GE InSight
Microservices & APIs

Solution Context

Opportunities

Today, functionality in InSight is delivered to GE's customers primarily through GE-developed applications such as InSight Web and InSight mobile applications.
Substantial opportunities exist for GE to **create and market secure, reliable, standards-based Application Programming Interfaces (APIs) for InSight** that will

Enable GE to:

- **Generate new revenue** streams from GE's existing investments in InSight
- **Market individual capabilities and packages of capabilities** in InSight as subscriptions
- **Gain deep visibility in demand and usage** of individual features and functionality in InSight through usage metering
- **Accurately invoice customers, users, and developers** based on their actual usage of InSight features and functionality

Enable GE's customers, InSight users, and application developers to:

- **Integrate securely with InSight** though standards-based Web interfaces
- **Incorporate GE InSight functionality into applications** and IT solutions
- **Create new and innovative solutions & applications** built on capabilities and functionality available in Insight
- **Automate human interactions** with InSight to reduce costs and exposure to operational risks
- **Automate reactions to events, trends and alarms** in InSight in order to shorten reaction times and prevent service disruption & outages

Additional opportunities are seen for **enhancements to reporting in InSight**:

- Ability to deliver reports to external systems through standard integration mechanisms (ex: HTTP/S POST)
- Ability to report on data from multiple data sources

