SCALABLE DATA ARCHITECTURES

from thousands to billions of events

@philip_pfo

NETFLIX

Please read the notes associated with each slide for the full context of the presentation

NETFLIX

Who am I?

Philip Fisher-Ogden

- Director of Engineering @ Netflix
- Playback Services (making "click play" work)
- 6 years @ Netflix, from 10 servers to 10,000s

Story

Netflix streaming – 2007 to present

Device Growth

2007
1 device

XBOX 360

2008
10s of devices

PS3

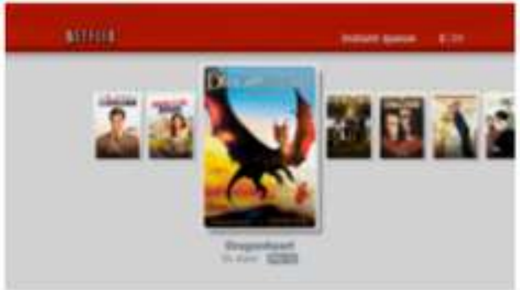
2009
10s of devices

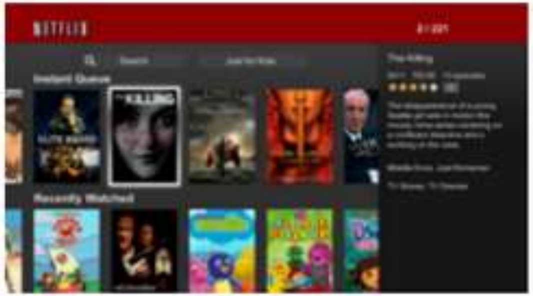
iPhone
iPad
Wii

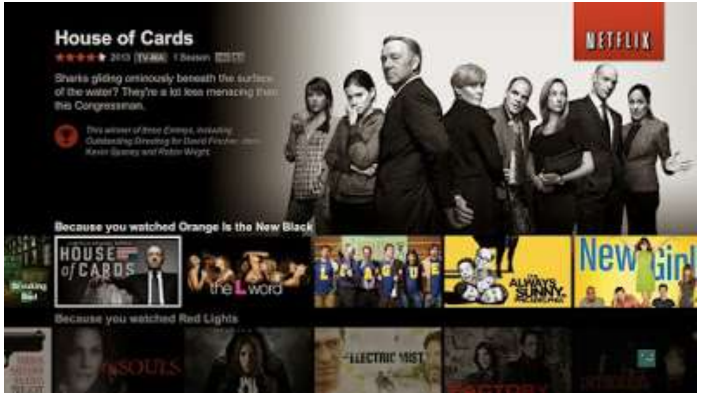
2010
100s of devices

2011+
1000+ devices

Experience Evolution






House of Cards

2013 TV-MA 1 Season

Sharks gliding ominously beneath the surface of the water? They're a lot less menacing than this Congressman.

Because you watched Orange Is the New Black

Because you watched Red Lights

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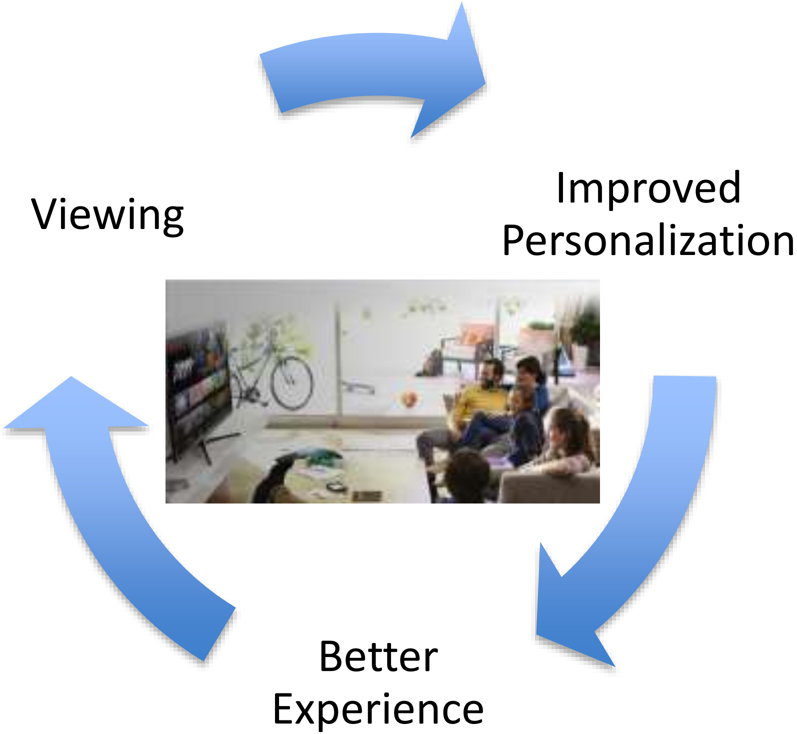
Subscribers & Viewing

53M global subscribers

50 countries

>2 billion hours viewed per month

Virtuous Cycle



Viewing

Improved Personalization

Better Experience

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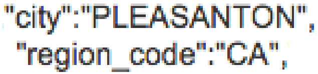
Viewing Data

Who, What, When, Where, How Long

10/13/14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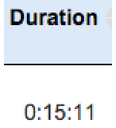
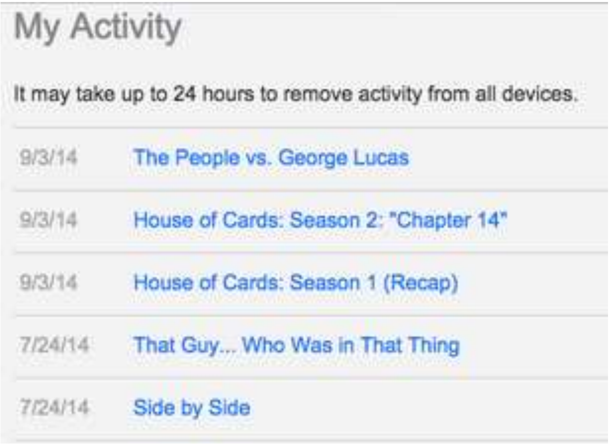


Duration
0:15:11

Latest Position

Real time data use cases

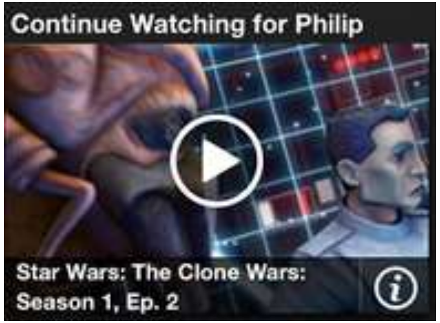
What have I watched?



My Activity

It may take up to 24 hours to remove activity from all devices.

9/3/14	The People vs. George Lucas
9/3/14	House of Cards: Season 2: "Chapter 14"
9/3/14	House of Cards: Season 1 (Recap)
7/24/14	That Guy... Who Was in That Thing
7/24/14	Side by Side

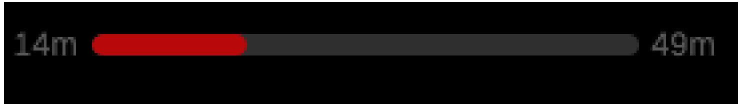


Continue Watching for Philip

Star Wars: The Clone Wars:
Season 1, Ep. 2

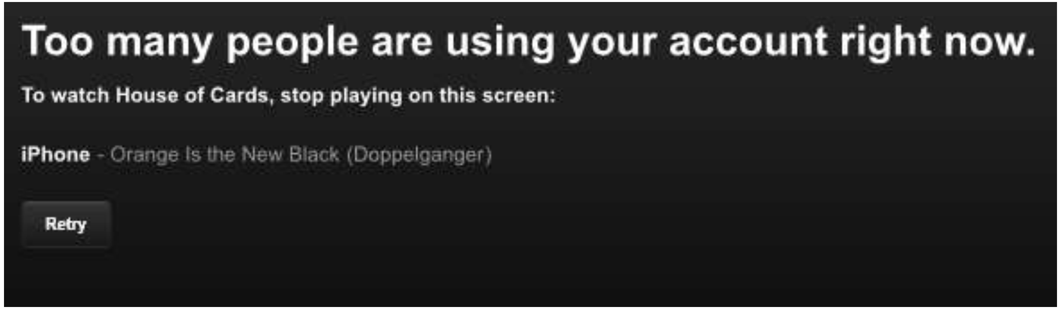
Real time data use cases

Where was I at?



Real time data use cases

What else am I watching?



Too many people are using your account right now.

