
OpenJS World 2022
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Loosely Coupled

Micro-Frontends And Capital One's Contact Centers

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OpenJS World 2022

Agenda

- From Monolith to Micro-Everything
- Implementation Details
- Choices and Learnings

“Daisy” - Photo Source/Credit: Patty Edds, Sr. Risk Manager, Technology

Who Are We?

Steve Husak
Distinguished Engineer

Joined Capital One in 2014.

Greenfield architectures, sound engineering principles, easy-to-use developer experiences

Noah Mandelbaum
Distinguished Engineer

Joined Capital One in 2012.

Architecture, technical teamwork.

Disclaimer

- You will see a lot of ~~cats~~ dogs in this presentation.
- Since we did cats last time and have updated the presentation for this talk, we shifted to dogs.
- We are inclusive to all pets.
- All the dogs here within are part of our Capital One family!

"Turkey" - Photo Source/Credit: Steven Black, Business Analyst, Retail Bank

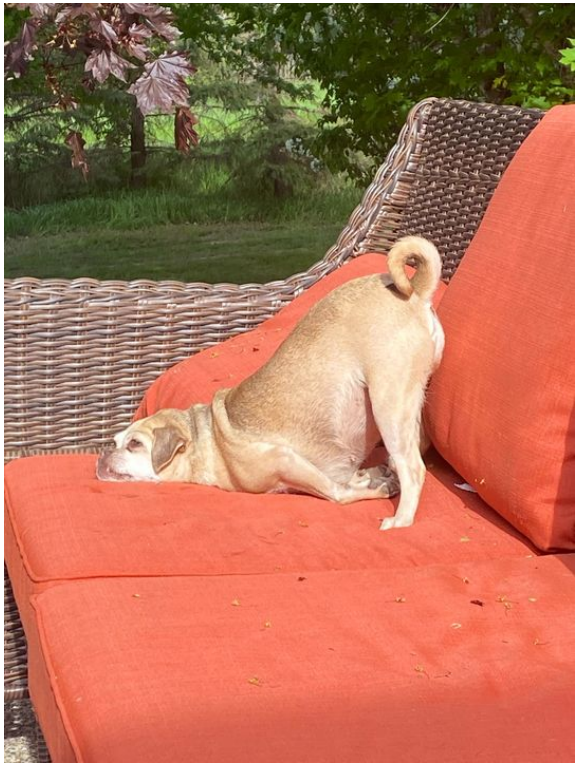
Our Monolith Emerged About 15 Years Ago

- The new system had to allow more than 20,000 contact center associates to help customers.
- We built it quickly - we had to replace an older contact center system due to contractual obligations.
- Capital One chose .NET WebForms, ASP.Net and C# running on Windows Servers - just about everything was server-side.

"Sawyer" - Photo Source/Credit: Christy Mazza, Principal Project Manager, Capital Markets

Running The Monolith Could Be Exhausting

- Legacy Infrastructure
  - 100+ on-premise servers to manage.
- Build/Test Cycle Was Slow
  - Developer experience was painful
  - Builds took a full day.
  - Testing took days.
- Large Batch Delivery
  - 1-2 releases a month with 100s of changes with hundreds of software engineers contributing to a single codebase.
  - Difficult to back out mistakes.
- Large Failure Blast Radius
  - Application was stateful and fault tolerance was suboptimal.
  - Many direct connections to data sources.



“Chloe” - Photo Source/Credit: Paula Kiley-Gerdes, Manager - Project Management, Retail Bank

Nobody Was Very Happy With The Monolith

- Different lines of business wished to release on their own cadences.
- Complex negotiations were required to make it all work.
- Our contact center agents could do their job, but they wanted the software engineers to fix bugs faster and make improvements faster.

"Shuri" - Photo Source/Credit: Alicia Neumann, Principal Associate, Marketing

New Ways Of Thinking Caught Our Eyes

- 2010 - the Continuous Delivery book was published.
- 2012 - Capital One began to embrace APIs.
- 2013 - Capital One started their public cloud journey with AWS (finished in 2020).
- 2014-2015 - the Capital One engineers who worked on the monolith began experimenting with SPAs and learned more about Node.js.

