What DBAs Don't Know About Mobile Apps and APIs

Andy Lech

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Topics

- Supporting APIs as a more direct path to your data
- Guaranteeing uniqueness in a stateless API client
- Adding narrower slices of data for just-in-time consumption
- Providing context to database decisions through the API

Part 1

Imagine your house was an app ...

Energy - User

[Web Site or Mobile App User]

- Energy Consumption
  - Just Works
- Energy Production
  - Somebody Else's Problem
- Resiliency
  - Generator (Maybe?)
- **Focus**
  - **Living My Best Life**

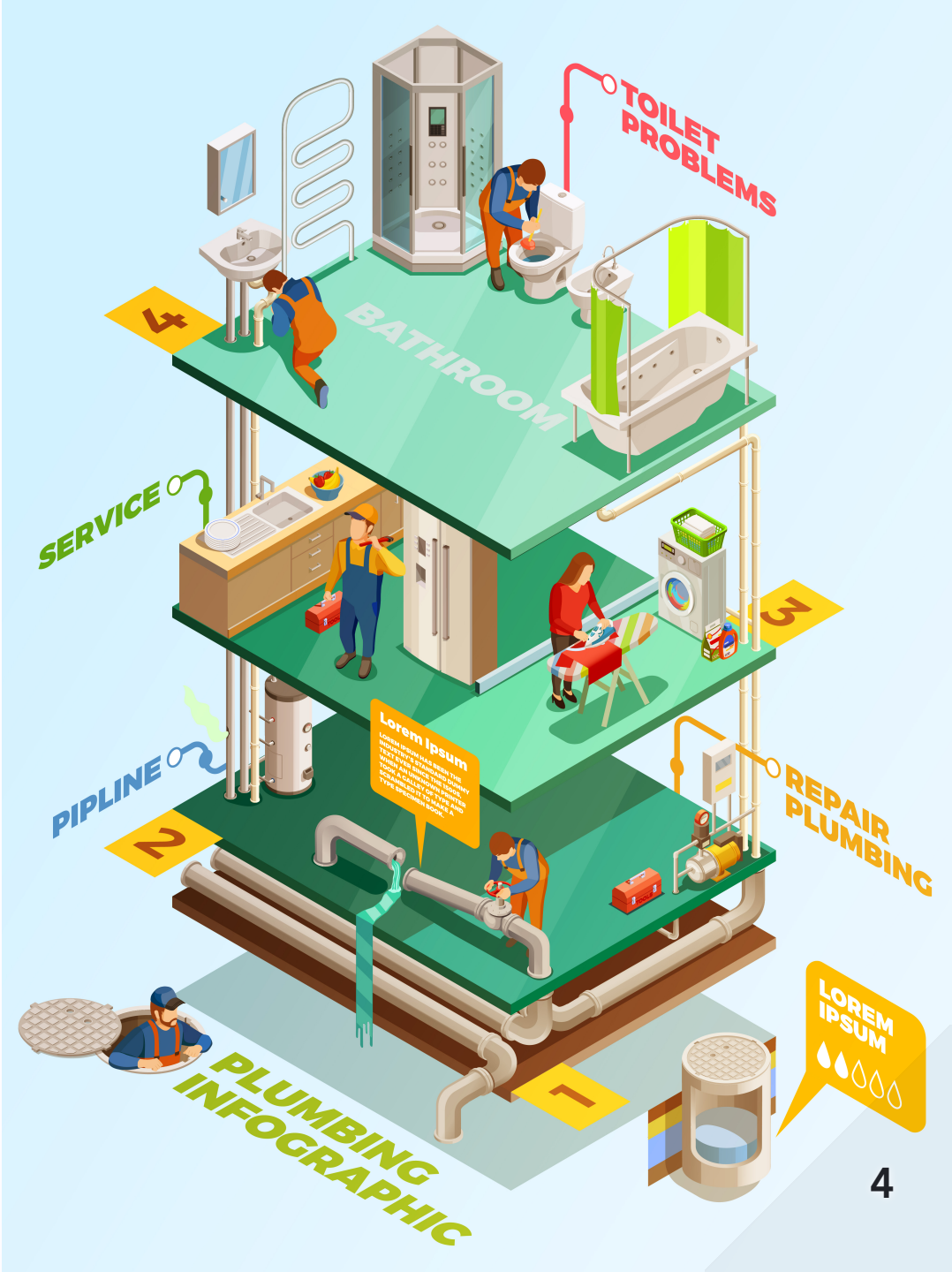
Image by macrovector on Freepik

Energy - Power Grid

[Web Site or Single Page Application Dev]