To watch House of Cards, stop playing on this screen:

iPhone - Orange Is the New Black (Doppelganger)

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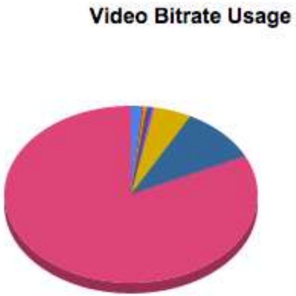
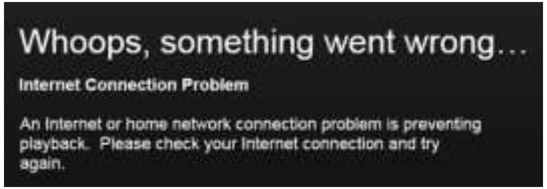
Session Analytics

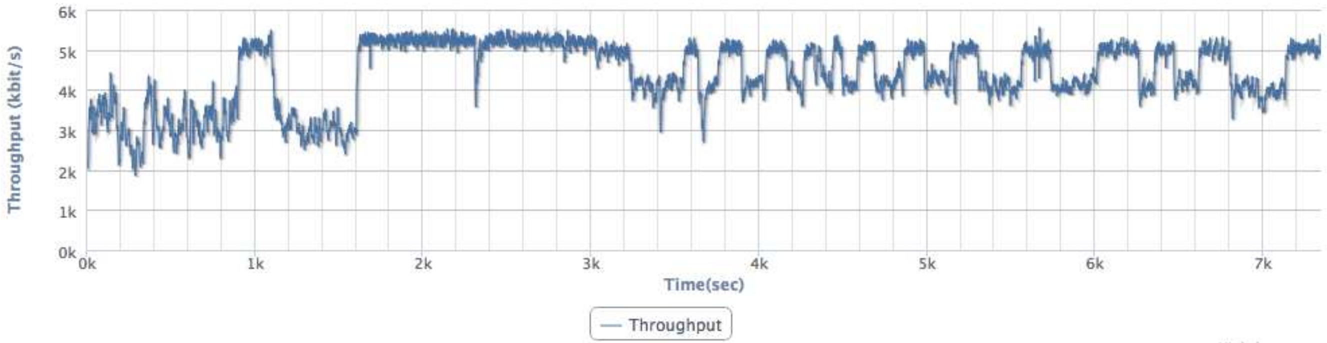


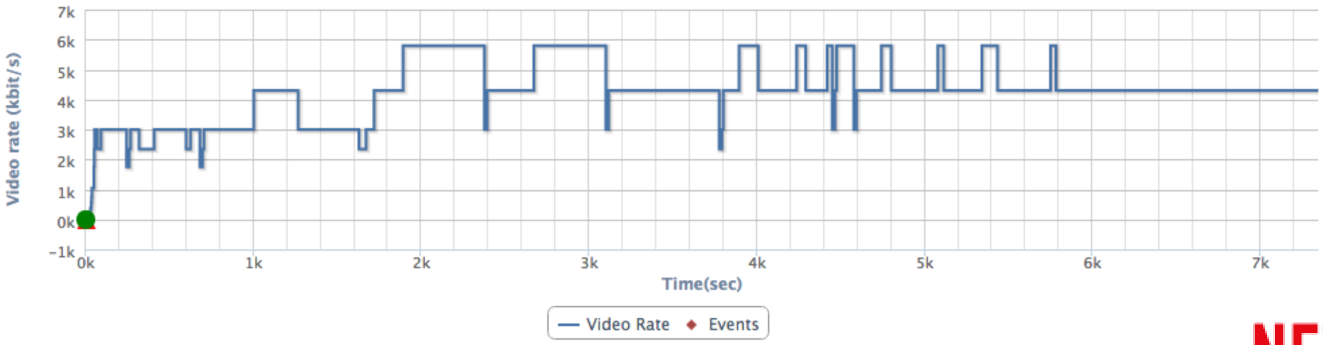

Whoops, something went wrong...

Internet Connection Problem

An Internet or home network connection problem is preventing playback. Please check your Internet connection and try again.

Session Analytics





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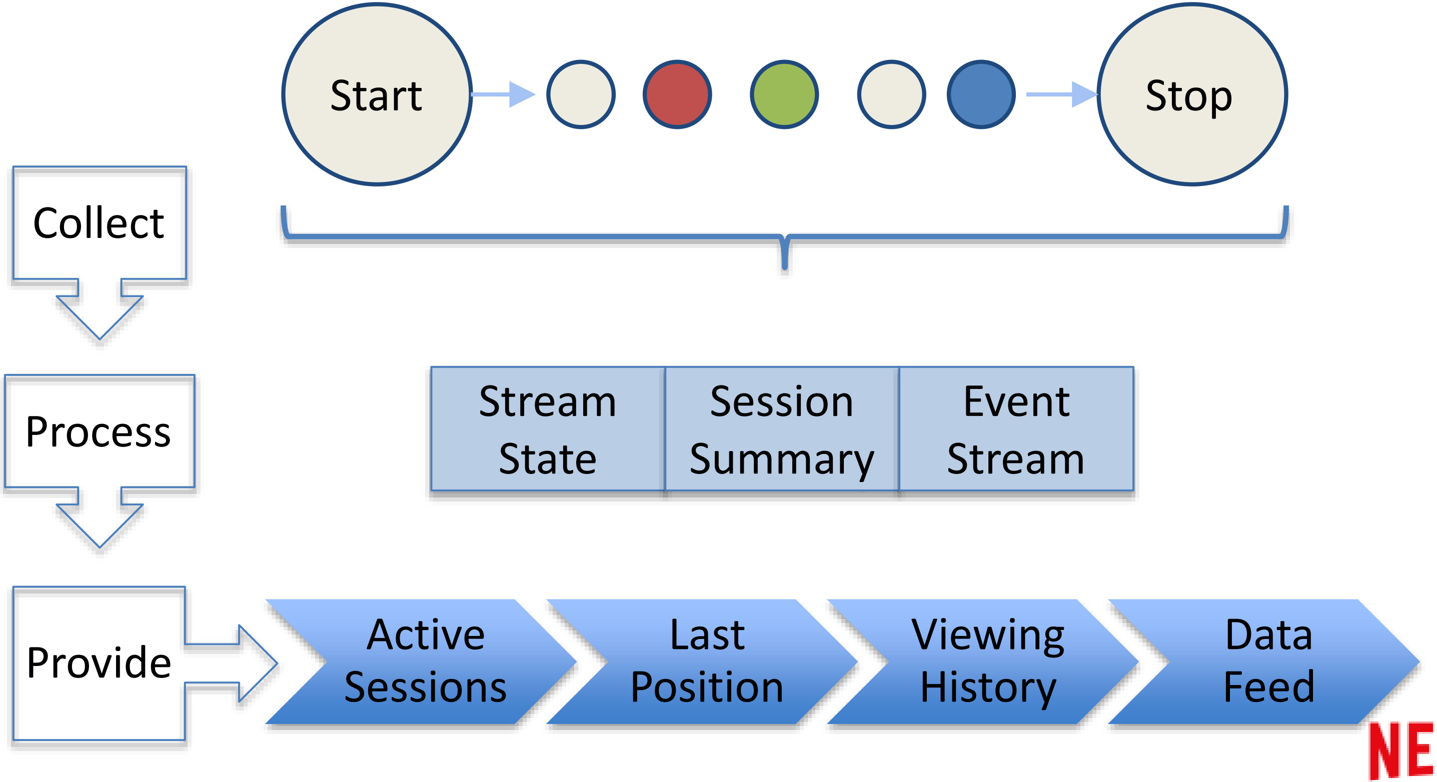
Generic Architecture