Solution Context

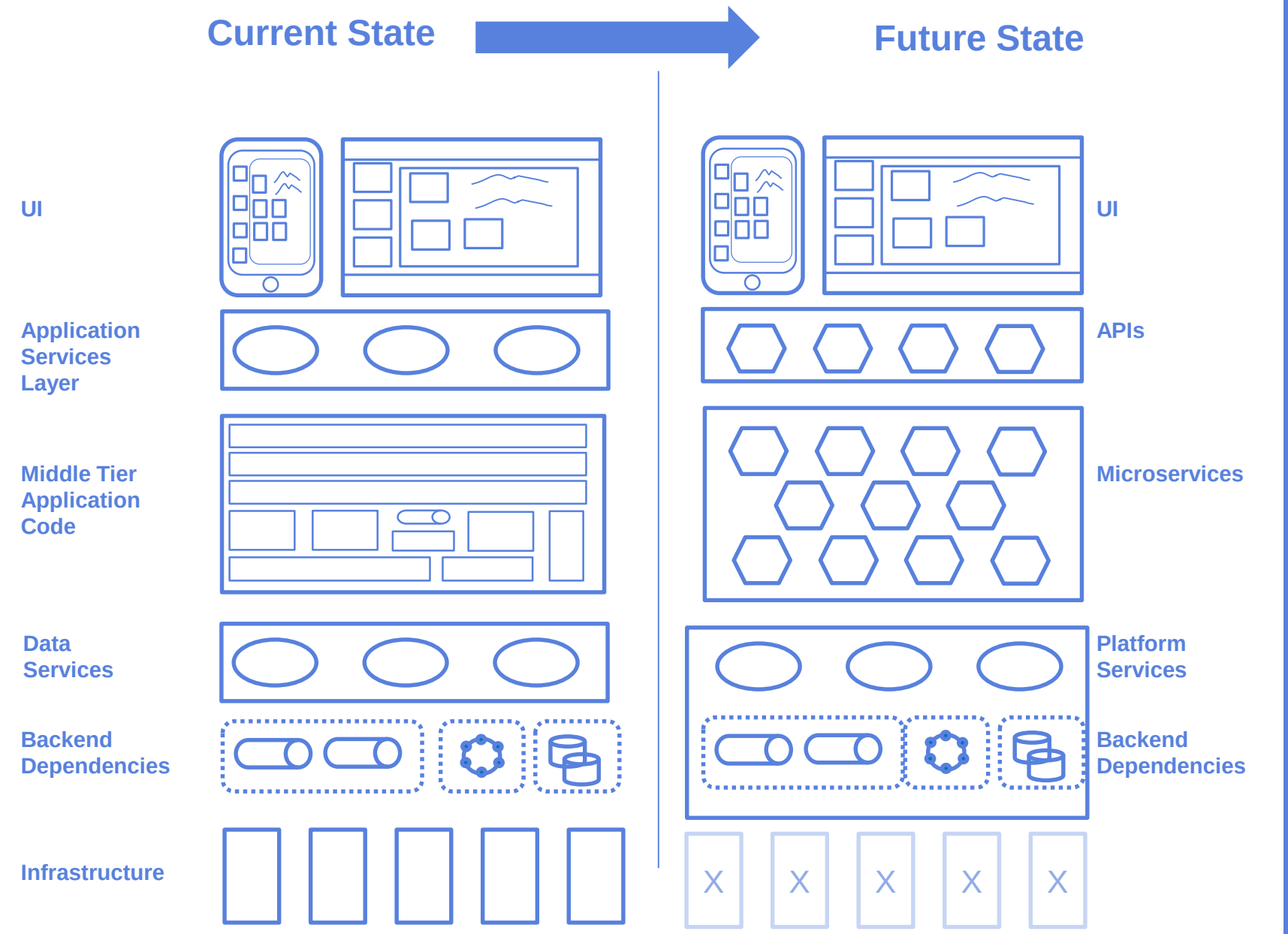
Goals/Objectives

- Modernize functionality in InSight by transforming existing functionality to cloud-native, hyper-scalable microservices
- Create a secure, scalable API layer which provides GE's customers, InSight users, and developers standards-compliant programmatic access to InSight capabilities and functionality through RESTful APIs
  - Initial focus area for APIs: Reporting
- Enhance InSight reporting to support the following additional use cases:
  - Multiple data sources (through data federation)
  - Delivery of reports to external systems through standards-compliant Web-based integrations: event notifications/web hooks, HTTPS posts, etc.

