

Architecting & Launching the Halo 4 Services

SRECON '15

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- Halo Services Overview
- Architectural Challenges
- Orleans Basics
- Tales From Production



Presence
Statistics
Title Files
Cheat Detection
User Generated Content

HALO WAYPOINT

The image displays the Halo Waypoint website interface across multiple devices. The desktop monitor shows the main dashboard with the following data:

- WAR GAMES MATCHMAKING:** 4,020,101 CURRENTLY PLAYING
- GAMES PLAYED:** A donut chart showing the distribution of game modes: CTF (303 GAMES), SLAYER (255 GAMES), OOOBALL (238 GAMES), KING OF THE HILL (209 GAMES), FLOOD (176 GAMES), EXTRACTION (146 GAMES), DOMINION (127 GAMES), and OTHER (95 GAMES).
- SUMMARY:** 2,201 GAME VICTORIES, 359 GAME DEFEATS, 830 KILLS, and 729 DEATHS.
- TOTAL PLAYTIME:** 7D 17H 44M
- MEALS EATEN:** 16

The tablet and smartphones show mobile versions of the website, including match details for 'RTAN OPS' and 'SLAYER' modes, player statistics, and game mode selection screens.

WAYPOINT SERVICE RECORD

LAST PLAYED YESTERDAY

- Profile icon
- Global icon
- War Games icon
- Spartan Ops icon
- Campaign icon
- Calendar icon

TTL L ASKAN

LSKH



CSR 49

SR 130

REG TEAM BATTLE

PATHFINDER - 10

COMPLETED

MAX RANK

SRWXOPPRPTENSKRGTK

WAR GAMES MATCHMAKING

2294 GAMES COMPLETED 1443 WINS 130 03H TOTAL PLAYTIME

WAR GAMES CUSTOM

35 GAMES COMPLETED 18 WINS 03H 23M TOTAL PLAYTIME

SPARTAN OPS

0 / 50 COMPLETED SOLO 0 / 50 COMPLETED COOP 00H 00M TOTAL PLAYTIME

CAMPAIGN

0 / 8 MISSIONS COMPLETED

SOLO CO-OP

RECENT GAMES

- STATS SUMMARY
- MOST PLAYED VARIANT STATS
- MOST USED WEAPON
- SPECIALIZATIONS
- COMMENDATIONS

SHARE [Social media icons]

RECENT GAMES

- HAVEN SLAYER WAR GAMES- YESTERDAY
- SHUTOUT SLAYER WAR GAMES- YESTERDAY
- SHUTOUT SLAYER WAR GAMES- YESTERDAY
- HAVEN SLAYER WAR GAMES- YESTERDAY
- SHUTOUT SLAYER WAR GAMES- YESTERDAY

STATS SUMMARY

OVERVIEW

130 06H 17M TOTAL PLAYTIME 11.22.12 PLAYER SINCE

0 / 7 TERMINALS FOUND 100% OVERALL COMMENDATIONS

WAYPOINT SERVICE RECORD

LAST PLAYED YESTERDAY

TIL L ASKAN

SR 130

PATHFINDER - 10

COMPLETED

SR: 49

WAR GAMES MATCHMAKING

2994 WINS
1443 LOSSES
130 03M TOTAL PLAYERS

WAR GAMES CUSTOM

35 WINS
18 LOSSES
03M 23M TOTAL PLAYERS

SPARTAN OPS

0 / 50 WINS
0 / 50 LOSSES
03M 03M TOTAL PLAYERS

CAMPAIGN

0 / 8 WINS
03M 03M TOTAL PLAYERS

- STATS SUMMARY
- MOST PLAYED VARIANT STATS
- MOST USED WEAPON
- SPECIALIZATIONS
- COMPONENTS

RECENT GAMES

MAP	SCORE	KILLS	PLACEMENT
HAVEN	160	17	4TH
SHUTOUT	715	14	2ND
SHUTOUT	750	17	6TH
HAVEN	100	14	5TH
SHUTOUT	105	10	3RD

STATS SUMMARY

OVERVIEW

130 03M 17M TOTAL PLAYERS | 11 22 12 PLAYED GAMES | 52 WEAPONS USED | 299 WINS

0 / 7 WEAPONS USED | 100% WEAPON COMPLETION | 52 WEAPONS USED

WAR GAMES MATCHMAKING

130 03M 04M TOTAL PLAYERS | 2994 WINS | 1443 LOSSES | 75348 TOTAL GAMES

WAR GAMES CUSTOM

00 03M 23M TOTAL PLAYERS | 35 WINS | 18 LOSSES | 753 TOTAL GAMES

SPARTAN OPS

00 03M 03M TOTAL PLAYERS | 0 WINS | 0 / 50 WEAPONS USED | 0 / 50 WEAPONS USED

CAMPAIGN

00 03M 03M TOTAL PLAYERS | 0 WINS | 0 / 8 WEAPONS USED

MOST PLAYED VARIANT STATS

MATCHMAKING SLAYER

00 03M 29M TOTAL PLAYERS | 25/87 WEAPONS USED | 43944 TOTAL GAMES

1360 WEAPONS USED | 868 WEAPONS USED | 1 40 WINS

CUSTOM SLAYER

SHUTOUT

LEGENDARY SLAYER BR

VICTORY BLUE TEAM

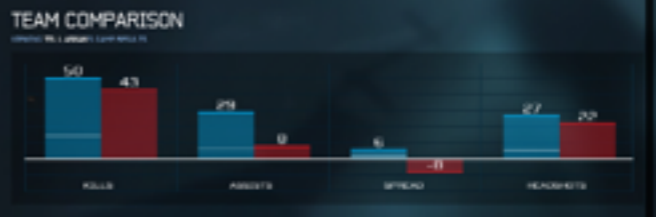
8 KILLS | 215 SCORE

5 KILLS | 215 SCORE

TEAM RESULTS

RANK	PLAYER	SCORE	KILLS	DEATHS	CSR
1	TORGEM	270	17	34	CSR 26
2	TIL L ASKAN	215	14	28	CSR 26
3	TIL YETI	200	11	28	CSR 15
4	TIL KYLID	145	8	21	CSR 24

RANK	PLAYER	SCORE	KILLS	DEATHS	CSR
1	SAVAGE SELVA	240	10	28	CSR 34
2	TIL YI FORNARYX	155	11	20	CSR 25
3	POT WOL TTY	130	7	19	CSR 29
4	ICOLIC BC	105	7	14	CSR 27