“Princess” - Photo Source/Credit: Noah Mandelbaum, Distinguished Engineer, Card

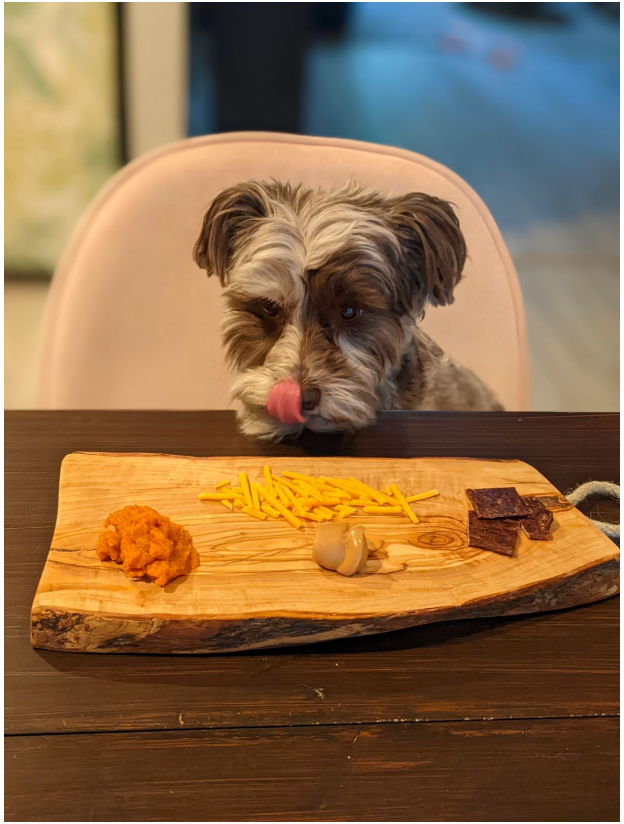
Micro-Frontend Architecture (2016) Really Excited Us

- Model based on business domains.
- Hide implementation details
  - be loosely coupled and contract-based in communication.
- Isolate failure.
- Decentralize as much as possible.
- Release independently.

“Ruby” - Photo Source/Credit: Christine Durlak, Admin Assistant, Enterprise Architecture

We Wanted It All!

- Clear lines of ownership to minimize organizational friction.
- The ability to deploy and release at any time - with little toil.
- Limited failure blast radius if a part of our platform encountered an error.
- Smaller, simpler codebases that developers could quickly understand.
- Room for our software engineers to iterate incrementally



“Presley” - Photo Source/Credit: Annette Bonacci, Principal Process Manager, Retail Bank

But Migration to MFEs Was Not Straightforward

- It would be wrong to say that any of us knew exactly what we were doing up front.
- We iterated multiple times - the new platform saw at least five major pivots as we built and discarded ineffective models.
- We had to have same functionality of the large legacy contact center application.
- Our product managers also wanted to introduce business process innovations while we were migrating.

"Luigi" - Photo Source/Credit: Rita Dilorio, Lead Software Engineer, Technology

We Learned We Needed A Good Foundation

- A single unifying design system that allowed the platform to create the illusion of a “single application”
- A standard CI/CD pipeline that automated everything.
- Open governance/knowledge shared among the groups that participated in the platform.
- Constant measurement of developer experience and end user experience.

“Hazel” - Photo Source/Credit: Alex Hardman, Solution Architecture, Commercial Bank

Where We “Sit” Today

- Reduced time to market with no outages
  - The legacy monolith averaged 1-2 releases a month.
  - In February 2022, the micro-frontend platform:
    - Had over 40 teams contributing at the same time.
    - Carried out over 230 independent releases (~12 release per day).
    - Achieved low change failure rate - no outages were associated with the ~230 releases.