Anticipated Outcomes

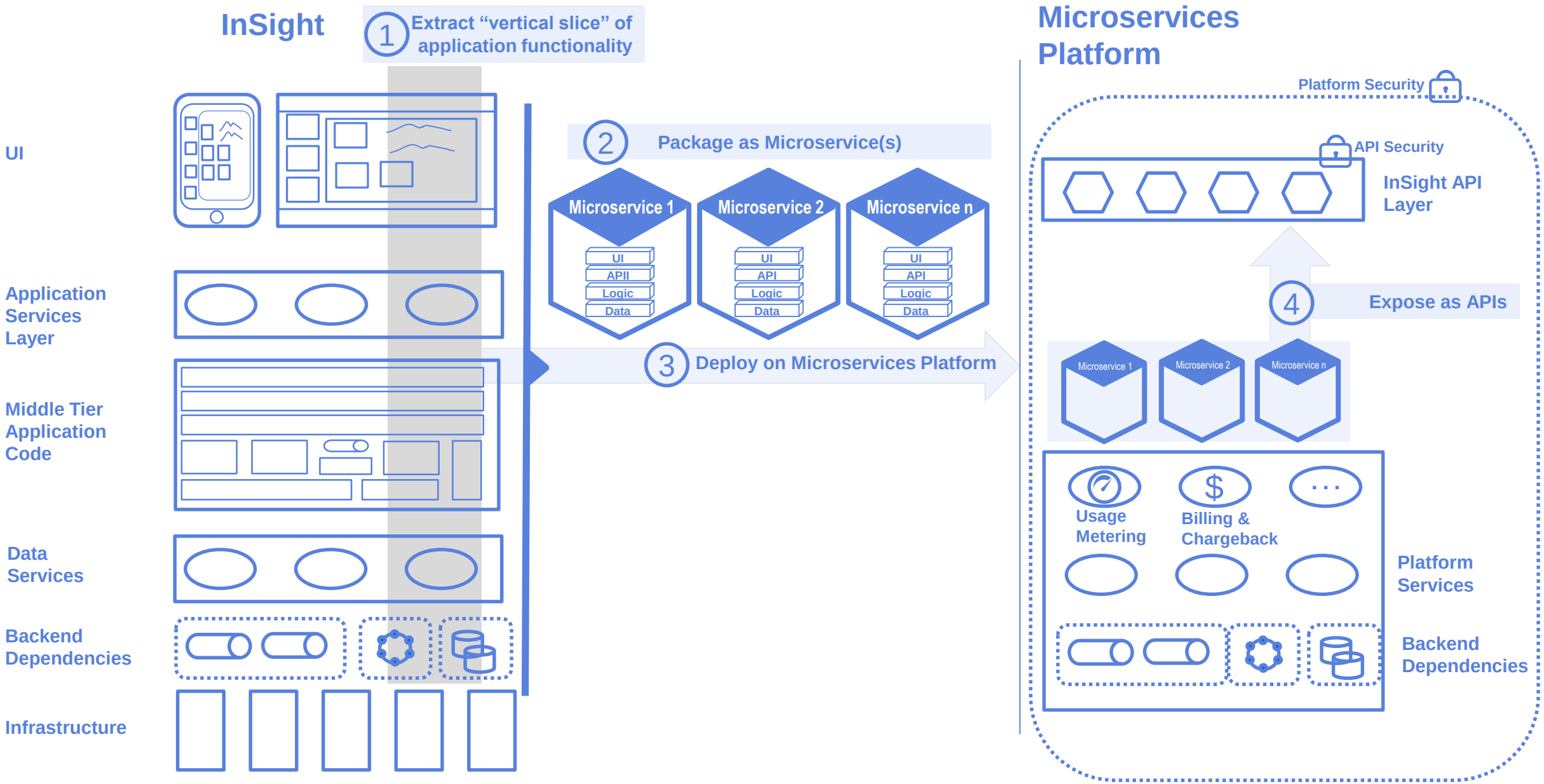
- Secure, scalable API layer in place
- 100% of GE InSight's reporting capabilities available through secure REST based APIs
- Reporting functionality is elastically scalable, leveraging cloud based infrastructure to automatically scale up and down as required, increasing infrastructure efficiency and reducing exposure to operational risks such as performance problems, scaling challenges, and service unavailability
- Functionality improvements around reporting are in place:
  - Reports are able to leverage data from multiple data sources
  - Reports are able to be delivered to external systems through standard Web based delivery mechanisms
- Continuous Integration and Delivery practices for version control, inspection automation, build automation, test automation, and deployment automation are in place and operational for reporting and for all new services created, minimizing time and manual effort required to deliver new functionality.