- User Consumption
  - Always
- Grid Production
  - Our Problem
- Resiliency
  - Our Backups Have Backups (Hopefully)
- **Focus**
  - **Keeping the Lights On (Literally)**

Image by macrovector on Freepik
[Equivalent energy image not available]



Energy - Solar/Wind

[Mobile App Dev]

- Energy Production
  - Local
- Grid Consumption
  - Backup
- Grid Production
  - Their Problem
- Resiliency
  - Battery, Power Grid
- **Focus**
  - **Smartly Using and Storing Energy**

Image by macrovector on Freepik

Andy Lech - What DBAs Don't Know About Mobile Apps and APIs

Part 2

Mobile is just like Web but smaller,

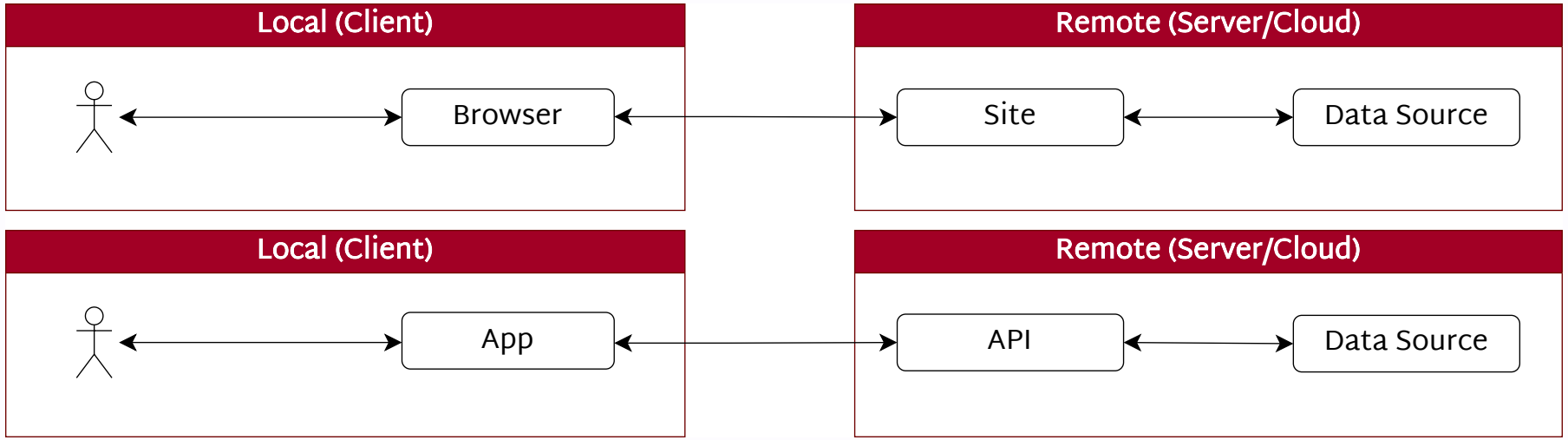
right!?

or

Web devs make bad Mobile devs

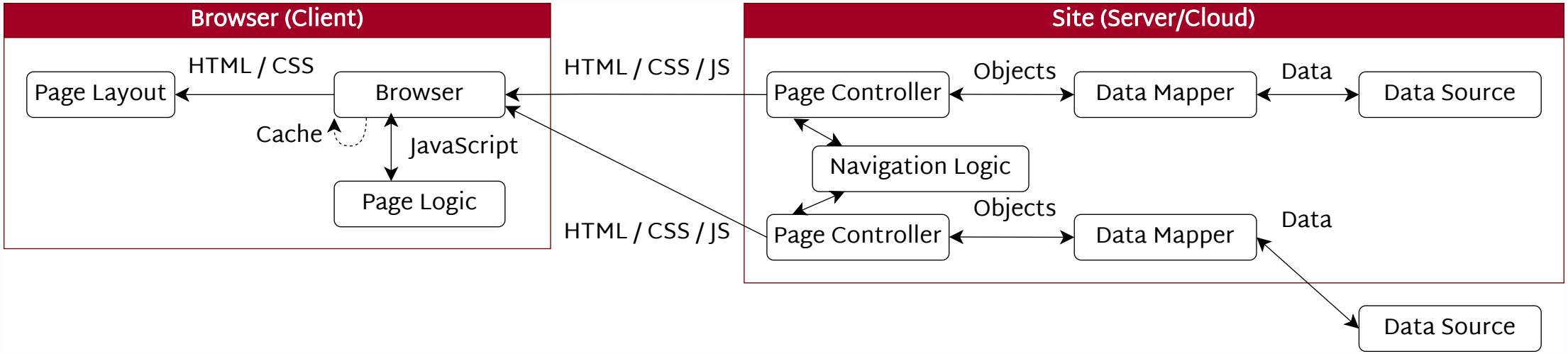
... but they can learn

Web vs Mobile - High Level



Same thing, right? Problem solved! Crisis averted!
Thank you and good night!