MEDAL DISTRIBUTION

HALO INFINITE PERFORMANCE MATCH-MAKING

GAMES PLAYED



SUMMARY



30 234 56M



HIDE SPECIFIC: REGION OF TERROR

19488 CURRENTLY PLAYING

6730	820 TEAM BATTLE	30%
2808	TEAM SLAYER	14%
2526	SWAT	13%
1425	CAPTURE THE FLAG	7%
1378	TEAM ACTION SACK	7%
525	FLOOD	3%
900	MEDAL MADNESS	5%
648	TEAM SNIPERS	3%
603	GRIPBALL	3%
554	TEAM DOUBLES	3%
447	RECOCHET	2%
433	RUMBLE PET	2%
141	TEAM THROWDOWN	1%

GAME VARIANTS: SLAYER

Grid of game variants: CAPTURE THE FLAG, SLAYER, OVERBALL, KING OF THE HILL, FLOOD, RECOCHET, EXTINCTION, EXPANION, RESCUE, DIRT BIKES

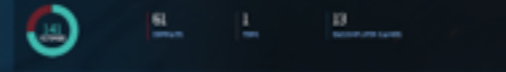
625, 41, 14863, 14863



2589	1267	+1332	2748
1872	972	+900	1547
490	398	+92	0

STATS BY MAP: HAVEN

ARMOR	ADAPT	COMETS	EMERSON
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



1029	444	+585	843
1000	600	+400	884

HAVEN



VICTORY BLUE TEAM

3 GOOSEFLAME, 9 M00SLY

TEAM RESULTS

1	CHEFRYKITCHEN	0	15	30	CSR 11
2	B IS FOR BUWO	0	29	45	CSR 8
3	PLAYLISTHETAL	0	29	47	CSR 12
4	PROFFYGORX	0	15	23	CSR 14
1	WISKEYTRIGGLIB	0	5	11	CSR 7
2	M00SE7	0	8	13	CSR 12
3	GOOSEFLAME	0	14	28	CSR 14
4	GALANARI	0	10	18	CSR 15

