
    services {
      name
    }
  }
}
```

```
type Order {
  id: ID!
  date: DateTime!
  invoiceAmount: Float
  invoiceDocument: Document
  products: [Product]
  services: [Service]
}
```

```
const resolvers = {
  Query: {
    customer: async (_, {id}, ctx) => {
      return data.customers.find(cust => cust.id == id)
    },
    product: async (_, {id}, ctx) => {
      return data.products.find(p => p.id == id)
    },
    order: async (_, {id}, ctx) => {
      return data.orders.find(ord => ord.id == id)
    }
  },
```

```
Order: {
  products: async (parentOrder, _, ctx) => {
    return data.products.filter(prd => parentOrder.products.includes
    ( parseInt(prd.id) ))
  },
  services: async (parentOrder, _, ctx) => {
    if(ctx.user.role !==  "vp"){
      throw Error("You are not allowed to access information about
      services")
    }
    return []
  }
},
```

Components of GraphQL API

- Schema
- Resolvers
- Query / Mutation / Subscription
  - Query: Used to read data
  - Mutation: Used to Edit/Create data
  - Subscriptions: Used for Real-Time data
  - Use Query language for all three.

```
query {
  customer(id: 1) {
    id
    name
    contactLanguage
    orders {
      id
      date
      products {
        id
        name
        document {
          documentUrl
        }
        images {
          imageUrl
        }
      }
    }
  }
}
```

GraphQL enables efficient data loading

GraphQL enables efficient data loading

- Get only what you ask for
  - Just the requested data is transferred through the network. No more, no less.
  - You only need one request to the backend no matter how you traverse the data graph
  - Multiple graph traversals can be combined into one request, reducing network delays
- As a result of the architecture:
  - Speed to features when data requirement changes
  - One can read the query in the frontend code and clearly understand what data comes back without having to be familiar with the backend.

```
query {
  customer(id:1){
    name
  }
  product(id:1){
    name
  }
}
```

```
{
  "data": {
    "customer": {
      "name": "TYSON CHICKEN LOUISIANA"
    },
    "product": {
      "name": "S800"
    }
  }
}
```

GraphQL enables efficient data loading

- Example from GraphQL API

Query to get just license Usage

```
query {
  licenseUsage {
    used
    available
  }
}
```

```
Response
{
  "used":50,
  "available":450
}
```

Query to get just detailed license Usage

```
query {
  licenseUsage {
    used
    available
    users {
      username
      used
    }
  }
}
```

```
Response
{
  "used":50,
  "available":450,
  "users":[
    {
      "username":"jean-paul",
      "used":20
    },
    {
      "username":"jeremiah",
      "used":30
    }
  ]
}
```

GraphQL enables efficient data loading

- Compare with Example from Simulation Portal

API to get just license Usage

```
/api/getLicenseUsage/
{
  "used":50,
  "available":450
}
```

API to get just detailed license Usage

```
/api/getlicenseUsageDetails/
{
  "used":50,
  "available":450,
  "users":[
    {
      "username":"jean-paul",
      "used":20
    },
    {
      "username":"jeremiah",
      "used":30
    }
  ]
}
```

GraphQL enables efficient data loading

- Compare with Example from Sensing Portal

```
GET /api/datasets/<dataset_id>/
GET /api/datasets/<dataset_id>/metadata/<key>
GET /api/datasets/<dataset_id>/tags
GET /api/datasets/<dataset_id>/channels
```

vs

```
query {
  datasets (id: dataset_id){
    data
    metadata
    tags
    channels
  }
}
```

Four End points to get various info in REST

In GraphQL, you ask for what you need

GraphQL enables Fine Grain Control

GraphQL enables Fine Grain Permissions Checks

- Because we can write resolver for each node, it is possible to perform permission check on every node.

```
type Order {
  id: ID!
  date: DateTime!
  invoiceAmount: Float
  invoiceDocument: Document
  products: [Product]
  services: [Service]
}
```

Resolver 1

Resolver 2

Resolver 3