Web Sites (Traditional)



- Server/cloud stack is the focus here, turning data into pages and layouts
- Complex layouts are generally built on top of templating frameworks
- **Web devs expect fat data pipes in the server/cloud stack to get large data payloads (object graphs) to choose what to filter/display in page layouts**

Web Sites (Traditional)

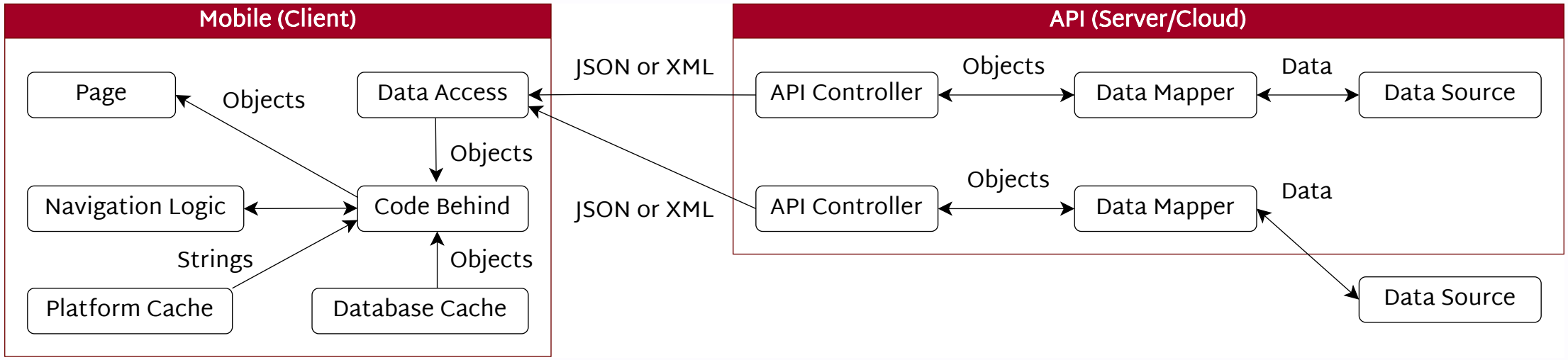
Browser (Client)

- Requests: Browse, Submit
- State Management: Cookies
- Data Mapping: None
- Caching: Local, Session, Cookies
- Resiliency: Browser
- **Dev Focus: Interactivity, Data Updates**
- **Data Goal: Fat Data Pipes (to Site)**

Site (Server/Cloud)

- Responses: Page Layouts (Whole)
- State Management: Server/Cloud
- Data Mapping: Source to Site
- Caching: Server/Cloud
- Resiliency: Server/Cloud, Services
- **Dev Focus: Layouts, State, Services**
- **Data Goal: Fat Data Pipes (inside Site)**

Mobile Apps



- App handles interactivity, page layouts, local caching, and API calls
- API stack delivers only data or status codes in response to app requests
- App pages tend to be focused on single tasks that call the API selectively
- **Mobile/API devs focus more on reliable, just-in-time data delivery**