InSight Platform Vision

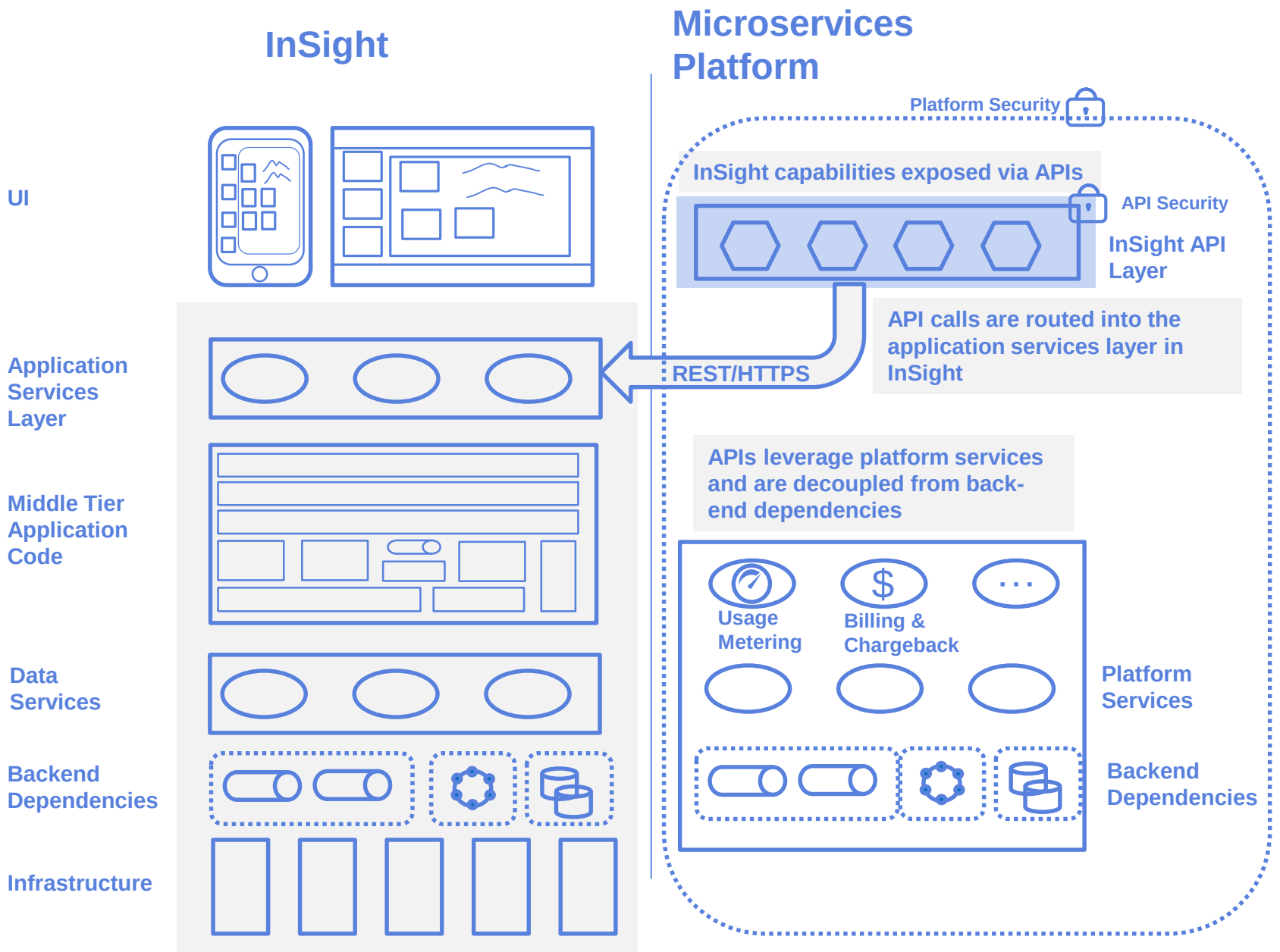


- APIs enable
  - Integration with InSight
  - Automation of interactions
  - Automating reactions to alarms, trends, and events
  - 3rd-party developers to create innovative solutions
- Microservices architecture enables:
  - Rapid, low impact evolution & replacement
  - Robust fault isolation
  - Deployment automation & flexibility
  - On-Demand Scalability
  - Small Testing Scope
  - Simple Optimization
  - Flexible Versioning
  - Shortened time-to-value
- Standardized platform services enable and simplify:
  - Security management
  - API Subscription management
  - Usage Metering
  - Chargeback & Billing
- **Cost efficiency is improved** by leveraging cloud computing economies of scale and reducing the need to manually operate and maintain server infrastructure