TEAM COMPARISON



MEDAL DISTRIBUTION

Halo:CE - 6.43 million

Halo 2 - 8.49 million

Halo 3 - 11.87 million

Halo 3: ODST - 6.22 million

Halo Reach - 9.52 million

Day One

\$220 million in sales

1 million players online



Week One
\$300 million in sales

4 million players
online

31.4 million hours



Overall
11.6 million players

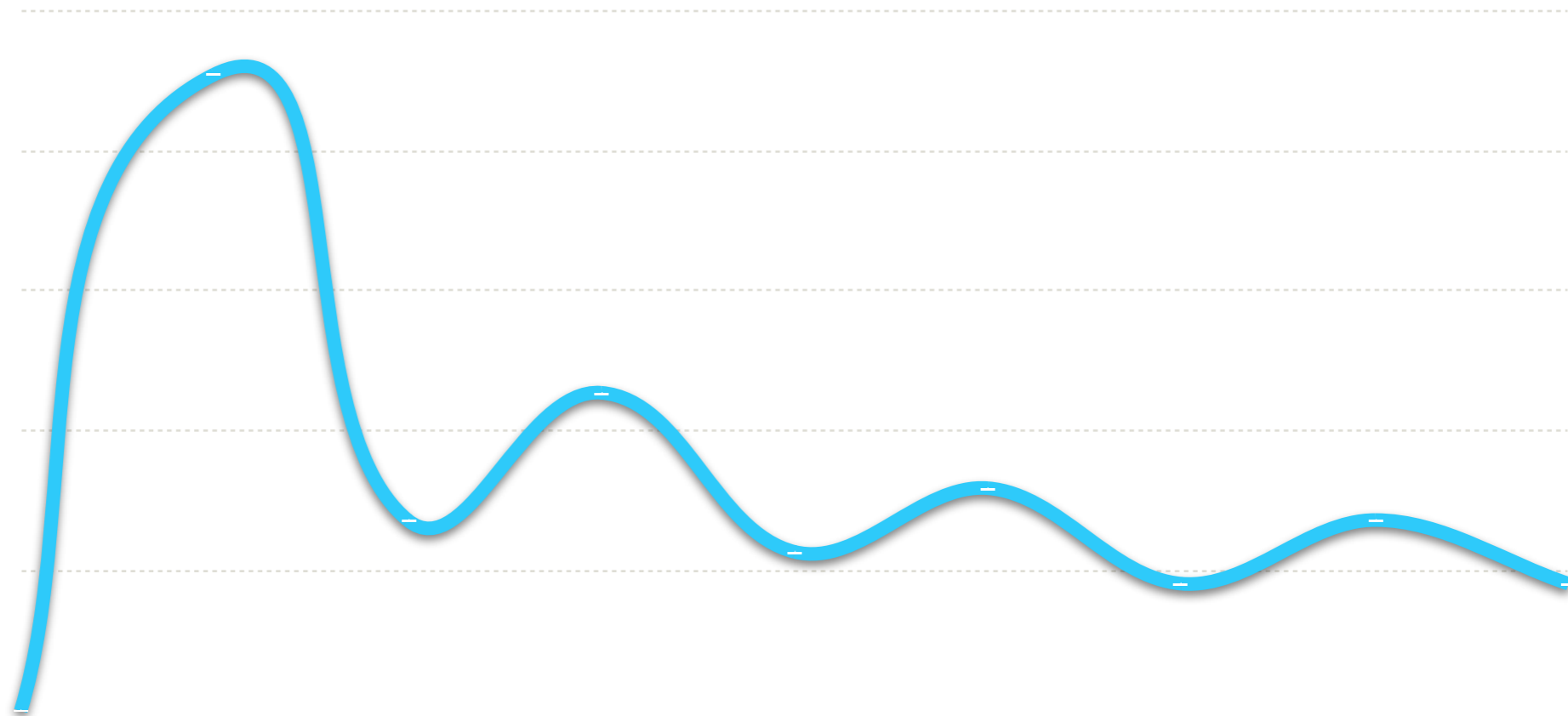
1.5 billion games

270 million hours

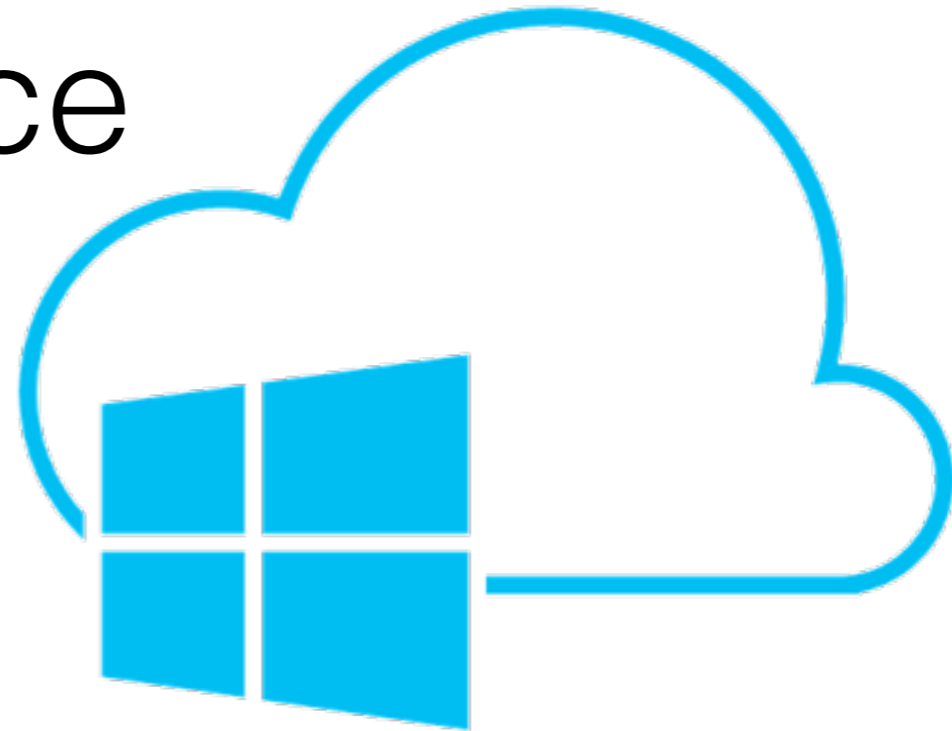


Architectural Challenges

Load Patterns



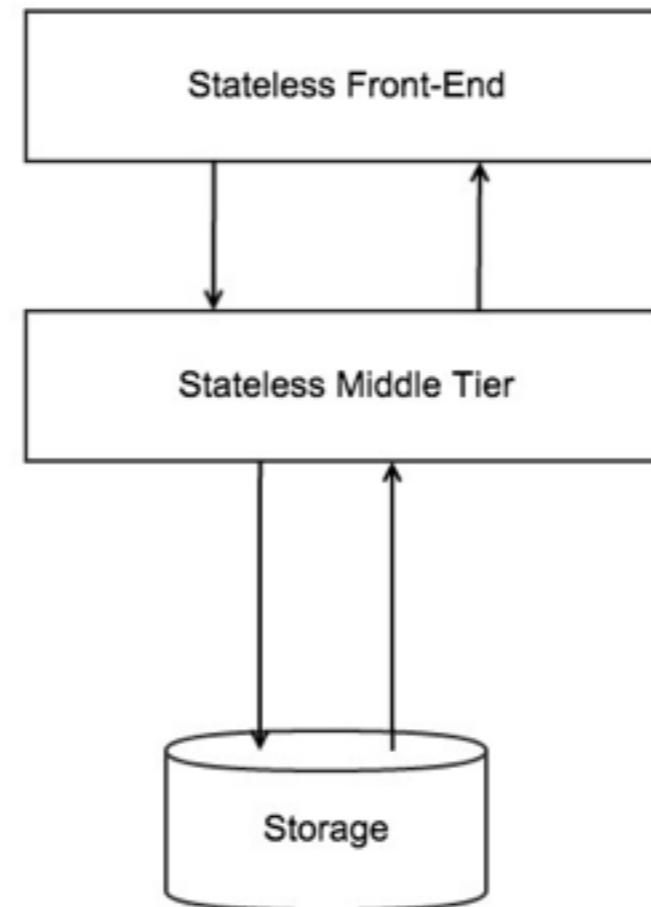
Azure Worker
Roles
Azure Table
Azure Blob
Azure Service
Bus