Mobile Apps

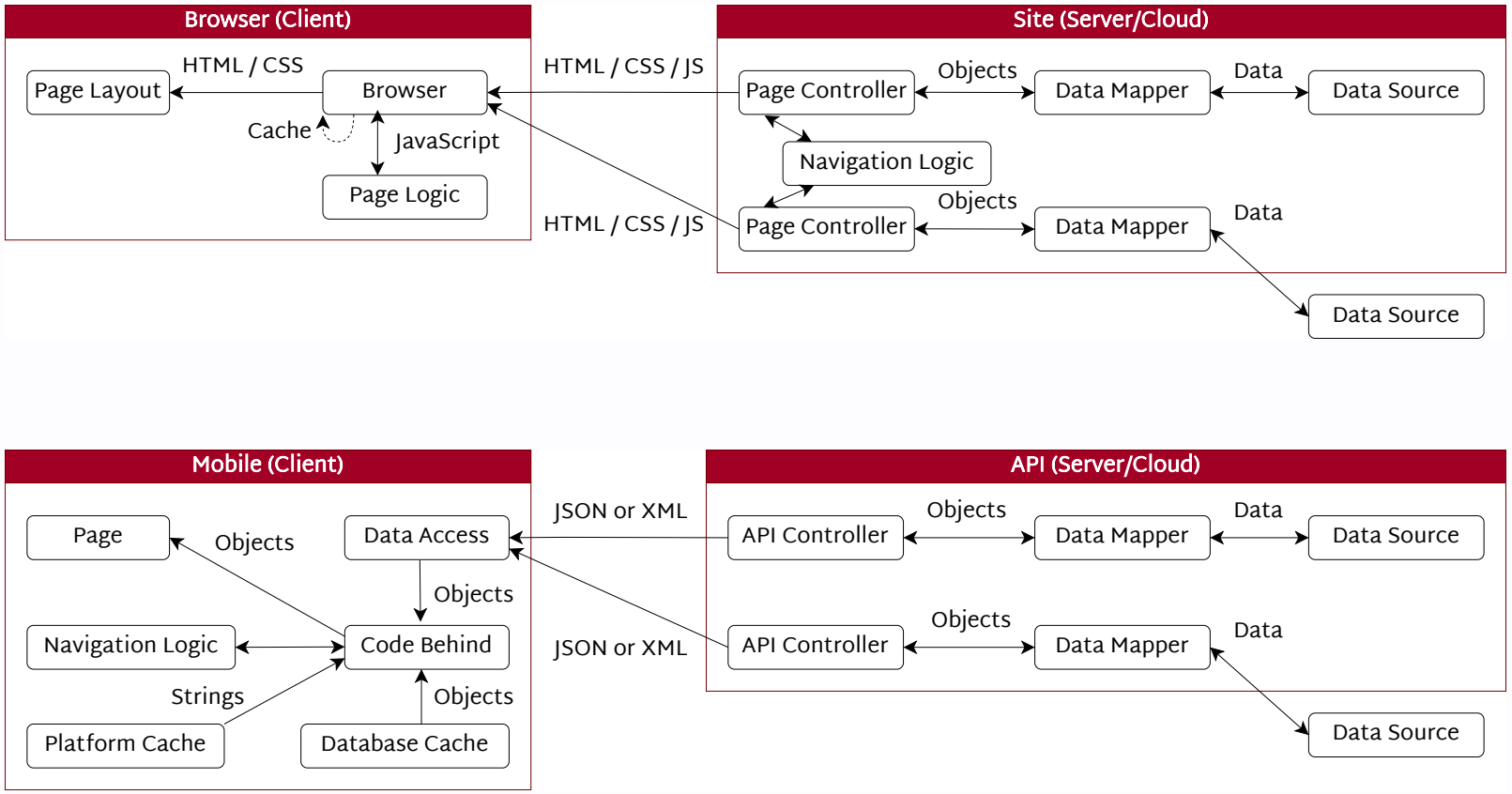
App (Client)

- Requests: API Calls
- State Management: ViewModels, Cache
- Data Mapping: API to App
- Caching: Platform, Local DB
- Resiliency: Network State
- **Dev Focus: Interactivity, Data Updates, Layouts, State, API Calls**
- **Data Goal: Smart Data Pipes (to API)**

API (Server/Cloud)

- Responses: Data (JSON/XML)
- State Management: Auth Tokens
- Data Mapping: Source to API
- Caching: Server/Cloud
- Resiliency: Server/Cloud, Services
- **Dev Focus: Data, Status Codes, Messages**
- **Data Goal: Smart Data Pipes (from App)**

Web and Mobile - Two Paths to Data



Part 3

"It's the data, stupid"

[Insert picture of James Carville]

[Insert picture of The War Room whiteboard]

API Design - Operations

- API calls are atomic operations that map closely to CRUD database operations

Create	Read	Update	Delete
Insert	Select	Update	Delete
POST	GET	PATCH PUT	DELETE

- Novice/lazy devs auto-generate API endpoints that map 1:1 to CRUD table operations
- Skilled devs curate API endpoints mapped to consumption patterns and app models
  - Data is often consumed like views of tables targeted to the specific tasks of pages
  - Audit trails don't need to be round-tripped to a consumer that may alter the data

API Design - Responses

- API operations that succeed synchronously have expected data and status codes

Method	Description	Response Status Code
PATCH	Create/Modify the resource with JSON Merge Patch	`200-OK` , `201-Created`
PUT	Create/Replace the *whole* resource	`200-OK` , `201-Created`
POST	Create new resource (ID set by service)	`201-Created` with URL of created resource
POST	Action	`200-OK`
GET	Read (i.e. list) a resource collection	`200-OK`
GET	Read the resource	`200-OK`
DELETE	Remove the resource	`204-No Content` ; avoid `404-Not Found`