```
Order: {
  products: async (parentOrder, _, ctx) => {
    return data.products.filter(prd => parentOrder.products.includes
    ( parseInt(prd.id) ))
  },
  services: async (parentOrder, _, ctx) => {
    if(ctx.user.role !==  "vp"){
      throw Error("You are not allowed to access information about
      services")
    }
    return []
  }
},
```

If the user is not a VP, don't return services fields

GraphQL enables Fine Grain Error Messages

- Because of permissions check, we also get fine grain error messages.
- Data that can be fetched is returned along with error message.

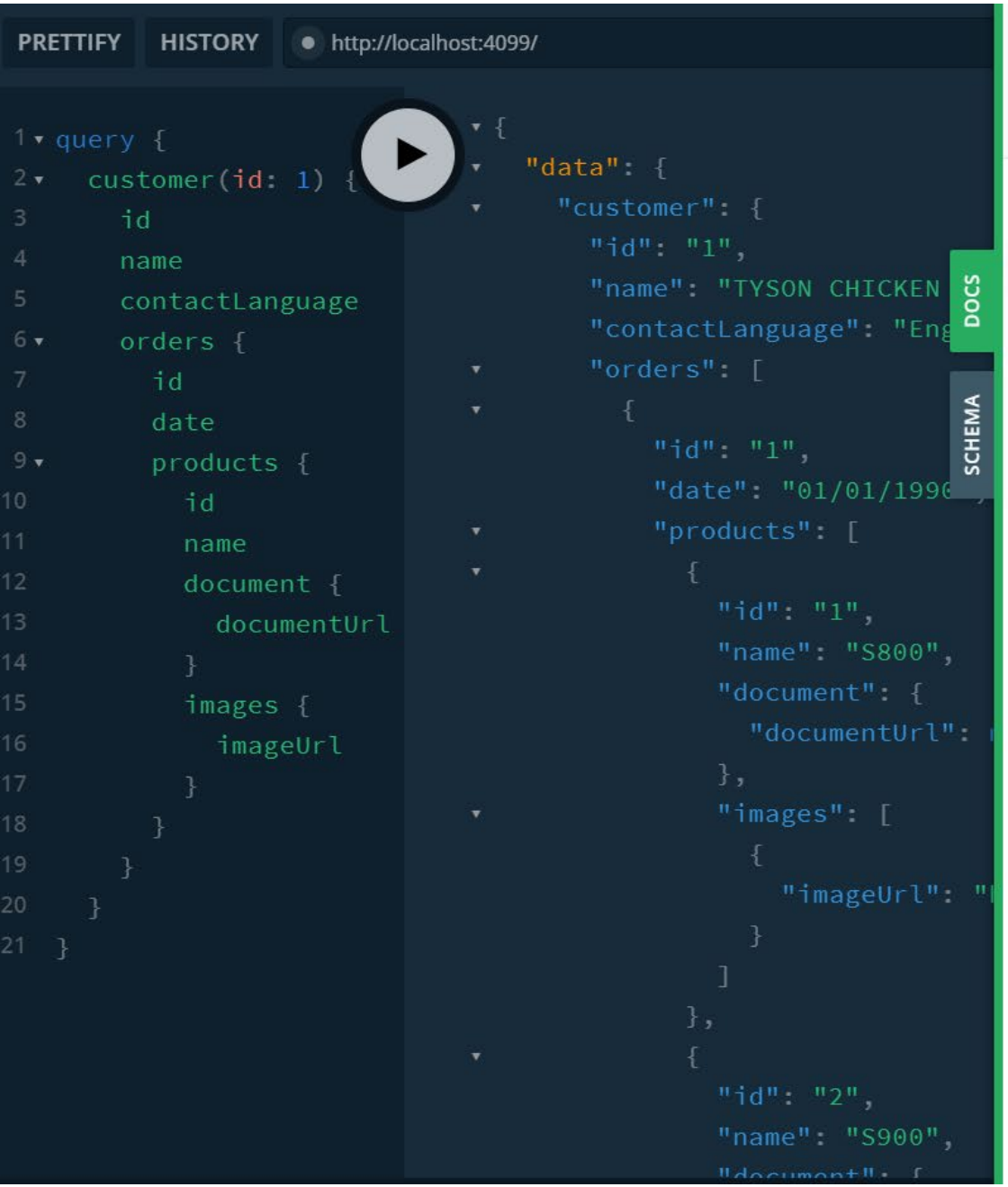
```
query {
  customer(id: 2) {
    id
    name
    contactLanguage
    orders {
      services {
        id
      }
    }
  }
}
```

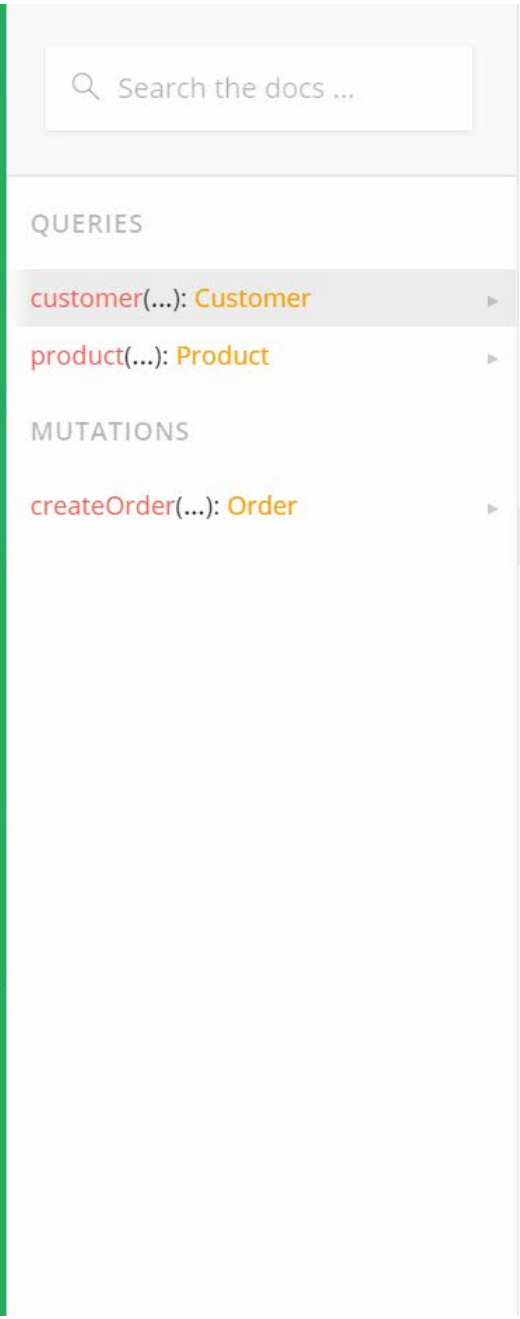