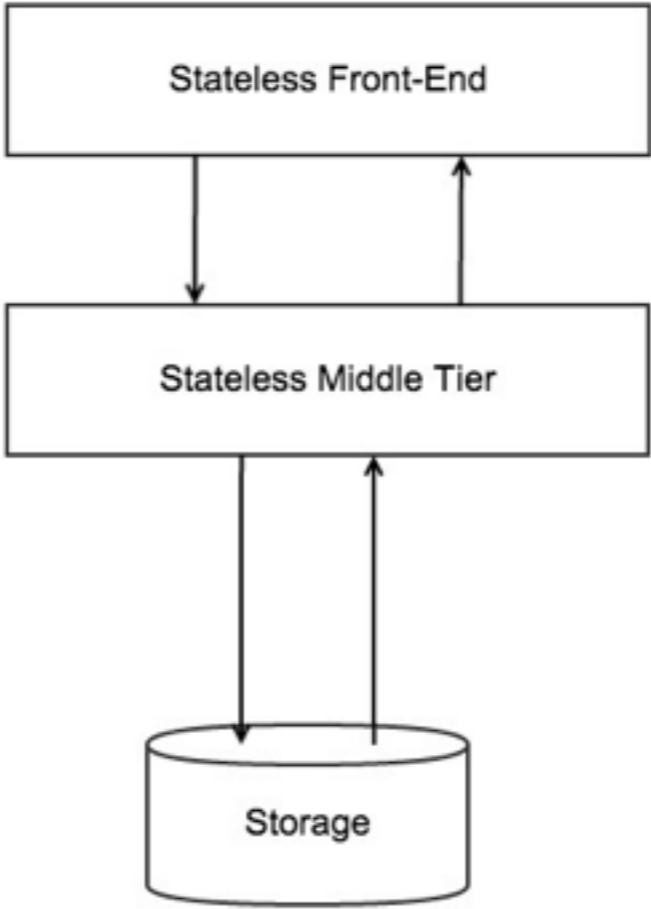
Always Available

Low Latency &
High Concurrency

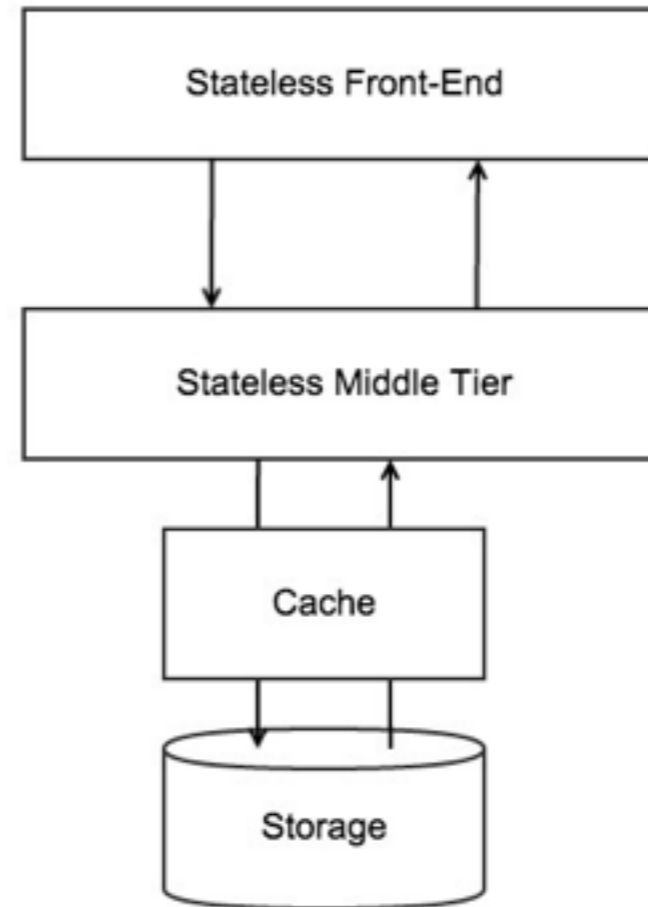
Stateless 3 Tier Architecture



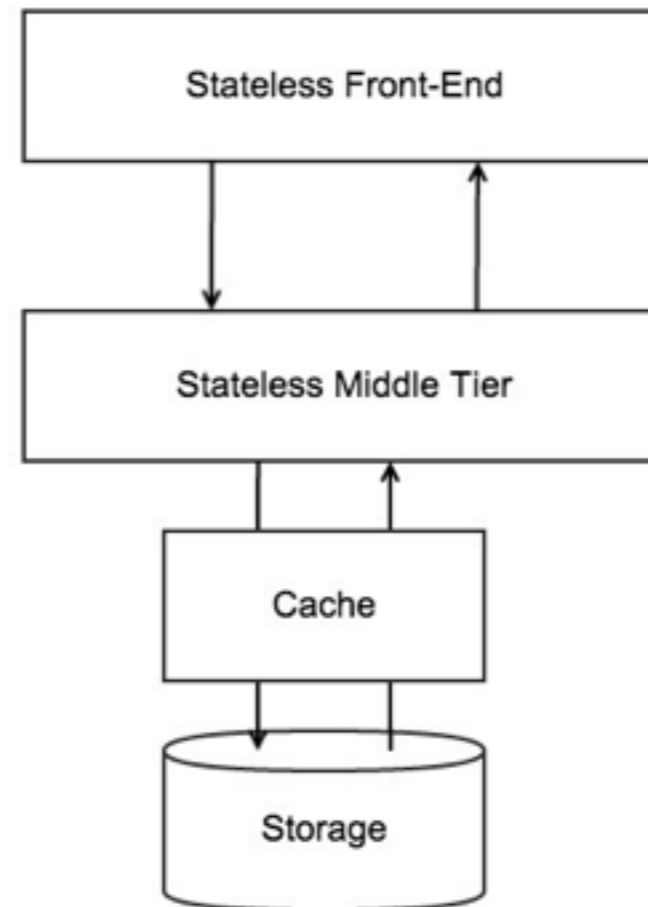
Latency Issues



Add A Cache



Concurrency Issues



Data Locality

The Actor Model

A framework & basis for reasoning about concurrency

*A Universal Modular Actor Formalism for Artificial Intelligence
Carl Hewitt, Peter Bishop, Richard Steiger (1973)*

Send A Message
Create a New Actor
Change Internal

State-full Services

Orleans: Distributed Virtual Actors for Programmability and Scalability

*Philip A. Bernstein, Sergey Bykov, Alan Geller, Gabriel
Kliot, Jorgen Thelin*

eXtreme Computing Group MSR

“Orleans is a runtime and programming model for building distributed systems, based on the actor model”

Virtual Actors

“An Orleans actor always exists, virtually. It cannot be explicitly created or destroyed”

Virtual Actors

- Perpetual Existence
- Automatic Instantiation
- Location Transparency
- Automatic Scale out