Source: Microsoft Azure REST API Guidelines github.com/microsoft/api-guidelines

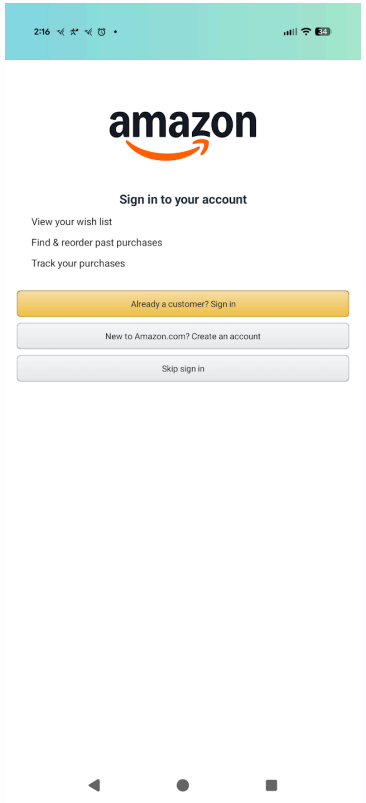
API Design - Stateless State Management

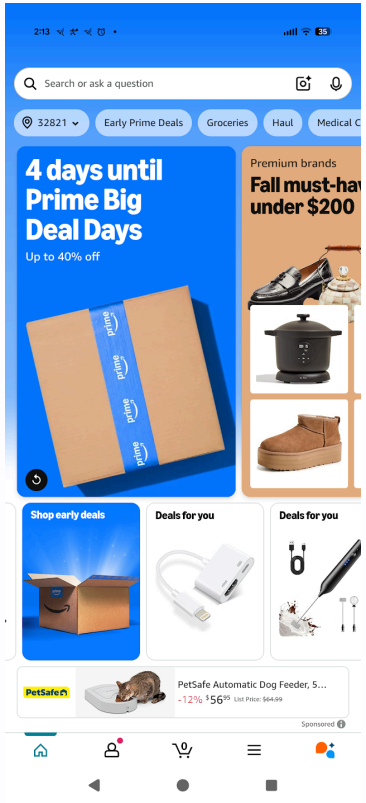
- JSON Web Tokens (JWTs) are commonly used to maintain state between API calls
- API clients get an encoded authentication token which contains the users rights
- API clients returns their tokens on successive calls which are matched to a secret key
- Secret keys are often generated on API server launch which may be tied a DB refresh
- More complex schemas for token generation and API rights and token expiration exist

Source: IETF RFC 7519 - JSON Web Token (JWT) datatracker.ietf.org/doc/html/rfc7519

API Design - Local Cache

- Tokens are often created on login, cached locally, and renewed in the background
- Apps often store the most recent token in fast secure platform-level key:value cache
- If a valid token exists on launch, the app can skip directly to a home page

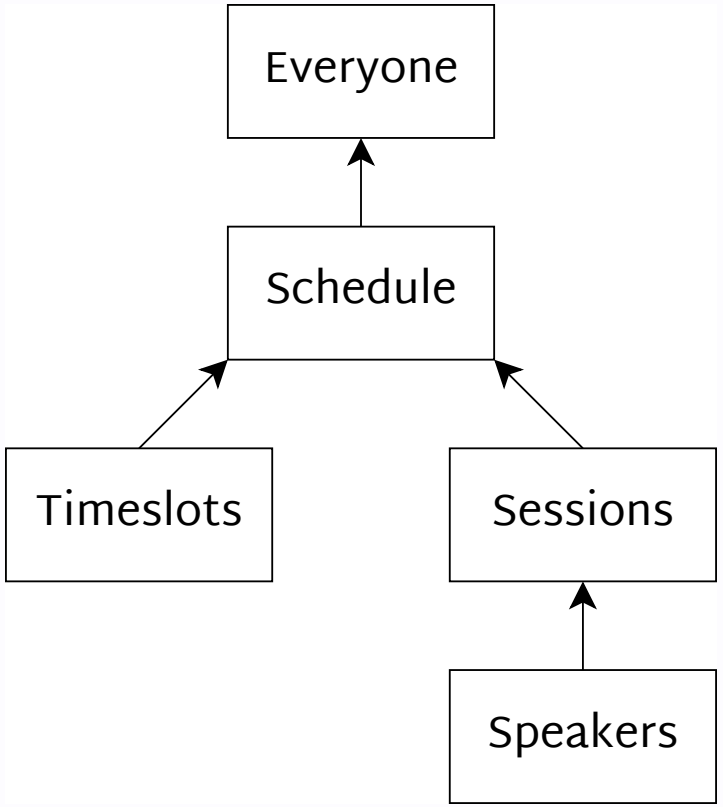




API Design - Conference - Schedule

Requirements

- Everybody gets the same schedule
- The schedule changes infrequently
- When the schedule does change, it often involves multiple sessions
- Event Wi-Fi is notoriously fickle