- Highly decomposed system that encourages incremental change
  - More than 100 micro-frontends and a similar number of independent Node.js services on the backend.
  - Bugs can frequently be resolved in hours without heroics.
  - 100% Cloud native.

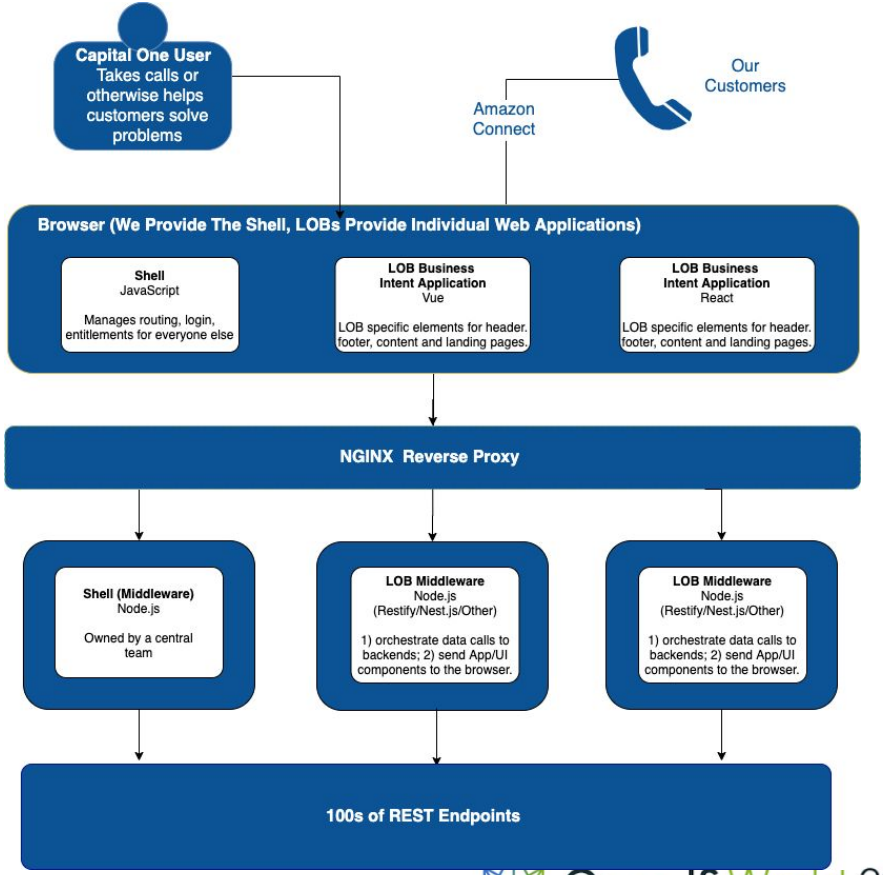
- Very good developer experience
  - Our internal surveys shows our developers really like working in our ecosystem, compared to comparable systems in our organization.

An App Shell With Multi-Level Routing

- Our federated model allows teams to choose the technologies that suit their needs while giving the customer a “single app” experience.

- Production libraries we use include:
  - Fastify
  - Pino
  - NestJs
  - React
  - Restify
  - Undici
  - Vue.js