Runtime

- Messaging
- Hosting
- Execution

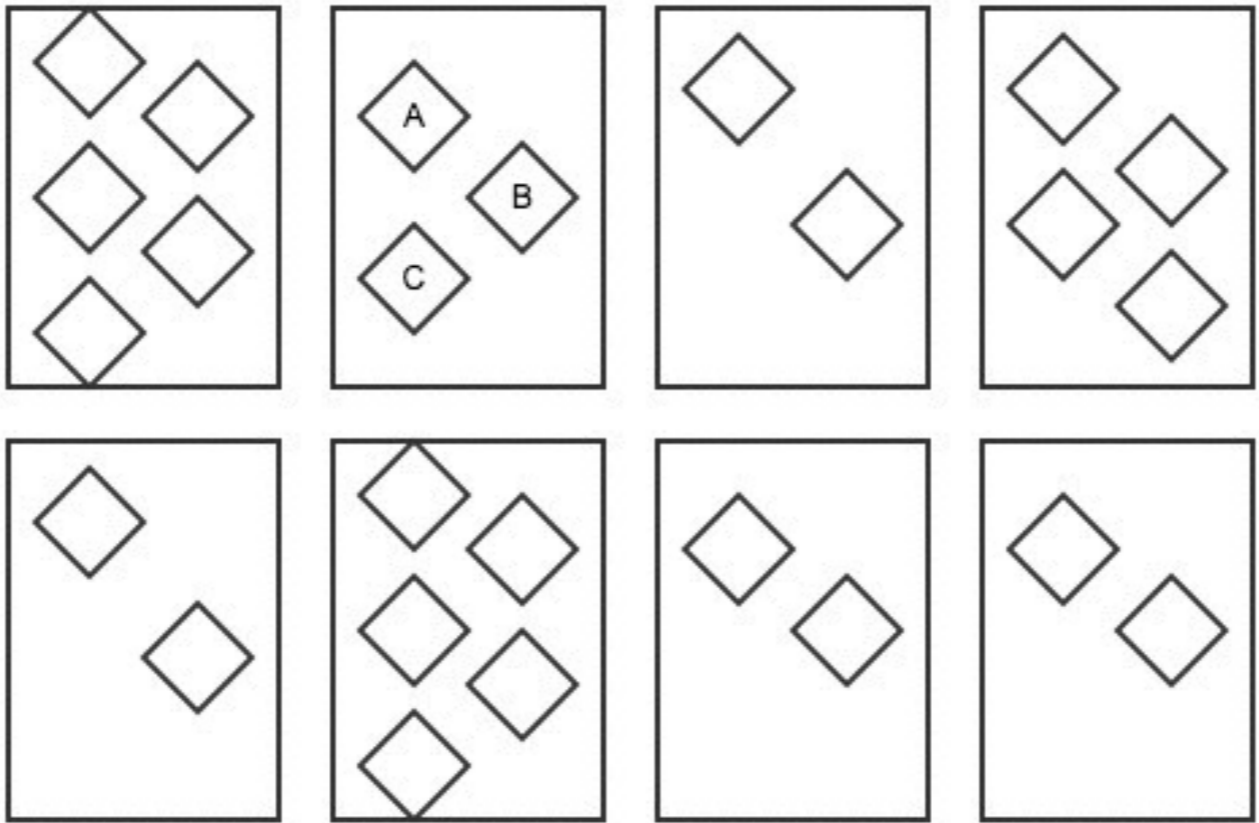
Orleans Programming Model

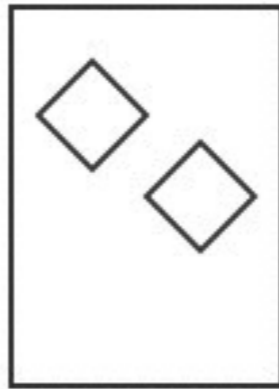
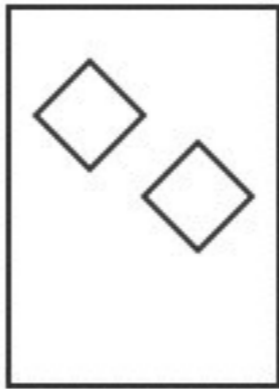
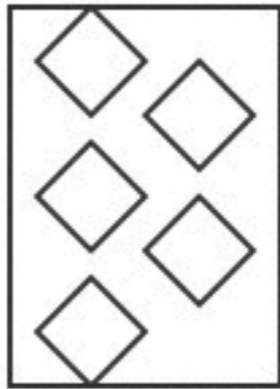
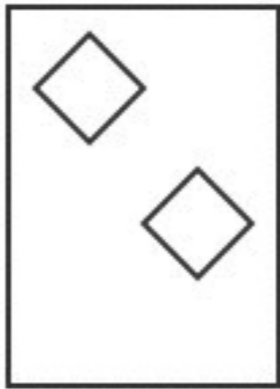
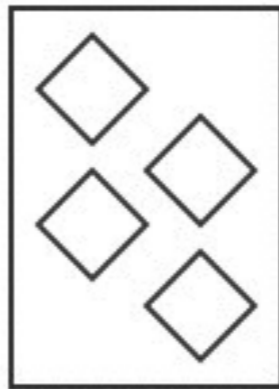
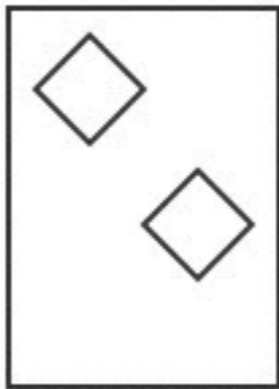
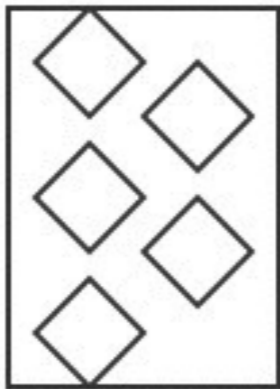
```
namespace HelloWorldInterfaces
{
    /// <summary>
    /// Orleans grain communication interface IHello
    /// </summary>
    public interface IHello : Orleans.IGrain
    {
        Task<string> SayHello();

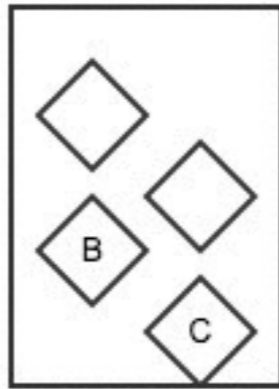
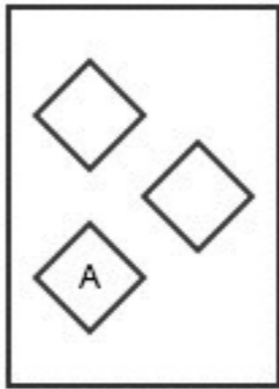
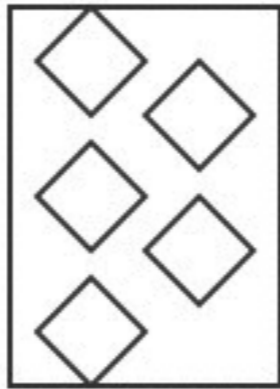
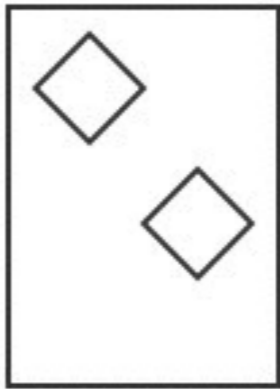
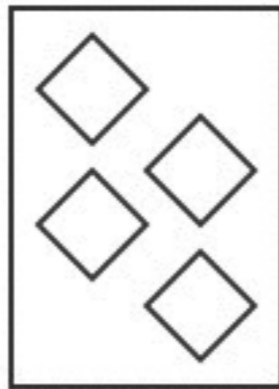
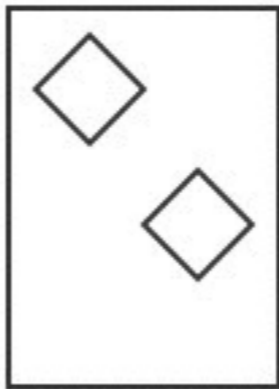
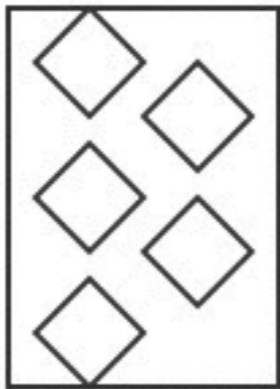
        Task<string> SayGoodbye();
    }
}
```