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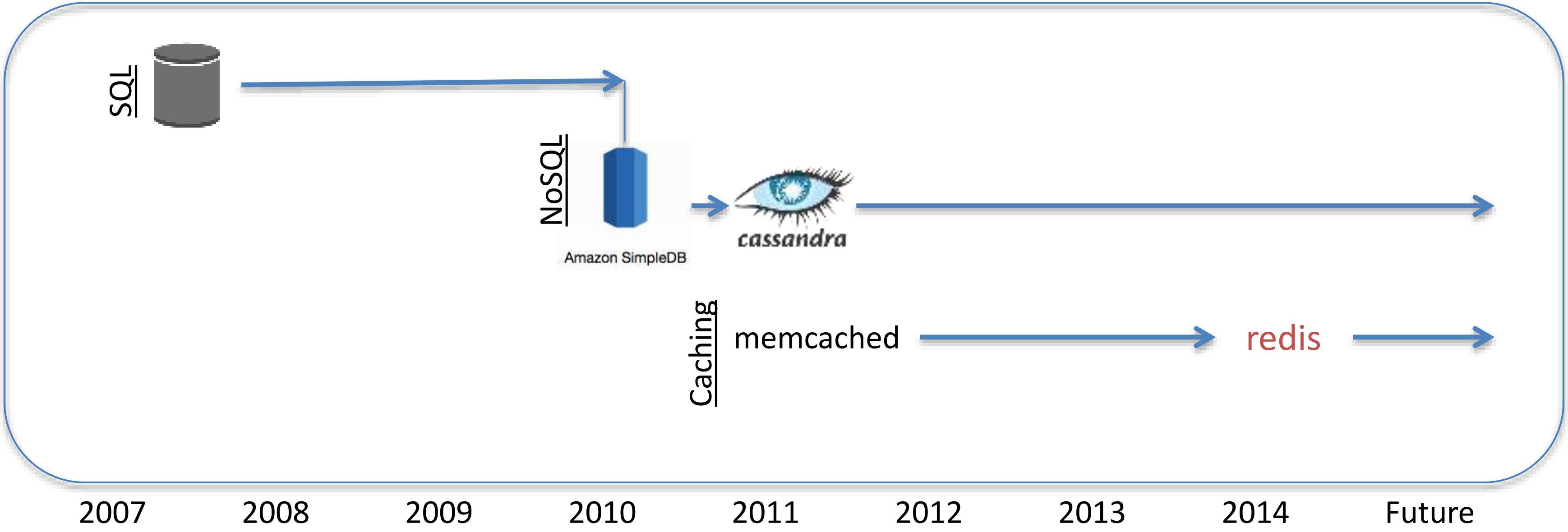
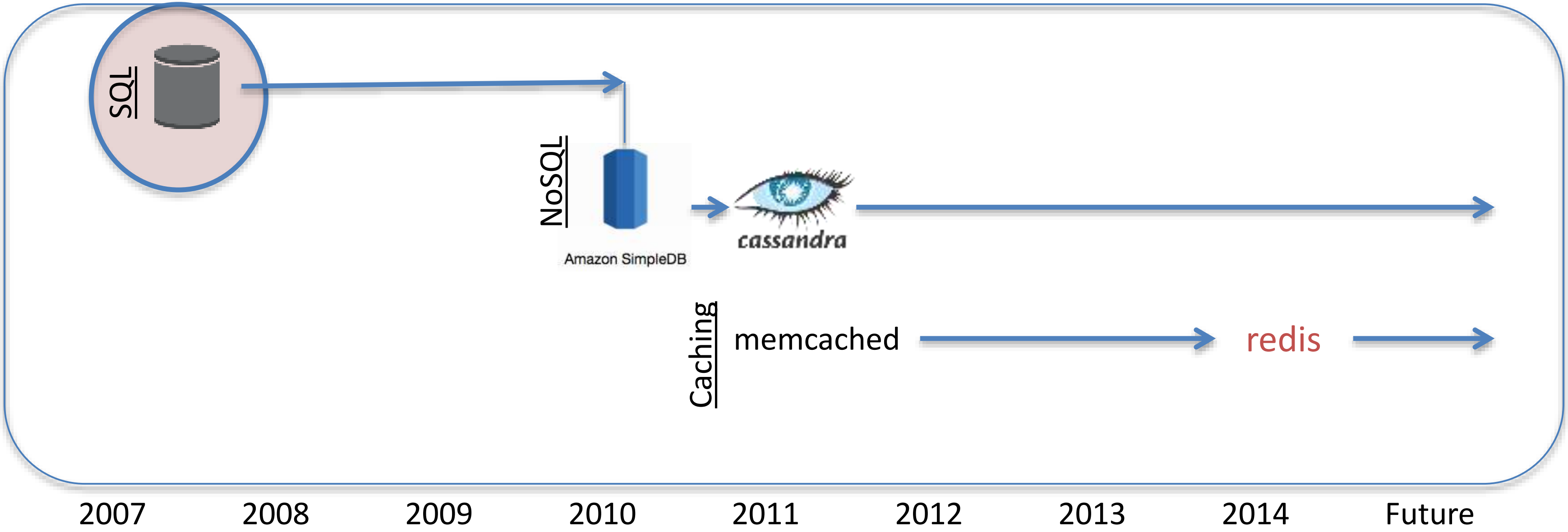
Architecture Evolution

- Different generations
- Pain points & learnings
- Re-architecture motivations

Real Time Data



Real Time Data – gen 1



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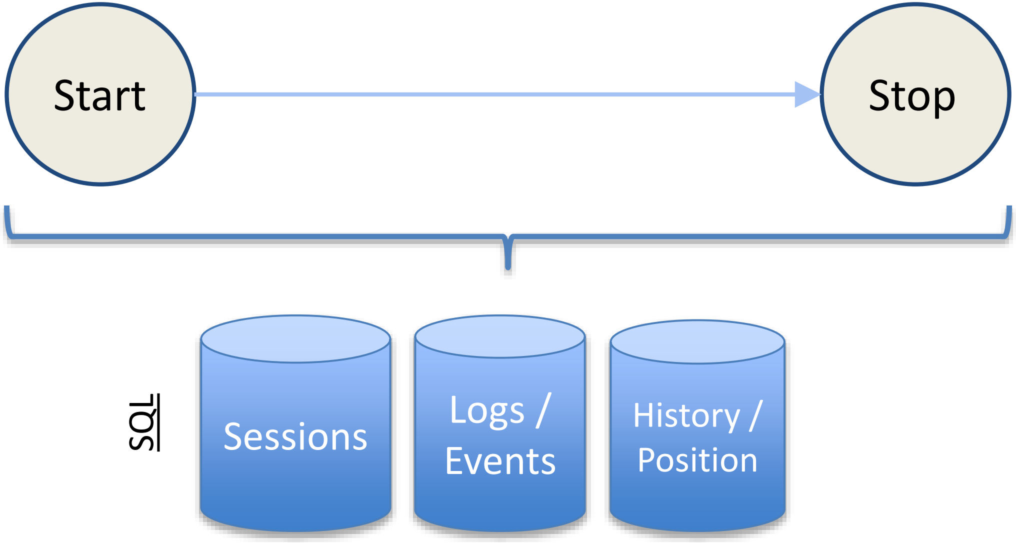
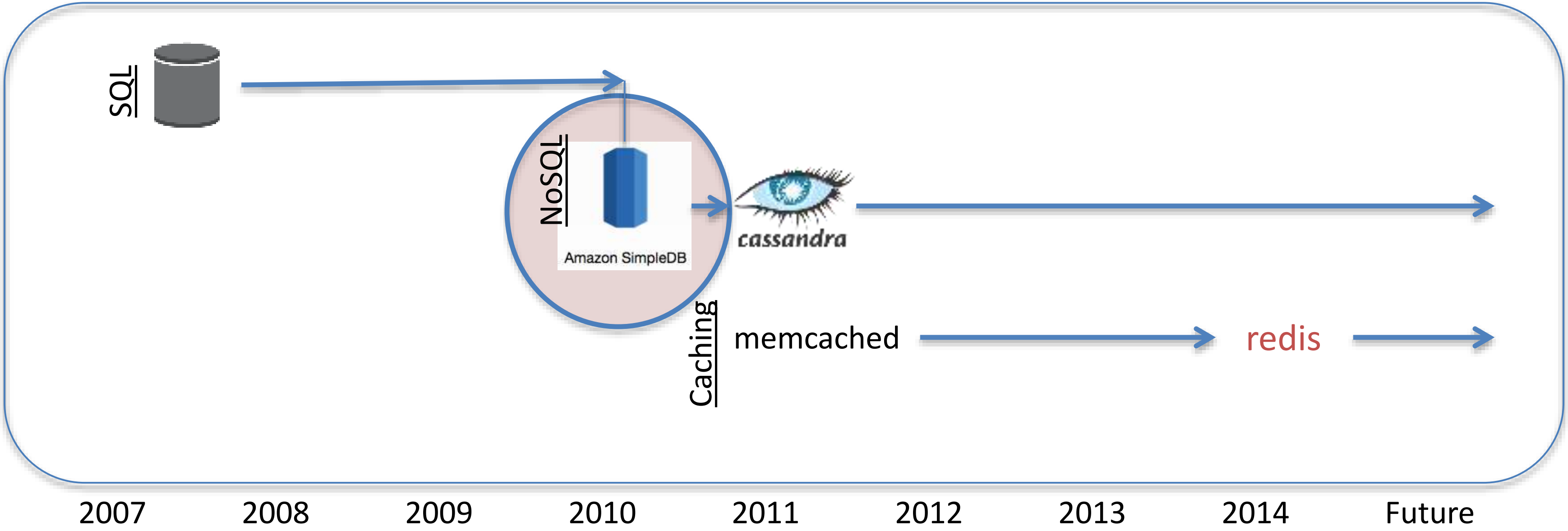
Real Time Data – gen 1