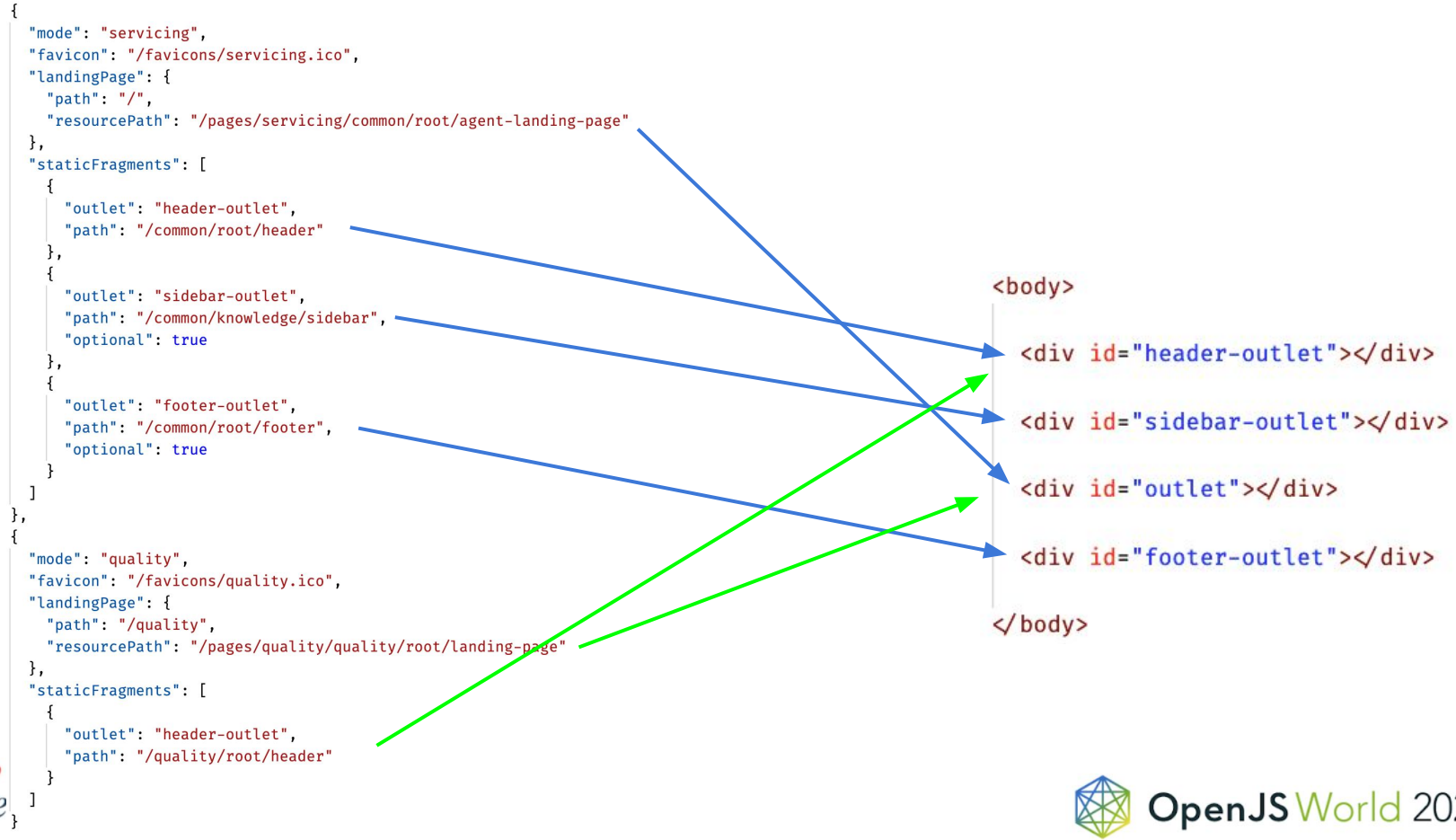
- Development dependencies include:
  - Cypress.io
  - Jest
  - Mocha/Sinon/Chai
  - Mountebank