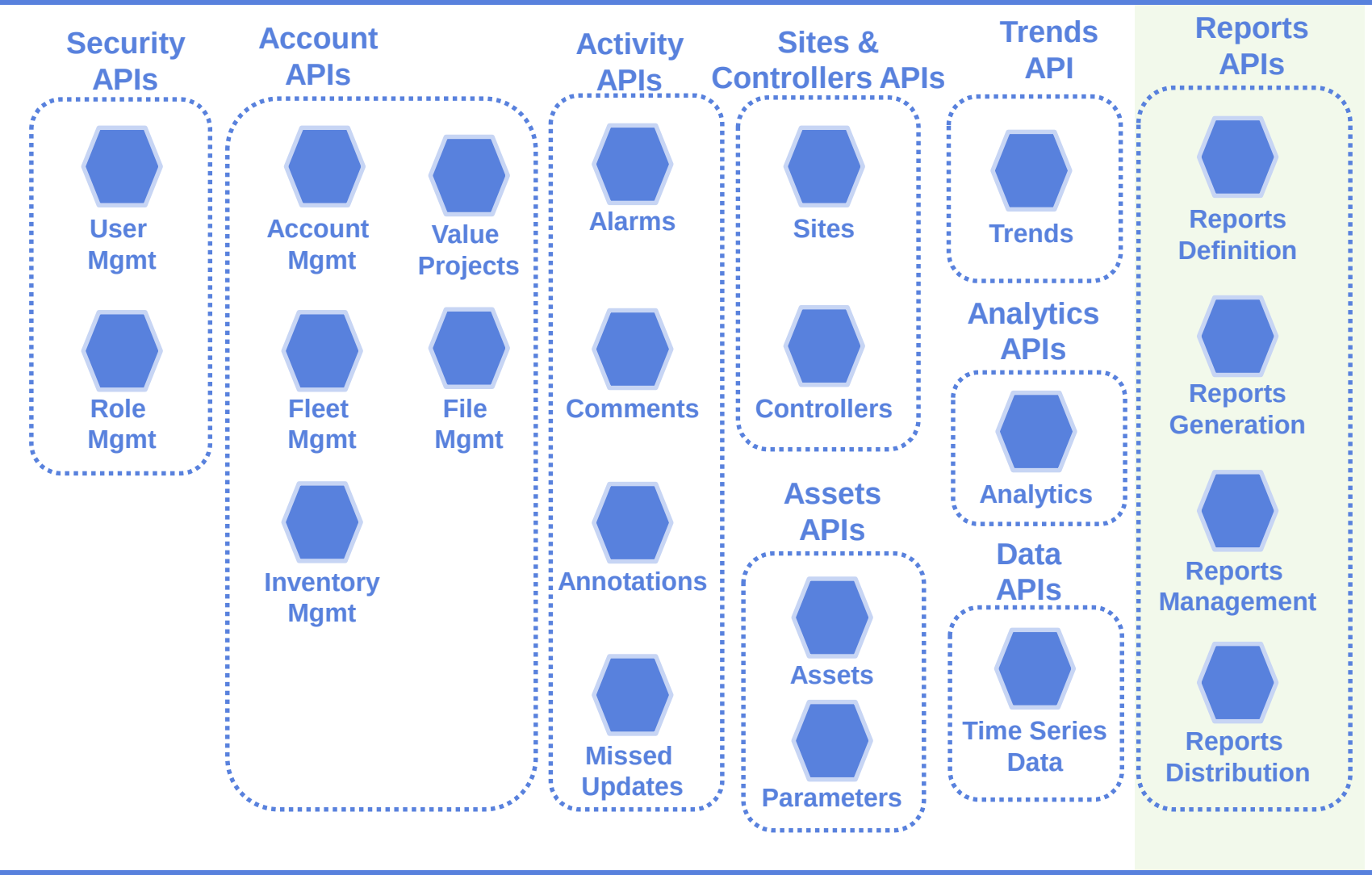
Microservices Transformation Process



InSight API Layer



InSight API Opportunity Landscape



Rationale

- **Fast time to value**
- **Low Risk** of undesirable "ripple effects" of changes due to high cohesion and loose coupling in reporting today
- **Changing anyway:** Need to touch reporting anyway to add desired enhancements
  - Multiple data sources
  - Reports delivery via standard web mechanisms (HTTP POST)
- **Opportunities to gain scalability improvements at same time**
  - Report metadata currently stored in Oracle; migrating to scalable database will **support larger customer base**
  - Generated reports are currently stored in network file storage; S3-like BLOB storage preferred for achieving true Web scale

Reporting User Stories

As a GE Insight user,

I want to be able to author, generate, view and schedule reports that incorporate data from multiple data sources,

So that my reports can utilize information residing in many different data stores,

Whereas today, I can only report on data contained in GE InSight.