Real Time Data – gen 1 pain points

- Scalability
  - DB scaled up not out
- Event Data Analytics
  - ad hoc
- Fixed schema

Real Time Data – gen 2



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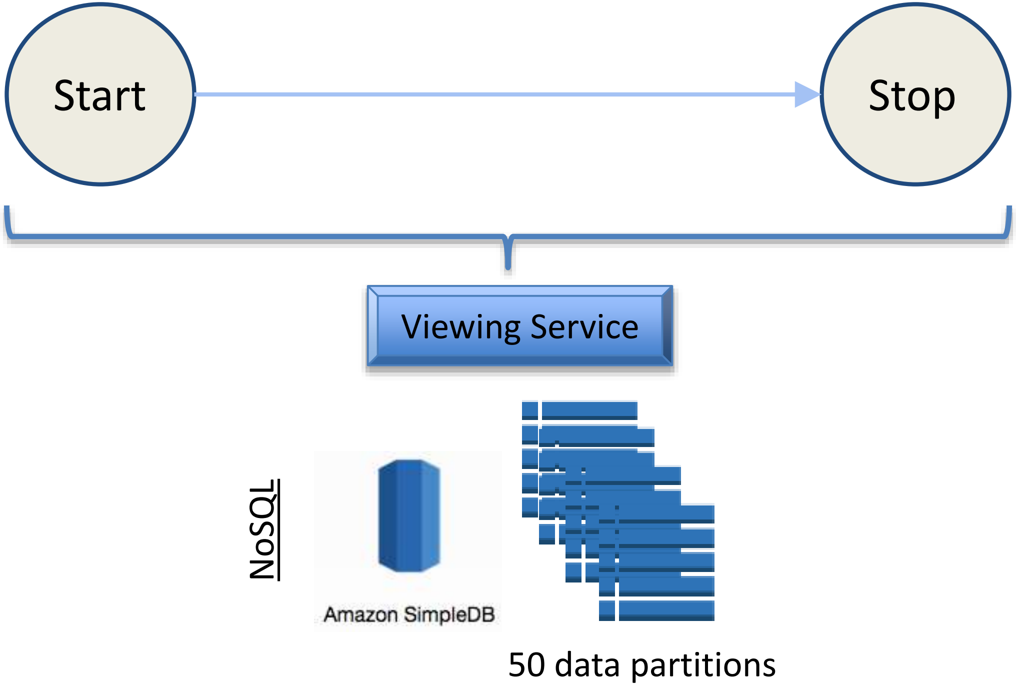
Real Time Data – gen 2 motivations

- Scalability
  - Scale out not up
- Flexible schema
  - Key/value attributes
- Service oriented

Real Time Data – gen 2



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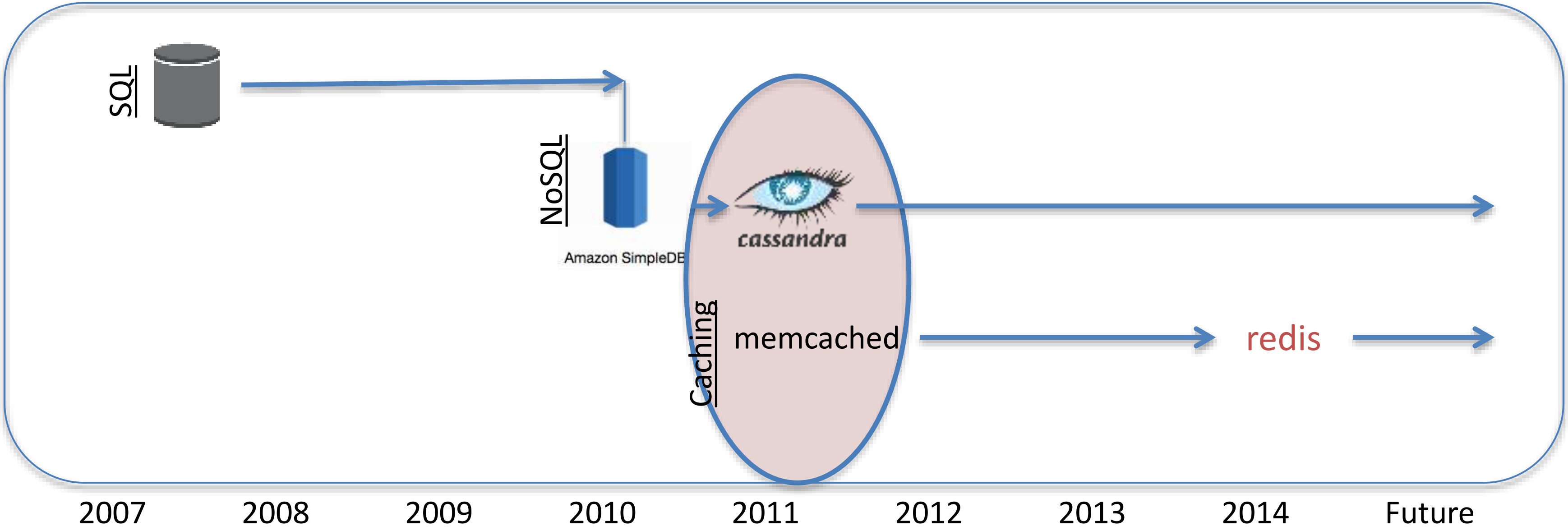
Real Time Data – gen 2 pain points

- Scale out
  - Resharding was painful
- Performance
  - Hot spots
- Disaster Recovery
  - SimpleDB had no backups

Real Time Data – gen 3



Real Time Data – gen 3 landscape

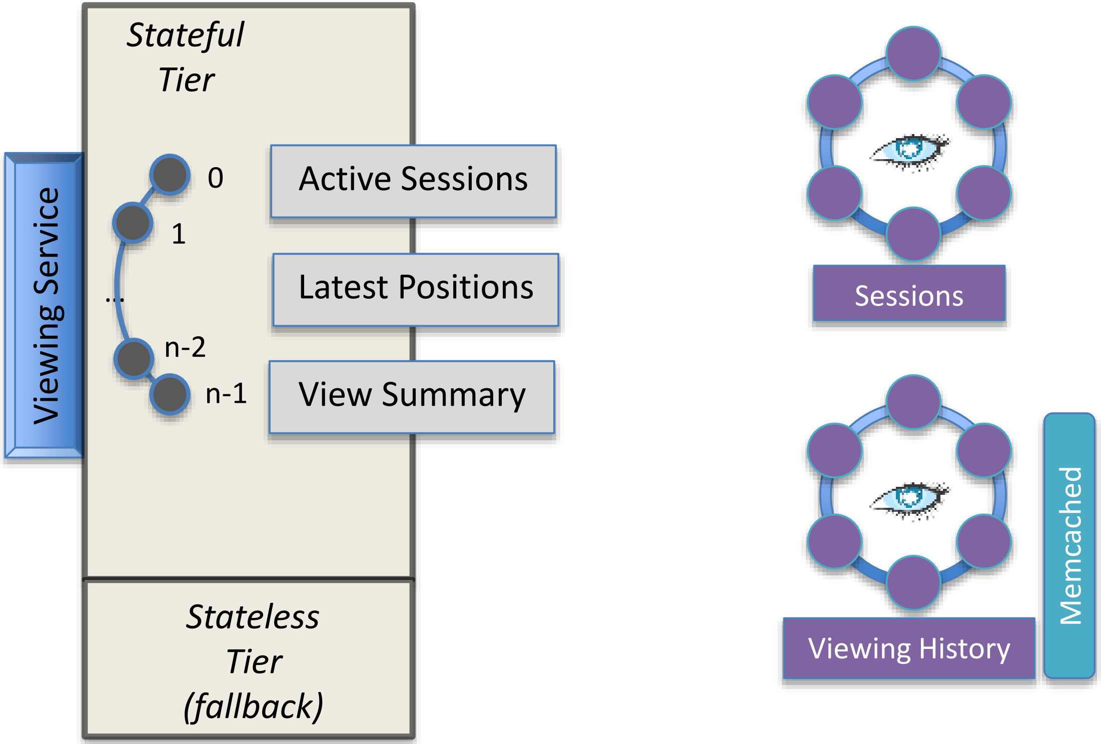
- Cassandra 0.6
- Before SSDs in AWS
- Netflix in 1 AWS region