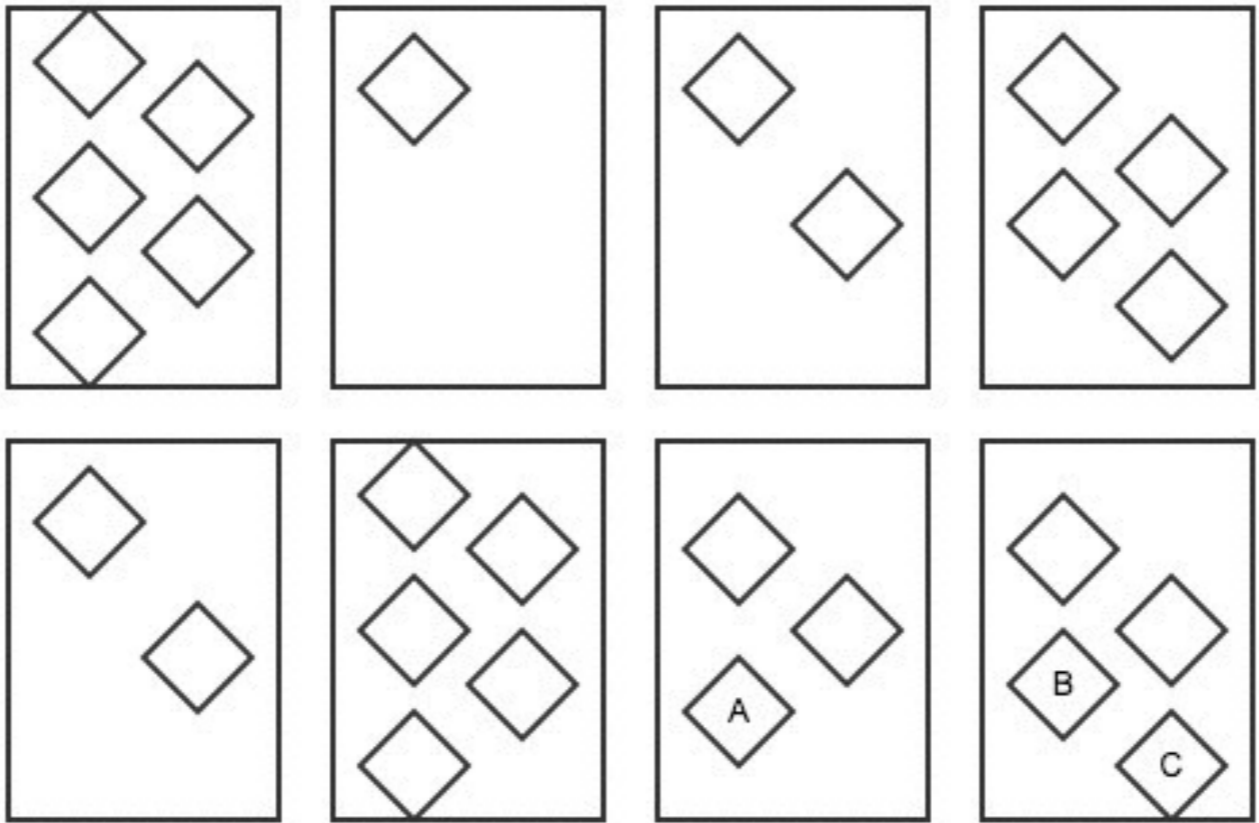
Reliability

“Orleans manages all aspects of reliability automatically”









Performance & Scalability

“Orleans applications run at very high CPU Utilization. We have run load tests with full saturation of 25 servers for many days at 90%+ CPU utilization without any instability”