Solution

- Send whole schedule w/o redundant data but time-gated and cached (check for status code `304-Not Modified`)

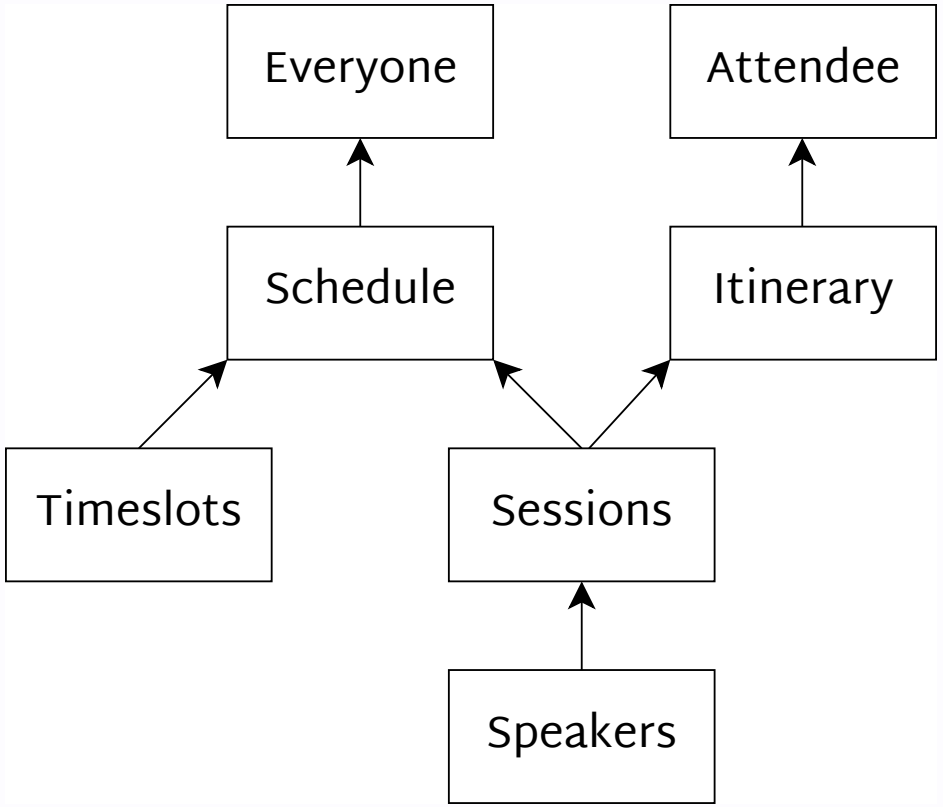
API Design - Conference - Itinerary

Requirements

- Everybody gets the same schedule
- Attendee adds sessions to itinerary
- Attendee shares their itinerary
- Event Wi-Fi is still fickle

Solution

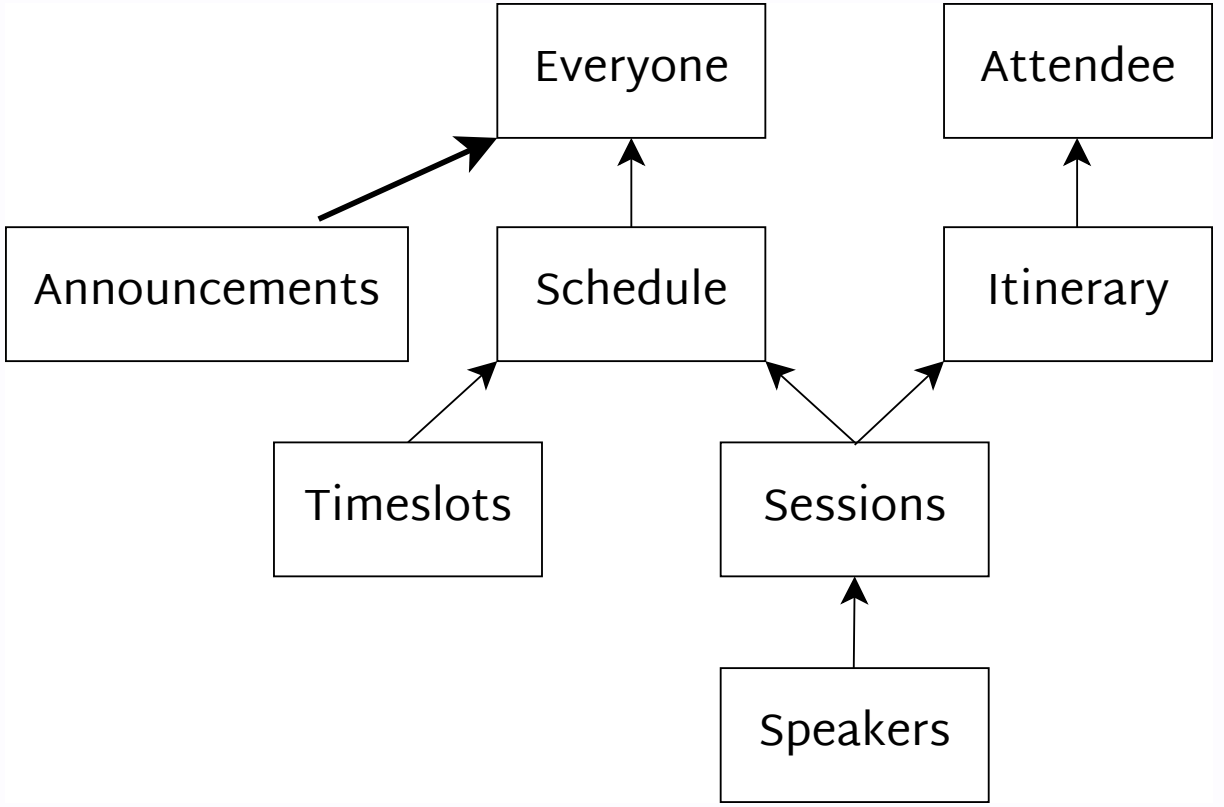
- Send itinerary as updated when network is available, managing sync