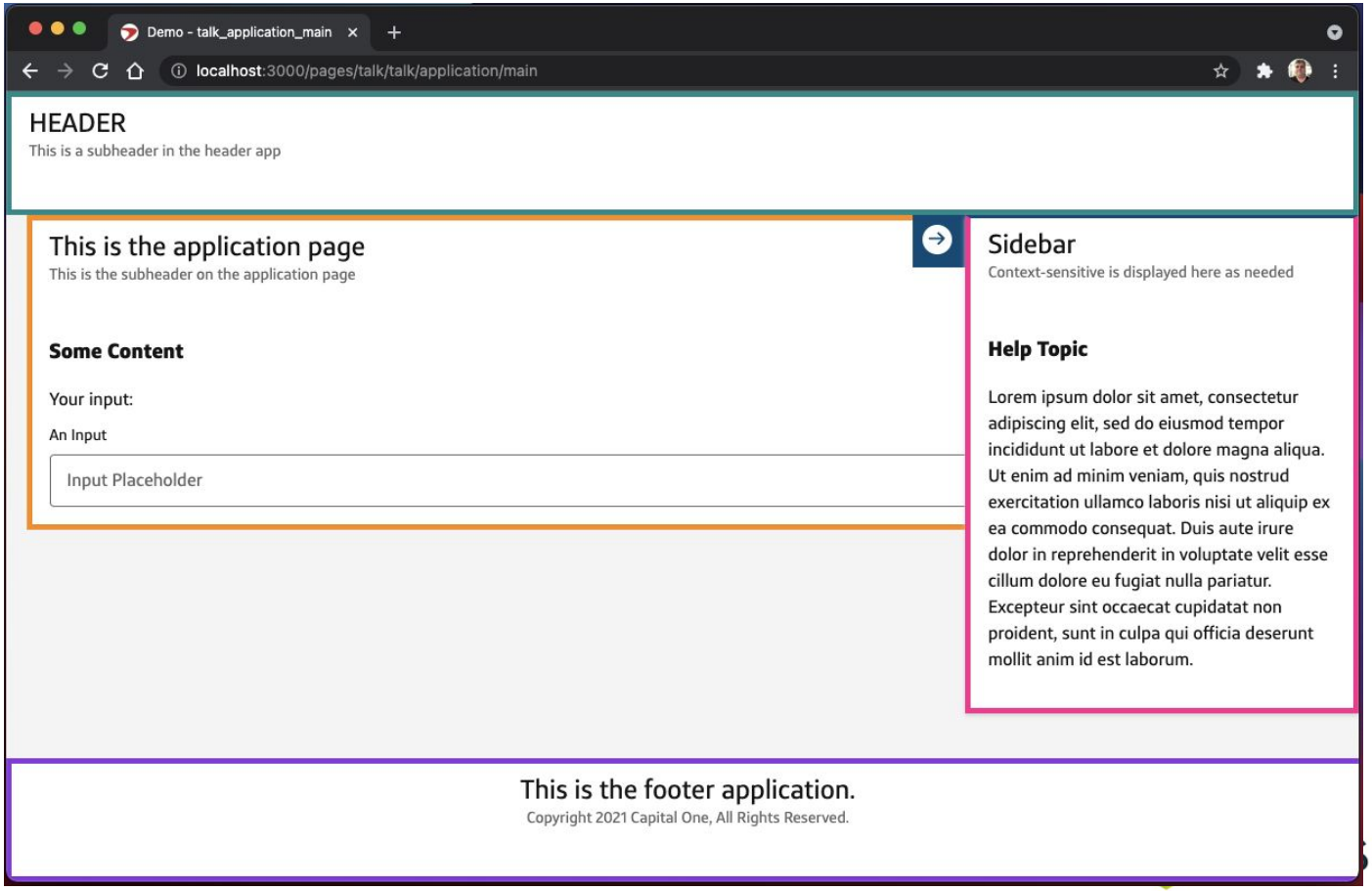
Routing by convention

/ tenant	/ domain	/ container	/ app	/ resource
Tells the system what configuration to use for page composition	Opaque organizational unit (business domain)	Coarse-grained group of functionality	Micro-UI code	Resources of the application

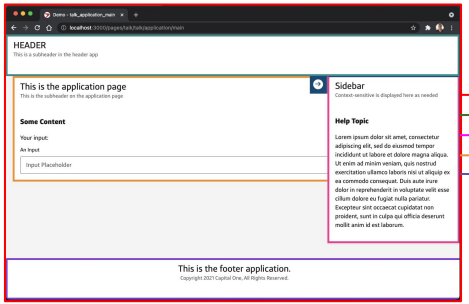
Configuration-based page composition keeps things flexible.