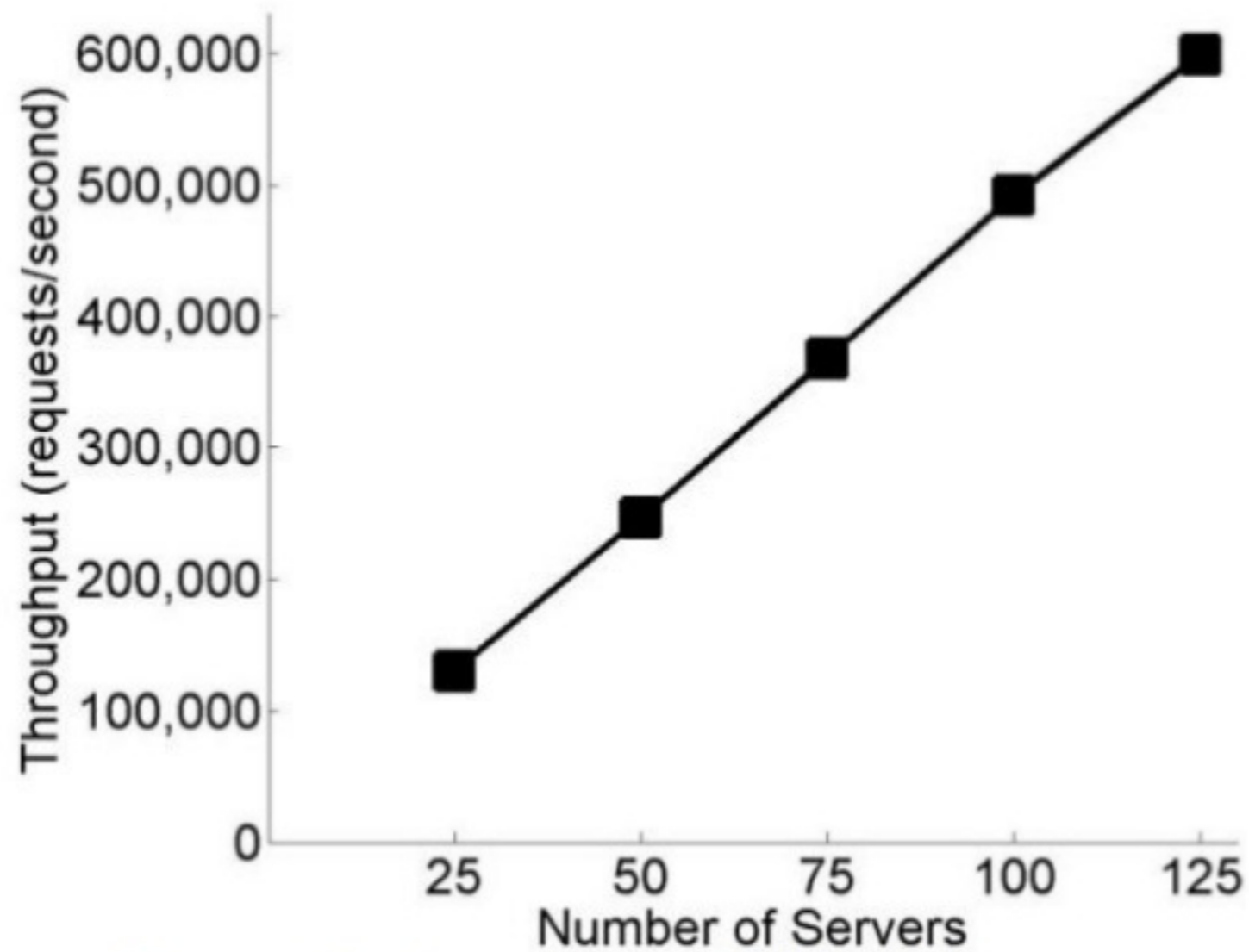
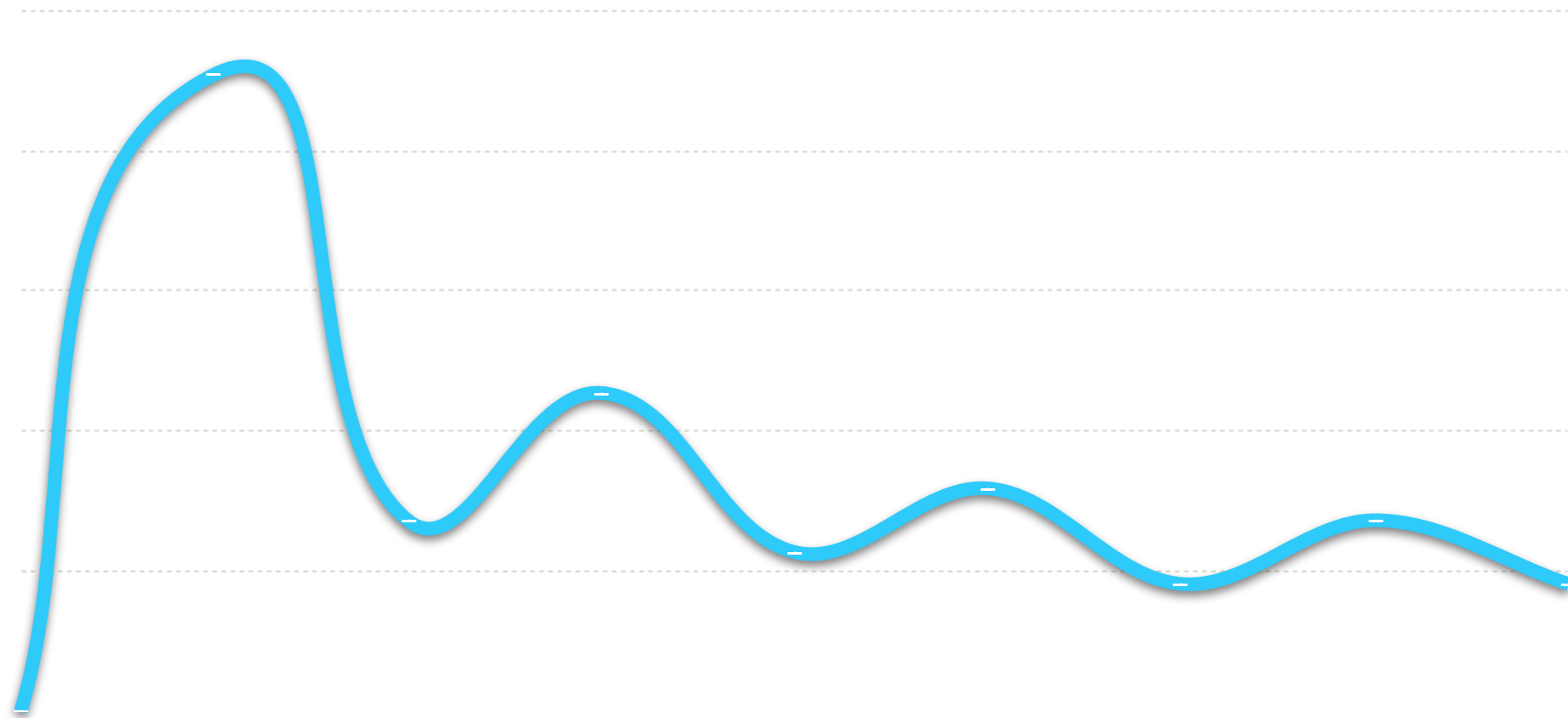


Figure 6: Throughput of Halo 4 Presence service. Linear scalability as number of server increases.