Real Time Data – gen 3 motivations

- Order of magnitude increase in requests

- Scalability
  - Actually scale out rather than up

Real Time Data – gen 3



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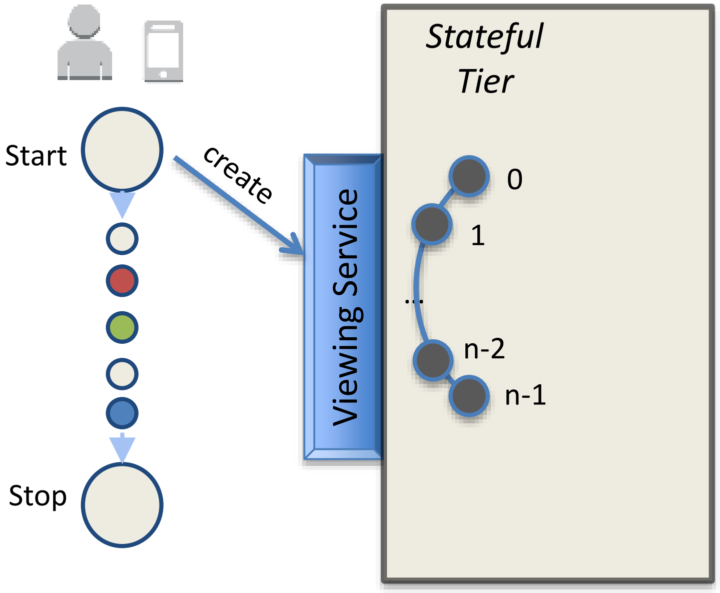
Real Time Data – gen 3 writes



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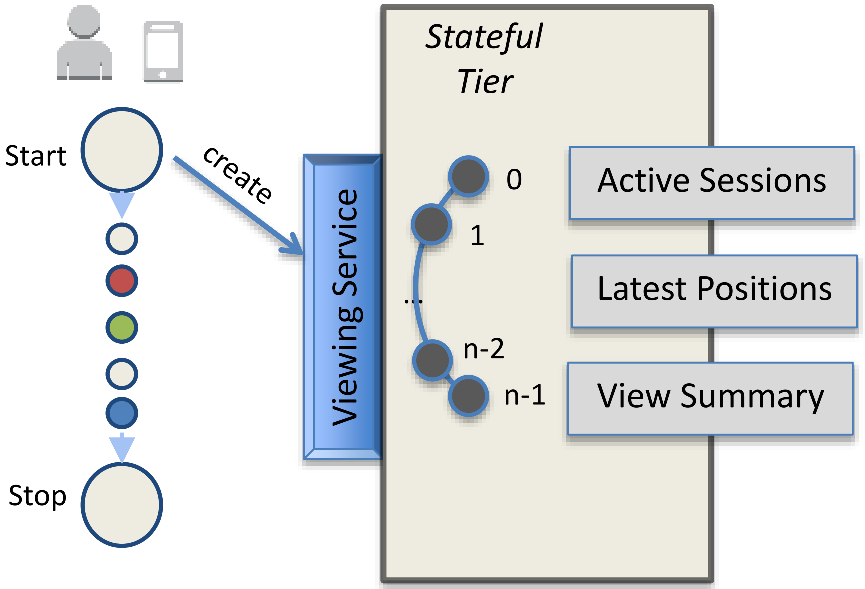
Real Time Data – gen 3 writes



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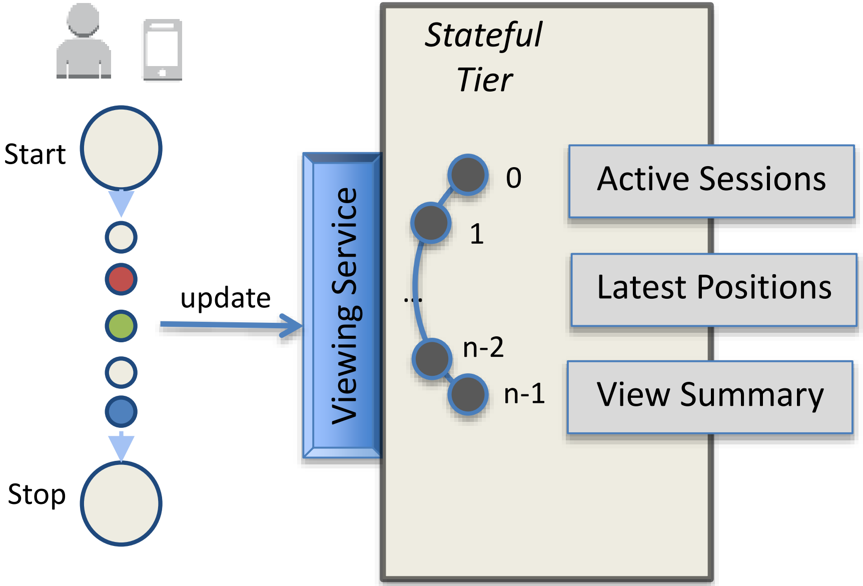
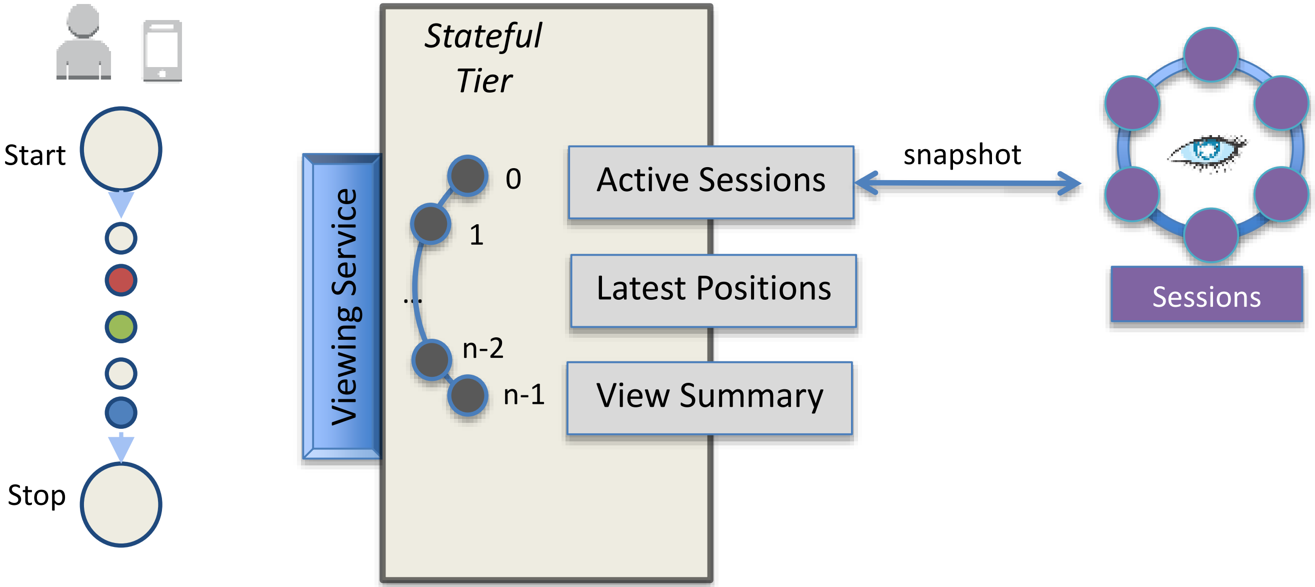
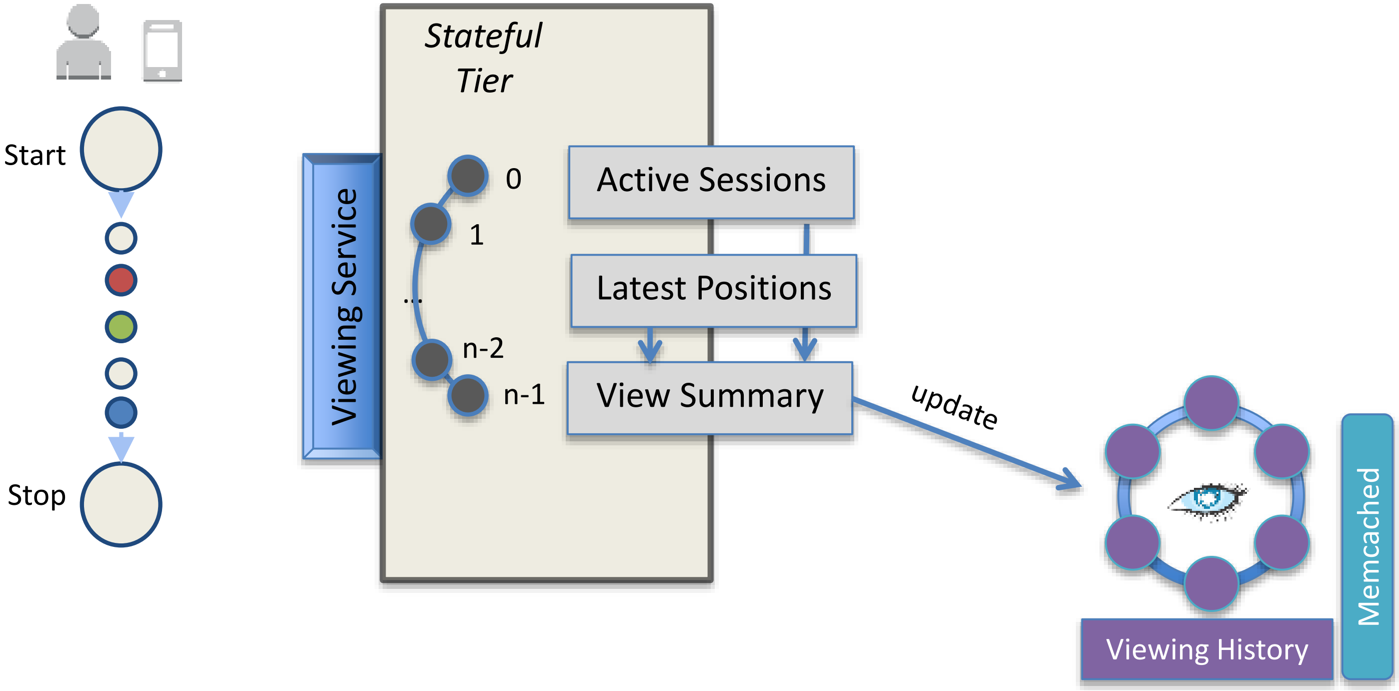
Real Time Data – gen 3 writes