```
{
  "data": {
    "customer": {
      "id": "2",
      "name": "TYSON CHICKEN CAJUN",
      "contactLanguage": "French",
      "orders": [
        {
          "services": null
        }
      ]
    }
  },
  "errors": [
    {
      "message": "You are not allowed to access information about services",
      "locations": [↔],
      "path": [↔]
    }
  ]
}
```

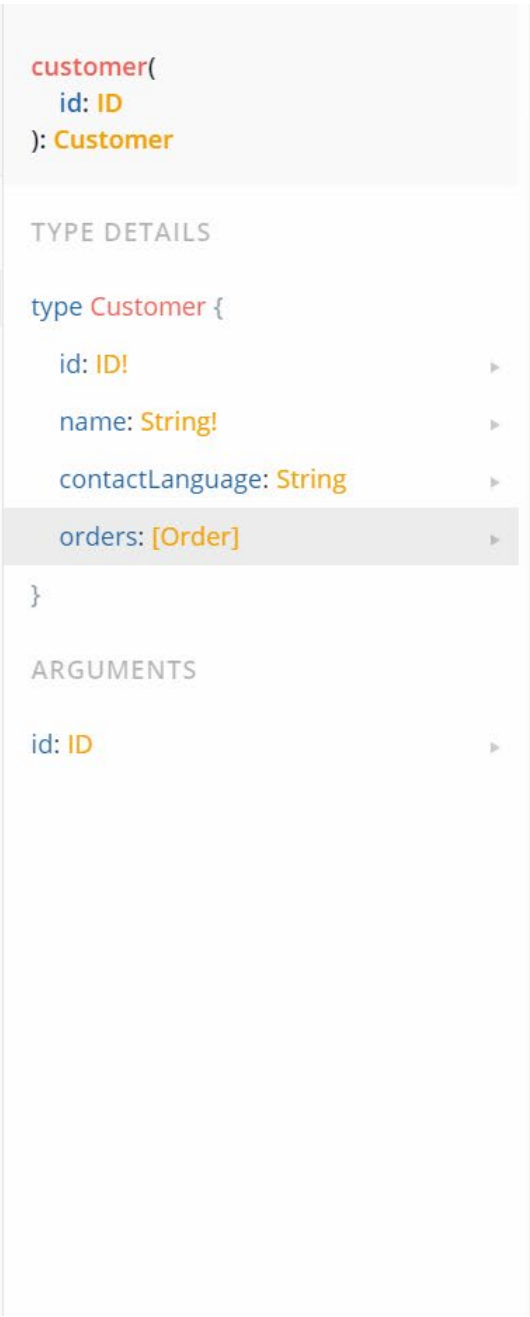
GraphQL enables writing less code

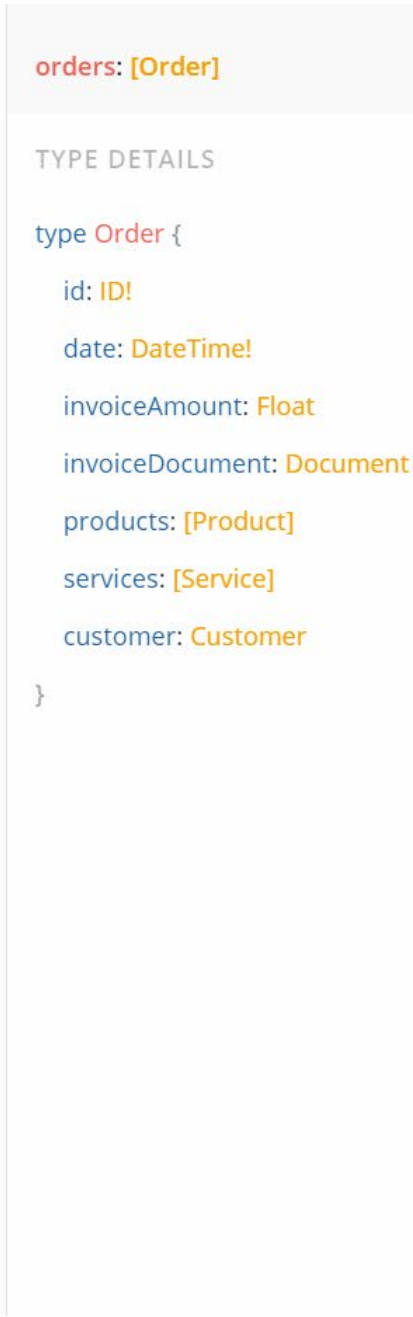
- Data plumbing is taken care of by GraphQL runtime.
- Do not need any extra code for arbitrary ways of traversing the graph

GraphQL is Self Documenting


PRETTIFY
HISTORY
http://localhost:4099/
query {
customer(id: 1) {
id
name
contactLanguage
orders {
id
date
products {
id
name
document {
documentUrl
}
images {
imageUrl
}
}
}
}
}
{
"data": {
"customer": {
"id": "1",
"name": "TYSON CHICKEN
"contactLanguage": "Eng
"orders": [
{
"id": "1",
"date": "01/01/199
"products": [
{
"id": "1",
"name": "S800",
"document": {
"documentUrl":
},
"images": [
{
"imageUrl": "
}
]
},
{
"id": "2",
"name": "S900",
DOCS
SCHEMA

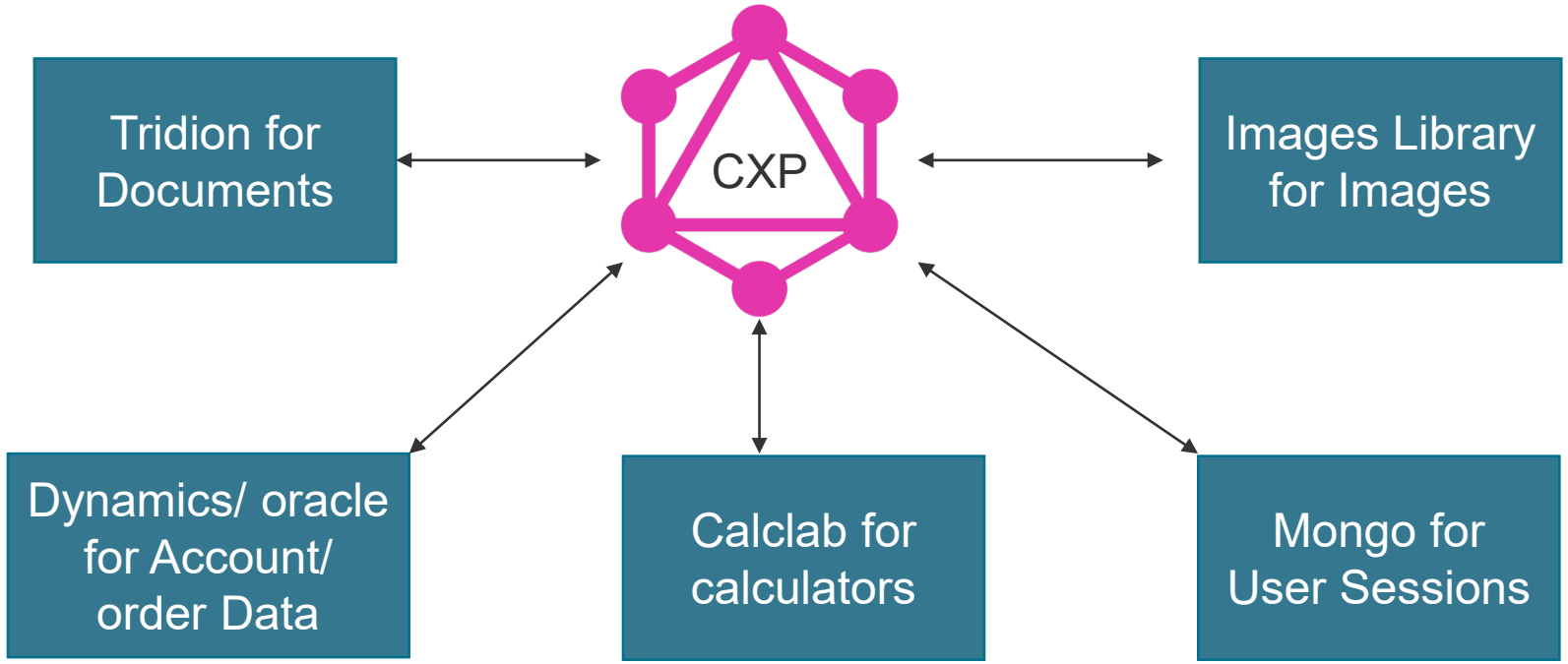

Search the docs ...
QUERIES
customer(...): Customer
product(...): Product
MUTATIONS
createOrder(...): Order


customer(
id: ID
): Customer
TYPE DETAILS
type Customer {
id: ID!
name: String!
contactLanguage: String
orders: [Order]
}
ARGUMENTS
id: ID


orders: [Order]
TYPE DETAILS
type Order {
id: ID!
date: DateTime!