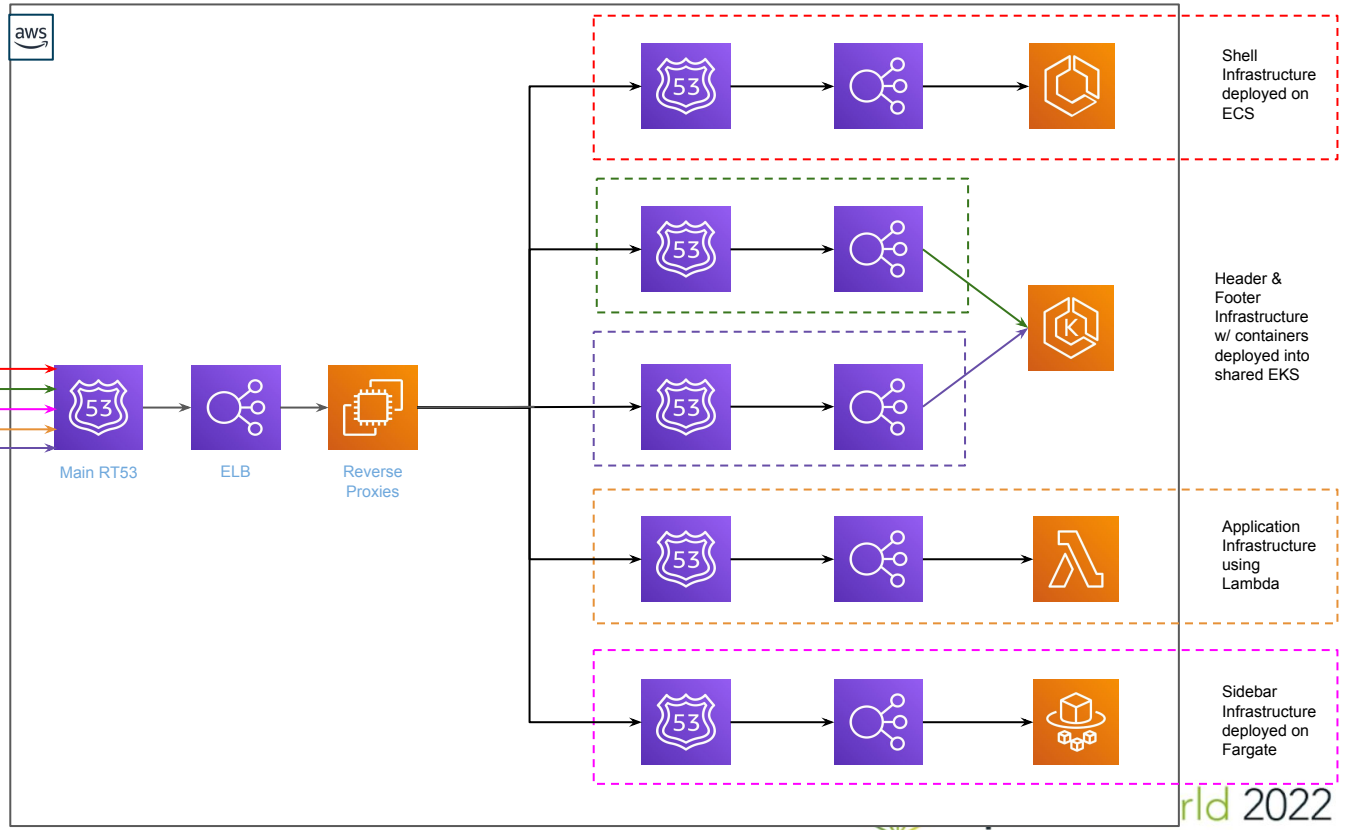


The end result is a cohesive application in the browser.



A reverse proxy brings it all together under one domain and allows for flexible hosting solutions.