Real Time Data – gen 3 writes



Real Time Data – gen 3 writes



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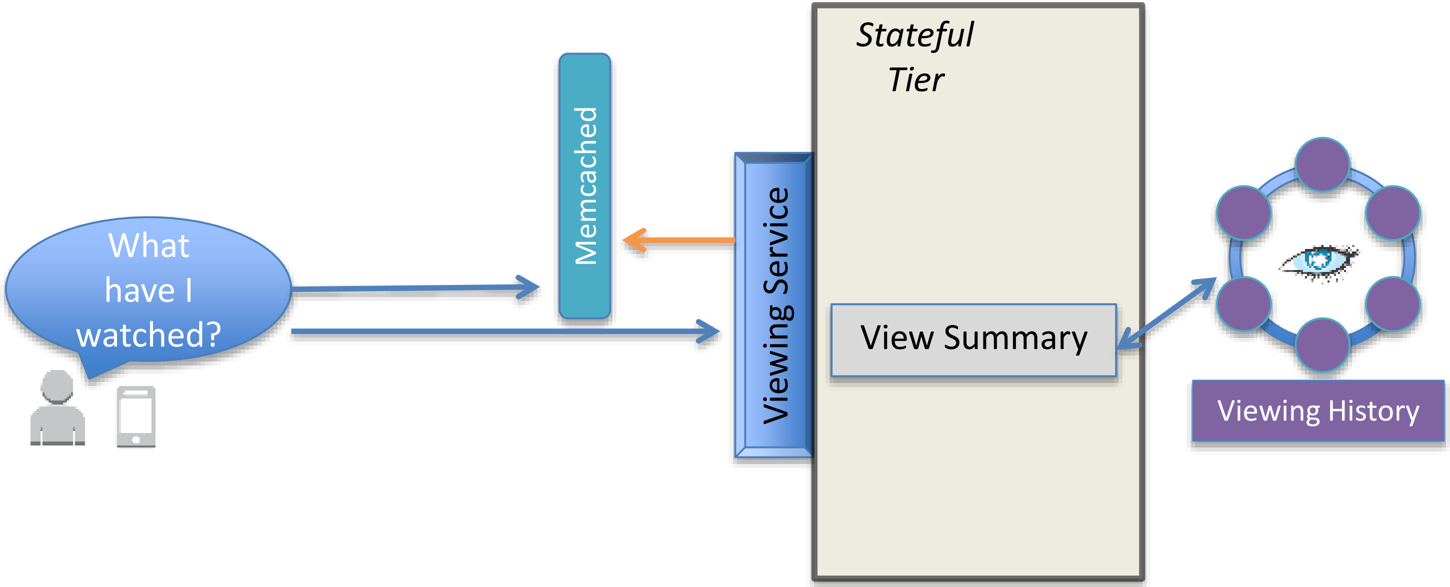
Real Time Data – gen 3 reads



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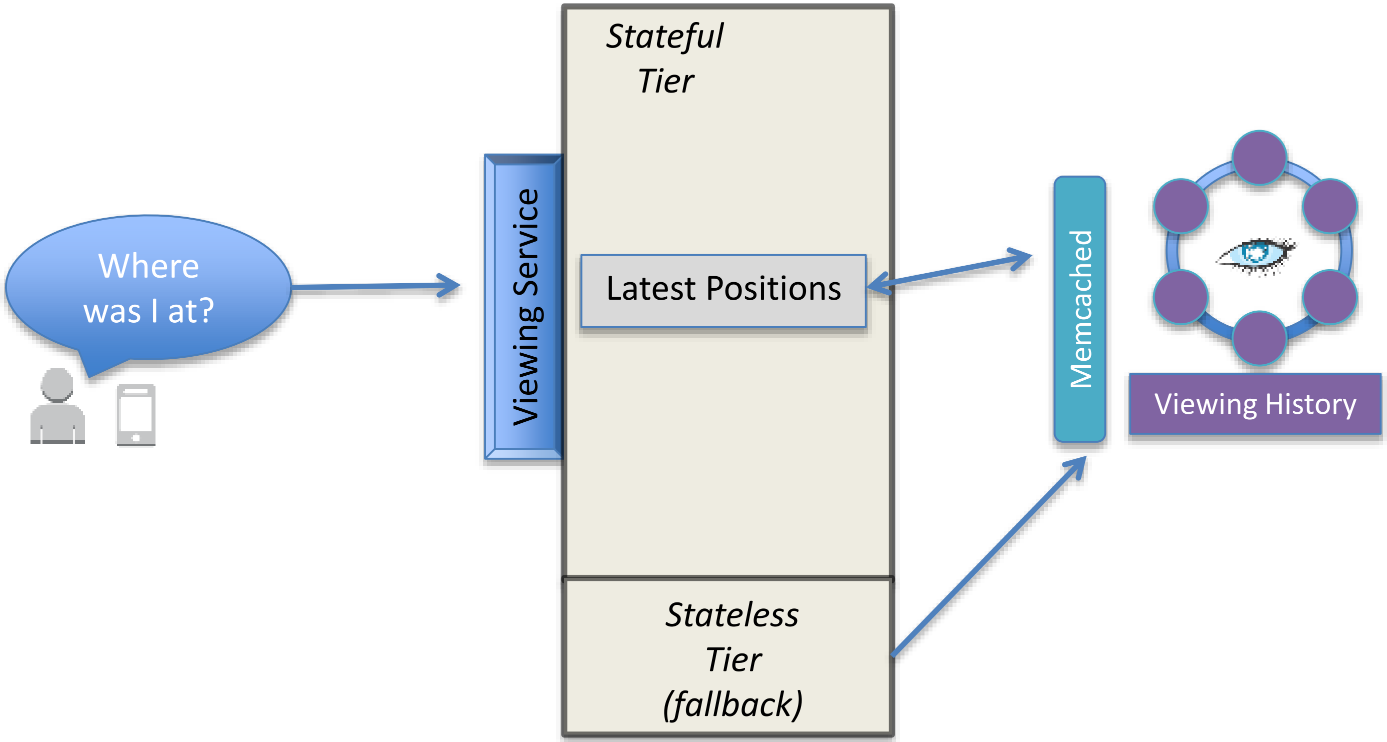
Real Time Data – gen 3 reads