invoiceAmount: Float
invoiceDocument: Document
products: [Product]
services: [Service]
customer: Customer
}

GraphQL is a perfect fit for Complex Interconnected Systems

GraphQL enables easy ways to combine different data sources



Why Industry Leaders are using GraphQL

- Capital One
  - Uses GraphQL as a way of wiring up various sources of data in their data analytics team.
- Tinder
  - Uses GraphQL to power their Blog called Swipe Life
- GitLab
  - Planning on moving completely to GraphQL based data API because of flexibility it provides
- Expedia / Airbnb
  - Use GraphQL to power their Frontends (website, app, client specific sites)
- Intuit
  - Uses GraphQL to connect all of their micro services together
- Facebook
  - GraphQL APIs has been powering their news feed since 2012

Why did we decide to use GraphQL with CXP?

- Complex web of data sources that need to be wired up together
- CXP needs will continue evolving. This enables us to not have to change our backend, even as frontend evolves
- Faster development time because of self-documenting API

Real Demo + Questions?

- Demo Topics
  - Schema Review
  - Resolver Review
  - Quick chat about permissions, authorization etc.

Extra Slides Below

Benefit of thinking of app data as a graph

- REST is the current best alternative. To build out our two requirements here are the rest endpoints. Compare this with GraphQL in later slides

REST Endpoints	
/customers	Returns list of customers
/customers/id	Returns info about customers
/customers/id/orders	Returns orders for the customer
/orders/id/documents	Returns documents related to a specific order
/orders/id/images	Returns images related to a specific order
/products/id/images	Returns images related to a specific product
/products/id/orders	Returns orders for product with a certain id
/orders/id/documents	Returns documents for a specific order

Challenges with REST

- Have to know requirements ahead of time.
- As a project evolves, new APIs get added to fulfill specific data requirements of evolving application.
- Clients and Front end developers do not have a automated way to know what's possible and how to query it.
- Always dealing with over-fetching or under-fetching

GraphQL enables more efficient caching

- With GraphQL, each Node is cached which creates efficiencies in caching
  - Compare with REST where resources are cached based on URL
- Consideration:
  - Node level caching is generally more complex to implement than URL level caching
  - Luckily the community has already developed lots of libraries for caching.

Consideration with GraphQL

- Simple web apps with 1 data source and limited API
- Mature applications where REST has been working, and there are no plans for extending the application.
- Applications where performance efficiency is the most important criteria of success
  - Especially important if you have one data source with complex queries