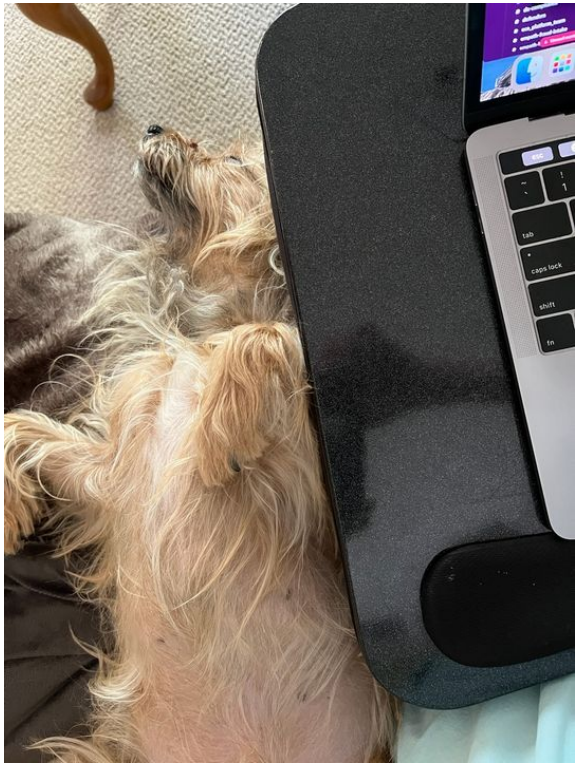
Lessons Learned along the way

- Provide A Good Developer Experience
- Limit Cognitive Load Using Node.js
- Decide on Mono Versus Poly
- Define A Support Model
- Never Stop Refactoring

“Louie” - Photo Source/Credit: Brooke Simone, Project Manager, Legal

Lesson Learned - Provide A Good Developer Experience

- Monolith required developers to build & run everything through IIS Server (remember it was ASP.Net based).
- Developers now only have locally what is needed for their development
- System runs in native Node.js processes and/or Webpack dev servers
- A “developer” proxy brings it all together
- We have a full set of maintained documentation with tutorials, how-tos and reference pages



“Scamp” - Photo Source/Credit: MaryAnne Gresham, Sr. Manager - Software Engineering, Card

Lesson Learned - Limit Cognitive Load Using Node.js

- Full-stack JavaScript simplifies the developer experience greatly
- Context switching has documented effects on developer productivity. Sticking to one language helped remove another forced context switch to developer work.
- Code, tools and testing patterns could be shared between the frontend and the backend.
- So far, no team has opted for using JavaScript on the frontend and another language on the backend (Java, Go).

"Wksi" - Photo Source/Credit: Heather A. Hosmer, Sr. Manager - Sr. Counsel, Legal

Lesson Learned - Decide on Mono Versus Poly

- This can be a tough topic - and it was in our space
- We like polyrepo because it preserves key characteristics of the microservice approach for UI applications:
  - Independent deployability
  - Modularity
  - Encapsulation
  - Clear ownership
- That is not to say this is the absolute right answer - you just have to consider the trade-offs

"Lewy" - Photo Source/Credit: Andy Littrell, Cafe Ambassador, Retail Bank

Lessons Learned - Define A Support Model

- Internal customers wanted assurances that our core components will remain secure and bug-free, so they can focus on business intent.
- We created a support model in which “trusted contributors” dedicate time to new library features, comprehensive documentation and security patches.
- We also employ a N-1 versioning strategy - consuming teams are asked to stay current with dependencies (although this can be a challenge).

“Iris” - Photo Source/Credit: Caroline De’Loach, Agile Delivery Lead, Technology

Lessons Learned - Never Stop Refactoring

- Be ready to refactor to best-in-breed tooling.
- As you get bigger, you have to think about the appropriate time to move to be secure and performant.
- Negotiate explicitly with your product partners as you move through the refactoring process.

"Winnie" - Photo Source/Credit: Larry Contratti, Sr. Manager, Design

Final Notes

- Our journey is not unique but the path we took is.
- We've achieved what we needed for our platform currently, but there is always more work to be done.

"Cosmo" - Photo Source/Credit: Steve Husak, Distinguished Engineer, Commercial Bank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