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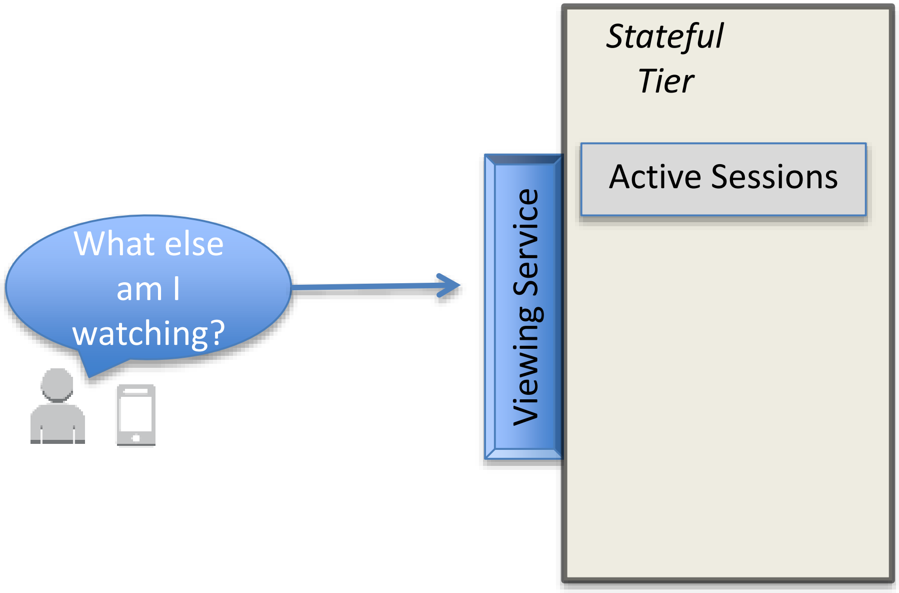
Real Time Data – gen 3 reads



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gen 3 - Requests Scale

Operation	Scale
Create (start streaming)	1,000s per second
Update (heartbeat, close)	100,000s per second
Append (session events/logs)	10,000s per second
Read viewing history	10,000s per second
Read latest position	100,000s per second

gen 3 – Cluster Scale

Cluster	Scale
Cassandra Viewing History	~100 hi1.4xl nodes ~48 TB total space used
Viewing Service Stateful Tier	~1700 r3.2xl nodes 50GB heap memory per node
Memcached	~450 r3.2xl/xl nodes ~8TB memory used

Real Time Data – gen 3 pain points

- Stateful tier
  - Hot spots
  - Multi-region complexity
- Monolithic service
- read-modify-write poorly suited for memcached

Real Time Data – gen 3 learnings

- Distributed stateful systems are hard
  - Go stateless, use C*/memcached/redis…
- Decompose into microservices

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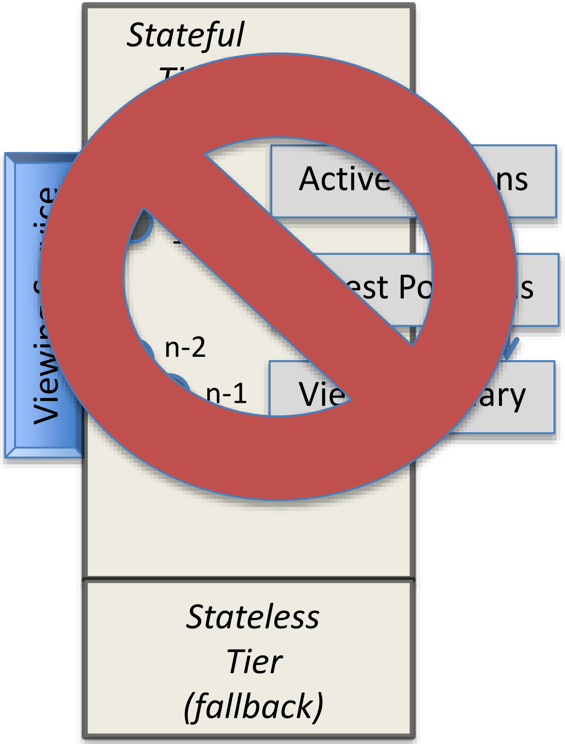
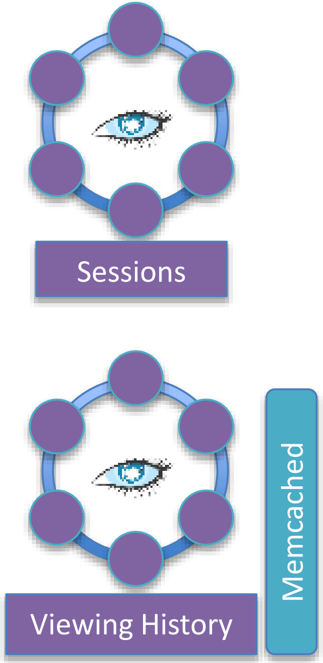
Real Time Data – gen 4





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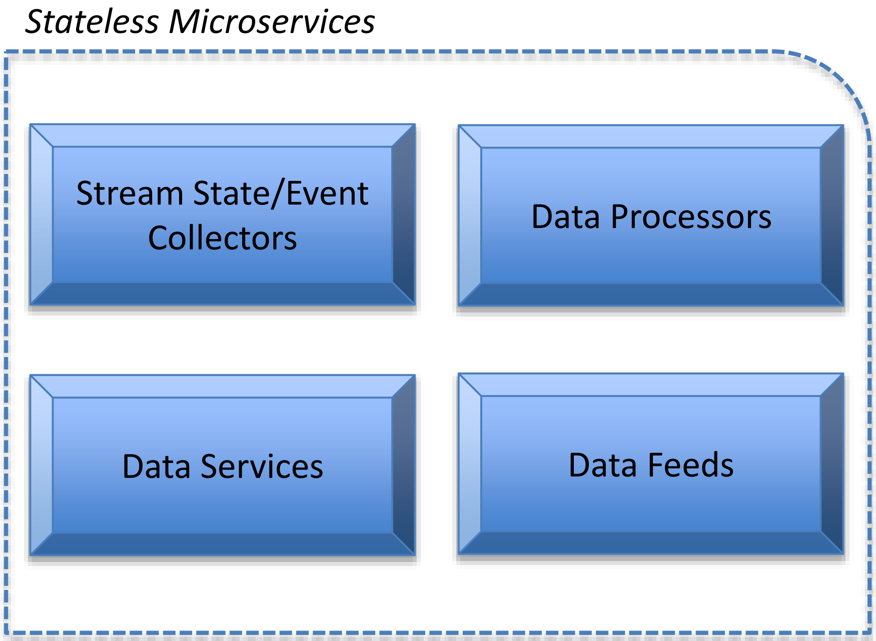
Real Time Data – gen 4