API Design - Conference - Announcements

Requirements

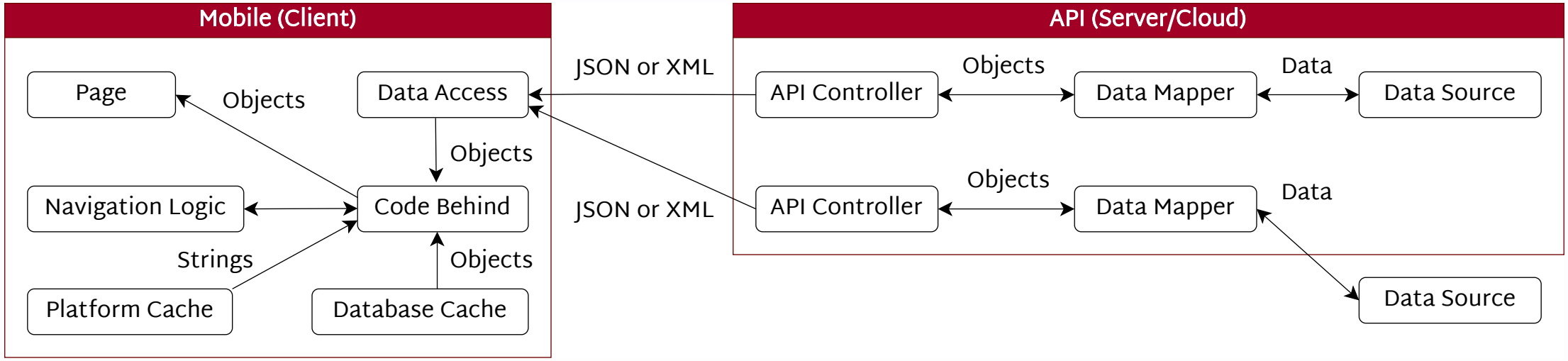
- Everybody gets the same schedule
- Everybody needs to get the same announcements
- Event Wi-Fi is more fickle now that everybody is checking their phones



Solution

- Use a highly-available service
- Poll API or wait for real-time data
- Or hope Slack, Twitter, etc. are up