As an application developer,

I want a set of easy-to-consume, well-crafted, well-documented, secure & scalable APIs that expose GE InSight's rich reporting functionality

So that I can build new and innovative applications and features that incorporate the powerful reporting capabilities available in GE InSight,

Whereas today, these capabilities of GE InSight are not available through APIs.

As a GE InSight user,

I want GE InSight to be able to automatically upload reports into my Web-connected system(s)

So that my GE InSight reports are automatically available in the systems I need them to be

Whereas today, delivery to my systems over HTTPS POST is not supported

Reporting: Current State

PUBLUC

InSight

Web | Hybrid | Mobile

Insight Web Services

PRIVATE

Cassandra Web Services

Time Series Data

Asset Data

Reporting Web Services

- Report Blueprints
- Report Templates
- Report Definitions
- Report Schedules

Report Generation

Report Generation Workers

Generated Reports

Report Distribution

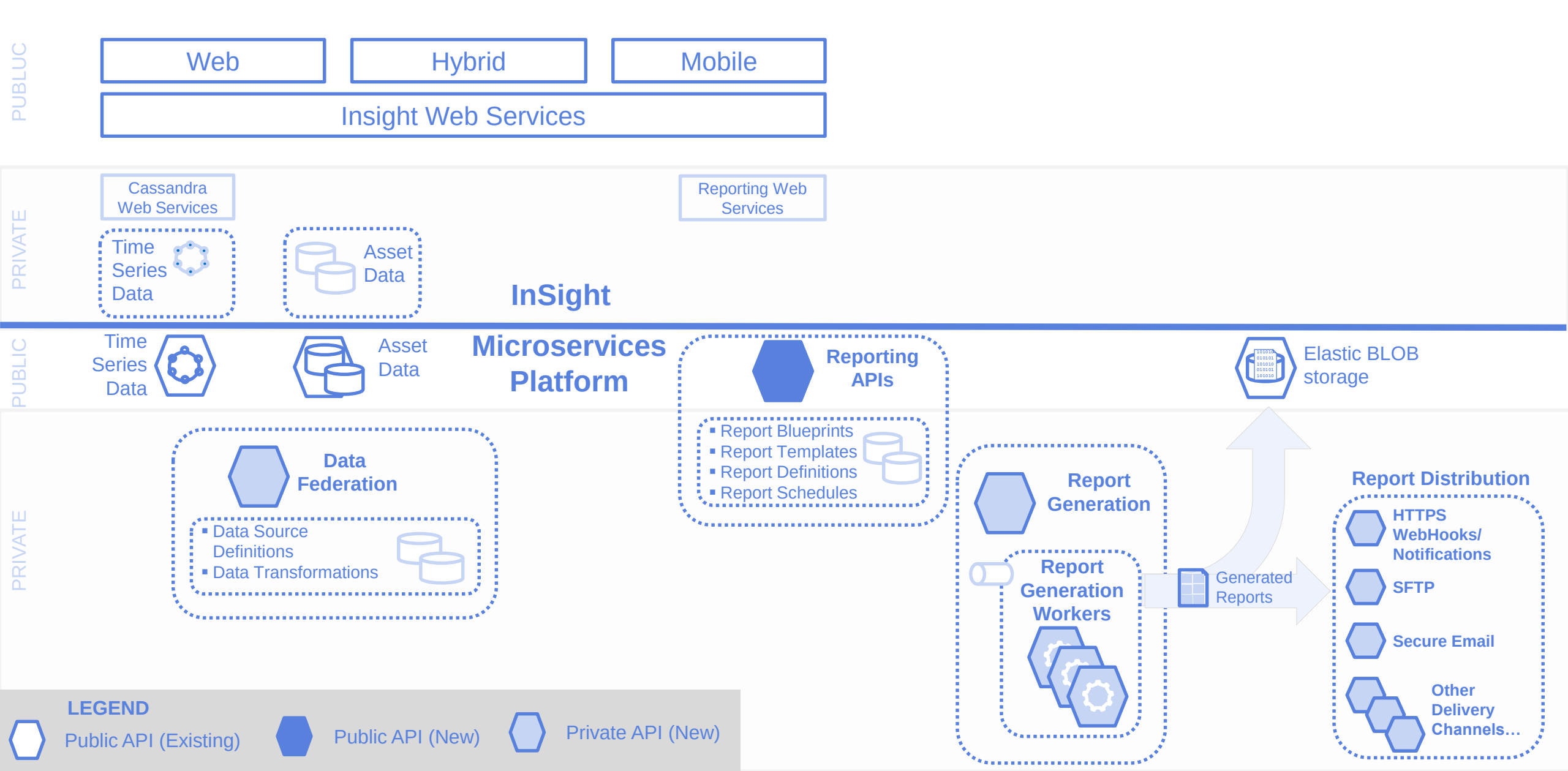
Network File Storage

LEGEND

Public Component

Private Component

Reporting: Future State



Prospective Timeline

Weeks 1-2	Weeks 3-4	Weeks 5-6	Weeks 7-8	Weeks 9-10	Weeks 11-12	Weeks 13-15+
Foundational Readiness	**Conception & Design**	**Reporting Services Buildout**	**Data Federation Services Buildout**	**Reporting Services Enhancements**	**Reporting Services Enhancements**	**Additional API /microservices**