Stateless Microservices

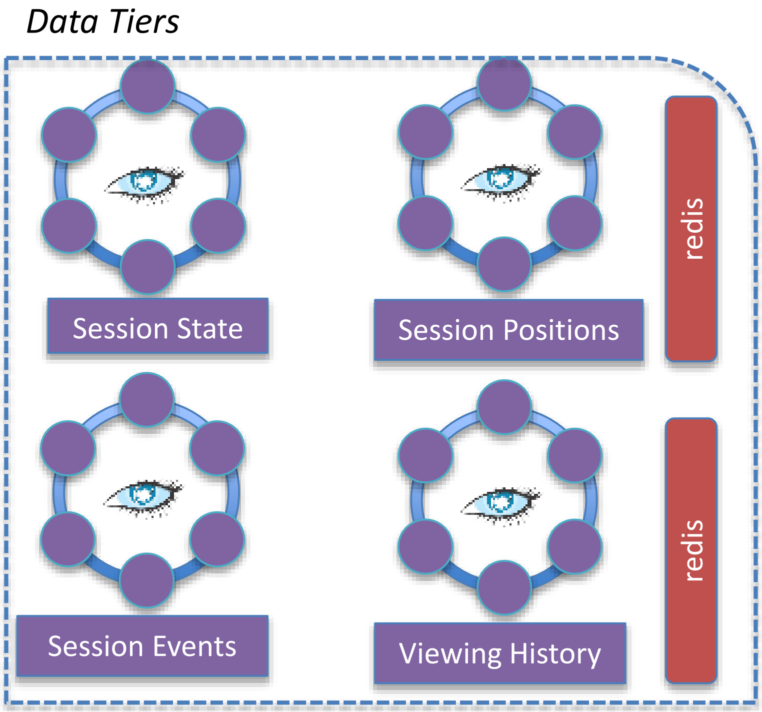
Stream State/Event Collectors

Data Processors

Data Services

Data Feeds

Real Time Data – gen 4



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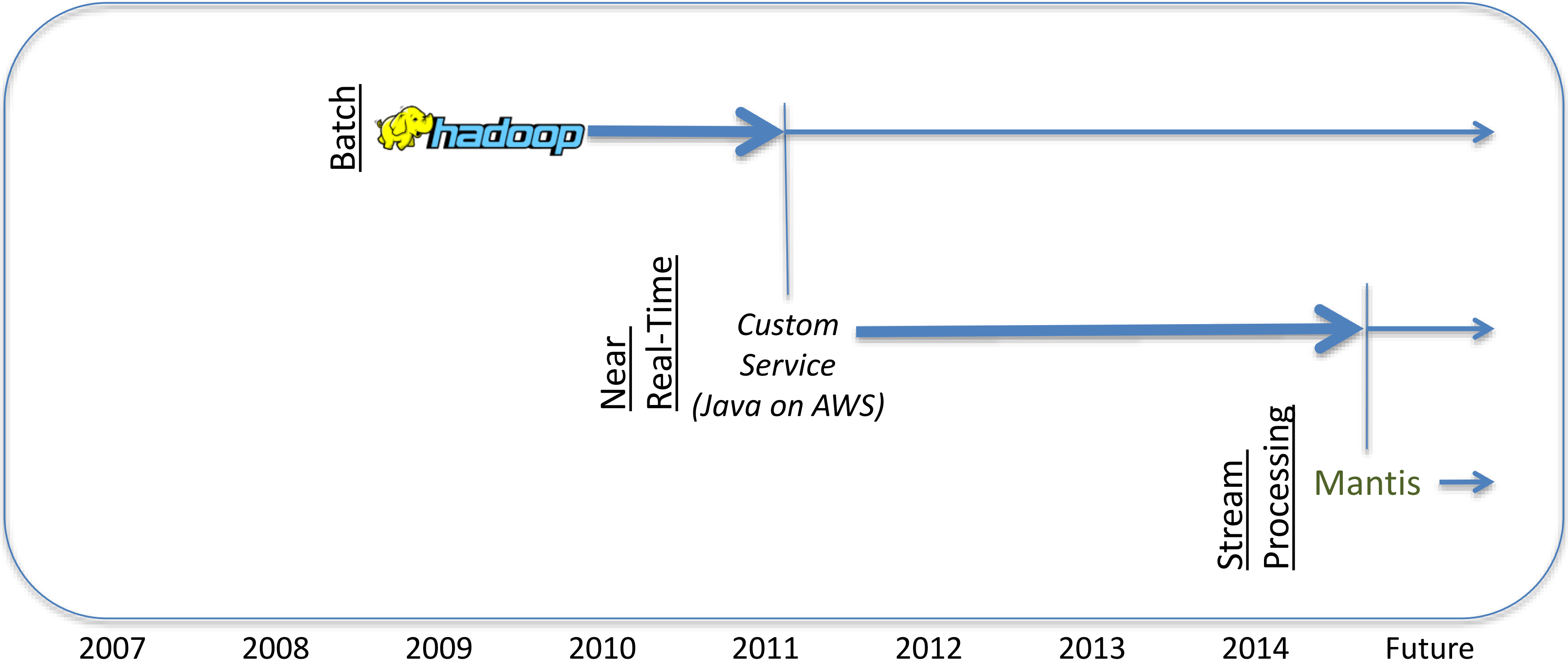
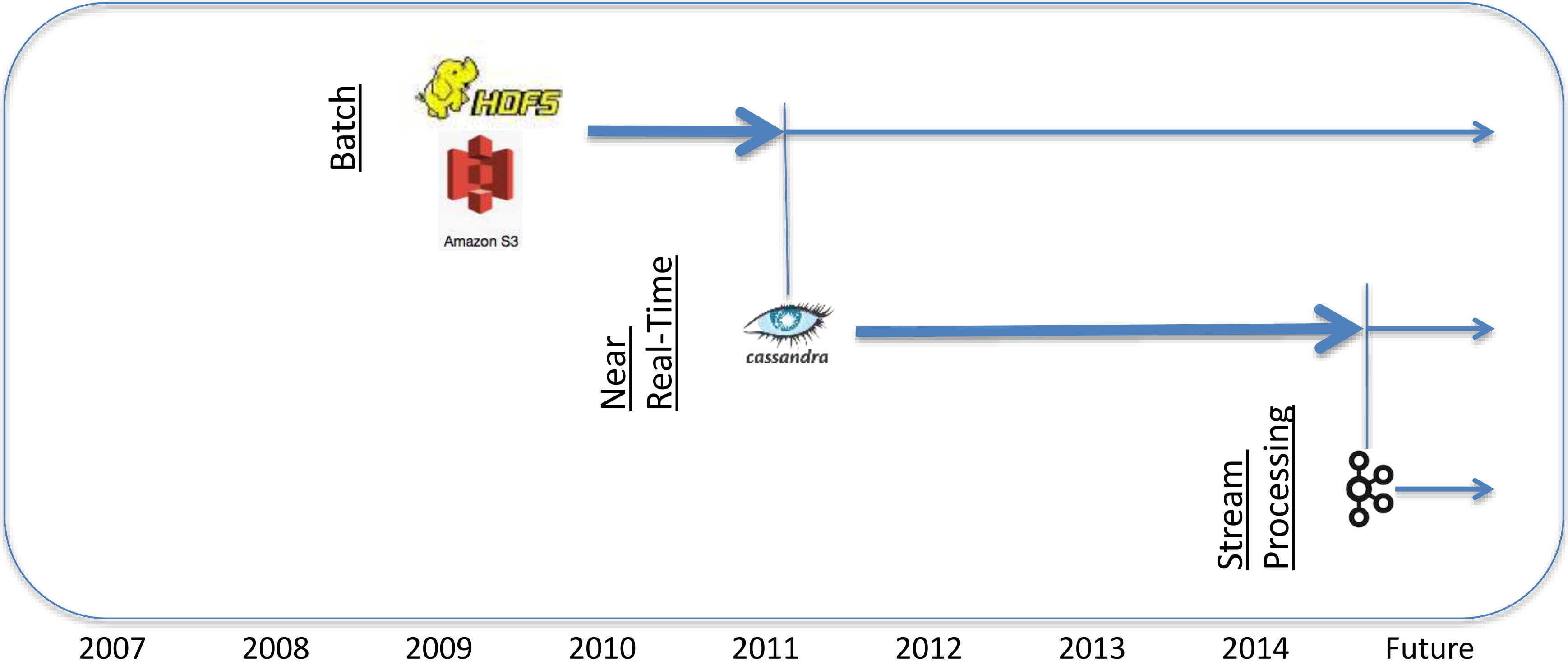
Session Analytics

- Summarize detailed event data
- Non-real time, but near real time
- Some shared logic with real time

Session Analytics - Processing

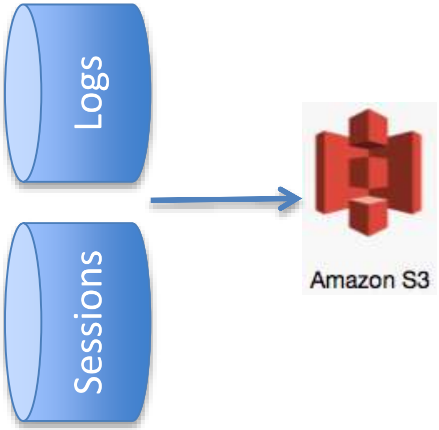


Session Analytics - Storage



Session Analytics – gen 1

- Storage



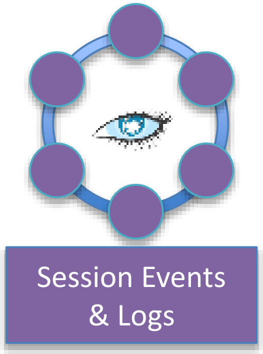
- Processing

Session Analytics – gen 1 pain points

- MapReduce good for batch
  - Not for near real time
- Complexity
  - Code in 2 systems / frameworks
  - Operational burden of 2 systems

Session Analytics – gen 2

- Storage



Session Events & Logs

- Processing

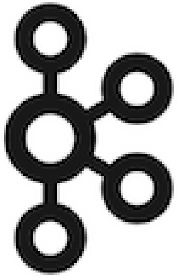
Java

Session Analytics – gen 2 learnings

- Reduced complexity
  - shared code and ops
- Batch still available
- New bottleneck
  - harder to extend logic

Session Analytics – gen 3 (*)

- Storage



- Processing

Storm

Mantis

Samza

Spark Streaming

Stream Processing Frameworks

Takeaways

- Polyglot Persistence
  - One size fits all *doesn't* fit all
- Strong opinions, loosely held
  - Design for long term, but be open to redesigns

Thanks!

@philip_pfo

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