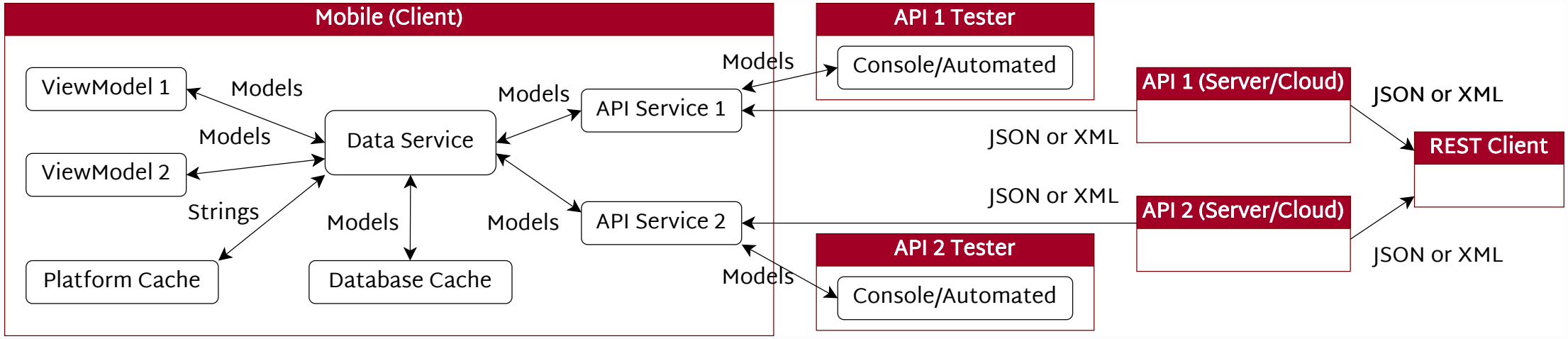
Mobile Architecture - High Level



Mobile Architecture - Real-world

- ViewModels
  - Moving navigation out of the View allows ViewModels to be tested individually with frameworks like ReactiveUI (RxUI)
- Api Services
  - Individually testable to return app Models and not just Data Transfer Objects (DTOs)
- Data Service
  - Decides whether to call the local cache DB, the platform cache, an API endpoint, or a service based on the requested data and the app lifecycle

Mobile Architecture - Real-world



API Design + App Design - Other Things

App Design

- Centralized analytics
- Centralized logging
- Auto-generated API wrappers (Refit)
- Centralized API retry (Polly)
- Platform customizations (Xamarin.Essentials)
- Platform dependency-injection

API Design

- Authorization tokens
- Refresh tokens
- eTags
- Idempotency
- Other HTTP status codes
- ProblemDetails
- ValidationProblemDetails

And so much more

Part 4

Explain yourself, dammit

[Insert picture of Lewis Black]

Problem Details

Pros

- Extensible JSON object
- Provides context to status code
- Can report errors or warnings
- Supported in .NET without ASP.NET
- Returned by Refit's ApiException

Cons

- Buggy return type in ASP.NET
- .NET implementations follow JSON

```
# NOTE: '\' line wrapping per RFC 8792
{
  "$schema": "https://json-schema.org/draft/2020-12/schema",
  "title": "An RFC 7807 problem object",
  "type": "object",
  "properties": {
    "type": {
      "type": "string",
      "format": "uri-reference",
      "description": "A URI reference that identifies the problem type."
    },
    "title": {
      "type": "string",
      "description": "A short, human-readable summary of the problem type."
    },
    "status": {
      "type": "integer",
      "description": "The HTTP status code generated by the origin server \
for this occurrence of the problem.",
      "minimum": 100,
      "maximum": 599
    },
    "detail": {
      "type": "string",
      "description": "A human-readable explanation specific to this occurrence \
of the problem."
    },
    "instance": {
      "type": "string",
      "format": "uri-reference",
      "description": "A URI reference that identifies the specific occurrence \
of the problem. It may or may not yield further information if dereferenced."
    }
  }
}
```

Source: IETF RFC 9457 - Problem Details for HTTP APIs www.rfc-editor.org/rfc/rfc9457.html

Problem Details - Logic Failure Example

```
POST /purchase HTTP/1.1
Host: store.example.com
Content-Type: application/json
Accept: application/json, application/problem+json

{
  "item": 123456,
  "quantity": 2
}
```

```
HTTP/1.1 403 Forbidden
Content-Type: application/problem+json
Content-Language: en

{
 "type": "https://example.com/probs/out-of-credit",
 "title": "You do not have enough credit.",
 "detail": "Your current balance is 30, but that costs 50.",
 "instance": "/account/12345/msgs/abc",
 "balance": 30,
 "accounts": ["/account/12345",
              "/account/67890"]
}
```

Problem Details - Validation Failure Example

```
POST /details HTTP/1.1
Host: account.example.com
Content-Type: application/json
Accept: application/json, application/problem+json

{
  "age": 42.3,
  "profile": {
    "color": "yellow"
  }
}
```

```
HTTP/1.1 422 Unprocessable Content
Content-Type: application/problem+json
Content-Language: en

{
 "type": "https://example.net/validation-error",
 "title": "Your request is not valid.",
 "errors": [
             {
               "detail": "must be a positive integer",
               "pointer": "#/age"
             },
             {
               "detail": "must be 'green', 'red' or 'blue'",
               "pointer": "#/profile/color"
             }
           ]
}
```

Part 5

Questions?

SQLOrlando

Scan the QR code to fill out session evaluations