▪ Onboard architect, technical product owner, dev engineers, SDETs ▪ Training & indoctrination for dev engineers on targeted microservices/ cloud platform(s), microservices frameworks, tools, processes and methodology in use on project ▪ Set up Agile team tools (JIRA, Confluence, etc.) ▪ Set up architecture repository ▪ Set up quality management tools ▪ Set up build automation pipelines (CI/CD)	▪ Populate initial product backlog ▪ Refine user stories and define initial acceptance criteria ▪ Backlog Grooming, Iteration Planning, ▪ JEDI design (Just Enough Design Initially): High level analysis/design/ test planning for early iterations ▪ First cut of API specifications for reporting services APIs ▪ Create test plans for reporting services APIs **Walkthrough: API designs & specifications, user stories**	▪ Migrate report metadata & schedules data sources to scalable cloud databases ▪ Migrate current report codebase to microservices architecture ▪ Enhance reporting services to use scalable blob storage for generated reports ▪ Integrate with security layers (OAuth2 etc.) **Demo: reporting services operational on cloud**	▪ Evaluate, select & stand up OSS packages for data mapping & integration ▪ Create and test workflows to normalize & transform data from multiple data sources ▪ Integrate with security layers (OAuth2 etc.) ▪ Enable for integration with reporting services **Demo: data federation services**	▪ Enhance reporting services to leverage data federation services ▪ Refine data federation API as needed ▪ Refine reporting services APIs to add seamless overlay to data federation services (specification of data sources, mappings, etc. in report metadata) **Demo: multiple data sources in reporting**	▪ Enhance reporting services to add capabilities to deliver reports to third parties via HTTP (webhooks/upload) **Demo: reports delivered through HTTP (webhooks/ upload)**	▪ …

Team Structure

Role	Responsibilities and Locations	Skill Sets and Experience
Microservices Architect	**Responsibilities:** • Provide Cloud, Microservices, and Java design and development best practices • Provide Subject Matter Expertise in Microservices development and deployment **Location:** • 1 Resource On-Site supported additionally from UST Cloud Architecture Practice	*Key role – master of everything* • Must have minimum 10 years of IT experience • Cloud Foundry expertise • Proficient in API Design concepts and best practices for RESTful service design • Expert level Java EE. Java EE certification preferred • Must be familiar with Python, PHP, HTML5, and AngularJS • Expert level at modern software paradigm, e.g., single page applications • Must have solid understanding of 12 factor principle and self-contained systems (SCS) • Expert level DevOps Automation - automate continuous integration and enable continuous delivery - build/deployment automation • Must be able to development reusable frameworks, components, and templates • Must be able to recognize the structural and behavior patterns and have the judgment to apply the appropriate solution patterns • Must be competent in agile development and team tools setup and configurations • Define requirements/Acceptance Criteria definition & refinement for early sprints • Identify development tools, standards, and guidelines • Setup tools, assets, APIs repositories • Must have great communication skills to all levels of stakeholders
Technical Product Owner/ Technical Lead	**Responsibilities:** • Leads software engineering team in creation of cloud-native solutions • Hands-on member of the engineering team building the solution • Iteration planning, managing and coordinating product and iteration backlog • User Story elaboration • Acceptance criteria development for complex **Location:** • 1 Resource On-Site	• Must have 8-10 years IT experience • Strong background in leading top performing software development/engineering teams • Must have expert level knowledge of agile development • Must have experience with Cloud Foundry, Java EE, DevOps, CI/CD • Must be familiar with Python, PHP, HTML5, and AngularJS • Must be a team builder, team enabler, and conflict competent • Must possess organizational dynamics awareness and be able to tackle challenging incidents gracefully • Define requirements/Acceptance Criteria definitions & refinements • Must be expert at user story elaborations • Expert understanding of API design principles • Strong understanding of API strategy from a business and technical perspective including API marketing, usage metering, API subscription management, API billing & chargeback, etc. • Must have great communication skills to all levels of stakeholders

Team Structure (cont'd)

Role	Responsibilities and Locations	Skill Sets and Experience
Software Dev Engineers	**Responsibilities:** • Develop defined Microservices • Develop Unit tests, integration tests, acceptance tests, consumer-driven contract tests • Support Quality Assurance efforts **Location:** • 4 Software Development Engineers On-site	• Must have 6-8 years IT experience • Must have experience agile development • Must have experience with Cloud Foundry, Java EE, DevOps, CI/CD • Must be familiar with Python, PHP, HTML5, and AngularJS • Must have a solid understanding of microservices architectures, challenges, and solution patterns • Strong experience in RESTful API design and implementation • Must be able to understand requirements and be able to deliver code consistent with requirements, architecture, development standards and guidelines • Must be competent in automated unit testing, automated integration testing, automated acceptance testing – TDD, BDD, ATDD
SDETS(Software Dev Engineers in Test)	**Responsibilities:** • Functional and non-functional testing of Microservices, APIs, and cloud native solutions • Guides overall test methodology and best practices **Location:** • 2 SDETS On-site	• Must have 6-8 years IT experience • Similar level of skills and background as Software Dev Engineer skillset above, with additional specialty and depth of experience in automated and manual testing • Mentors software development engineers in implementing automated testing practices at all levels within a cloud native solutions architecture • Must be able to validate software against specifications • Must be able to setup test environment • Must be able to setup configurations for various environments • Must be able to create and execute automated tests against complex microservices architectures and test services in-depth • Must be self-starter
Cloud Infra Architect	**Responsibilities:** • Provisioning and configuration of compute instances • Setting up perimeter and endpoint connectivity and routing • Setting up perimeter, endpoint, and data security • Migrating server, middleware, application, and service workloads to IaaS • Establishing effective cloud-scale logging, monitoring, audit trails and operational dashboards **Location:** • 1 Cloud Architect On-site	• Must have 6-8 years cloud infrastructure experience with strong experience in architecting cloud first applications on AWS; expert in AWS provisioning, application deployment and data migration on AWS • Designs high availability applications on AWS across availability zones and availability regions • Deep knowledge of monitoring, logging and cloud management tools for AWS • Experienced in provisioning and configuration management tools like Ansible, SaltStack, Chef, Puppet • Excellent experience in REST API design and documentation • Knowledge of Hadoop, Kafka, Spark, etc. • Knowledge of Lucene/Solr, Elastic Search, etc. • Deep knowledge of the internals of PaaS platform, like Cloud Foundry, other leading PaaS solutions • Hands-on experience in PostgreSQL, Cassandra, Redis, Zookeeper

imagination at work