Load Patterns

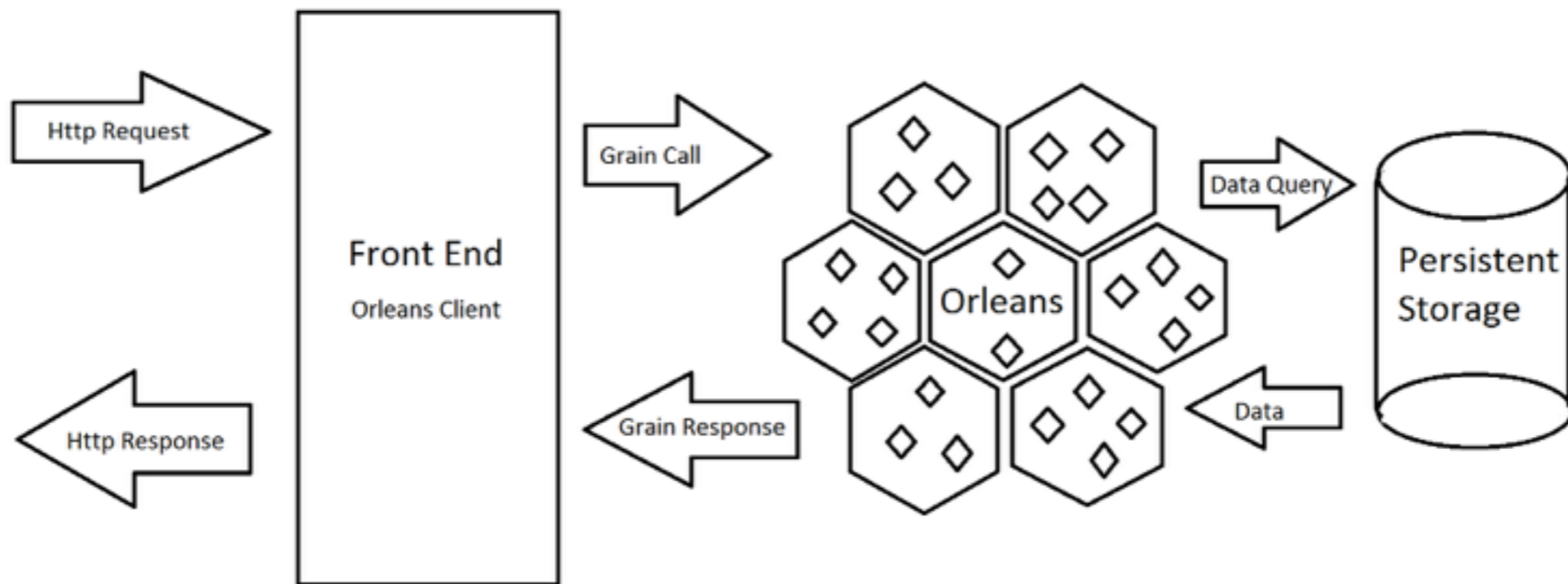


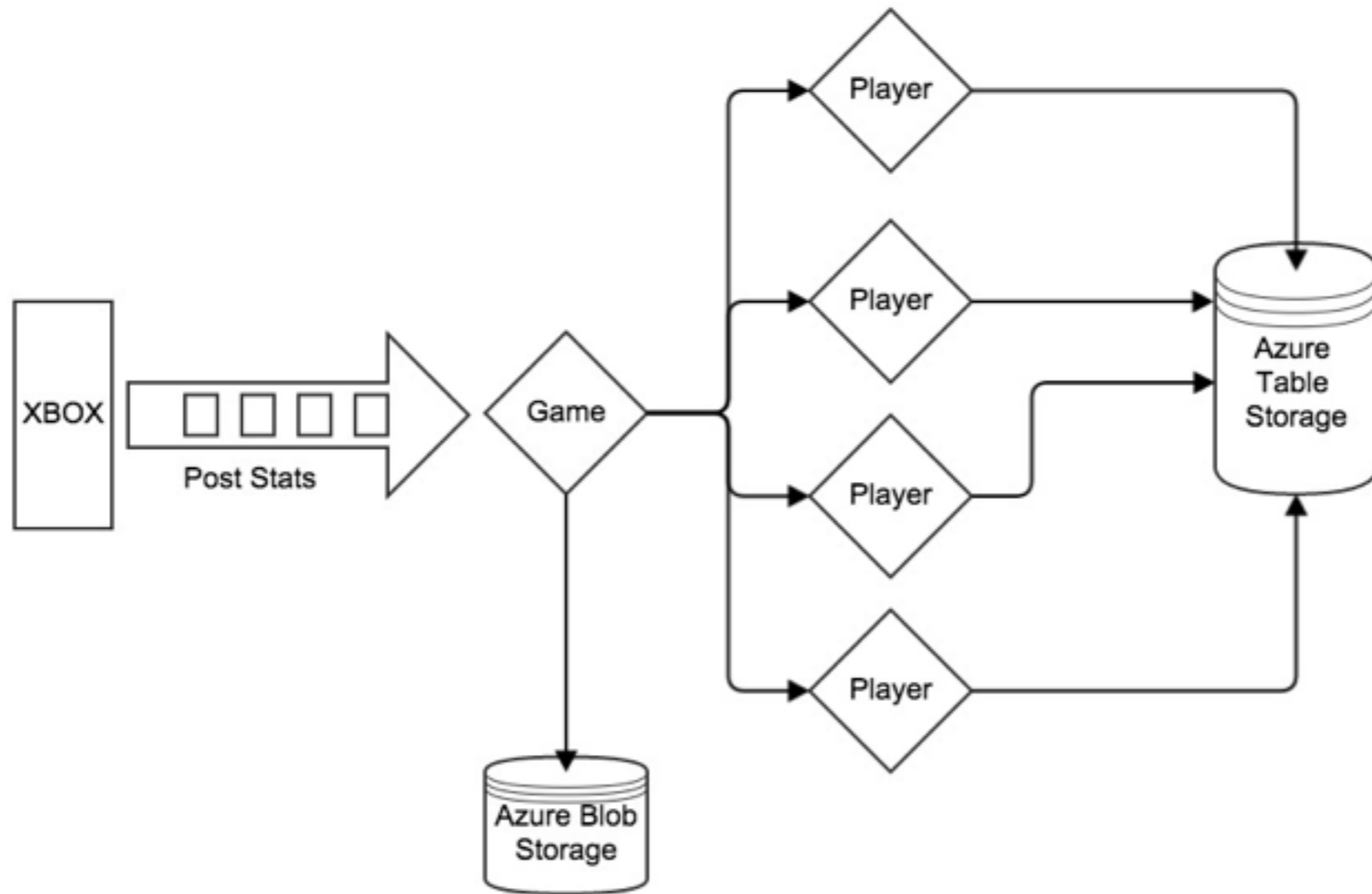
Orleans is AP

- Statefull Services
- Virtual Actor Abstraction
- Self Healing Frameworks

Orleans & Halo







Get Orleans

<https://github.com/dotnet/orleans>

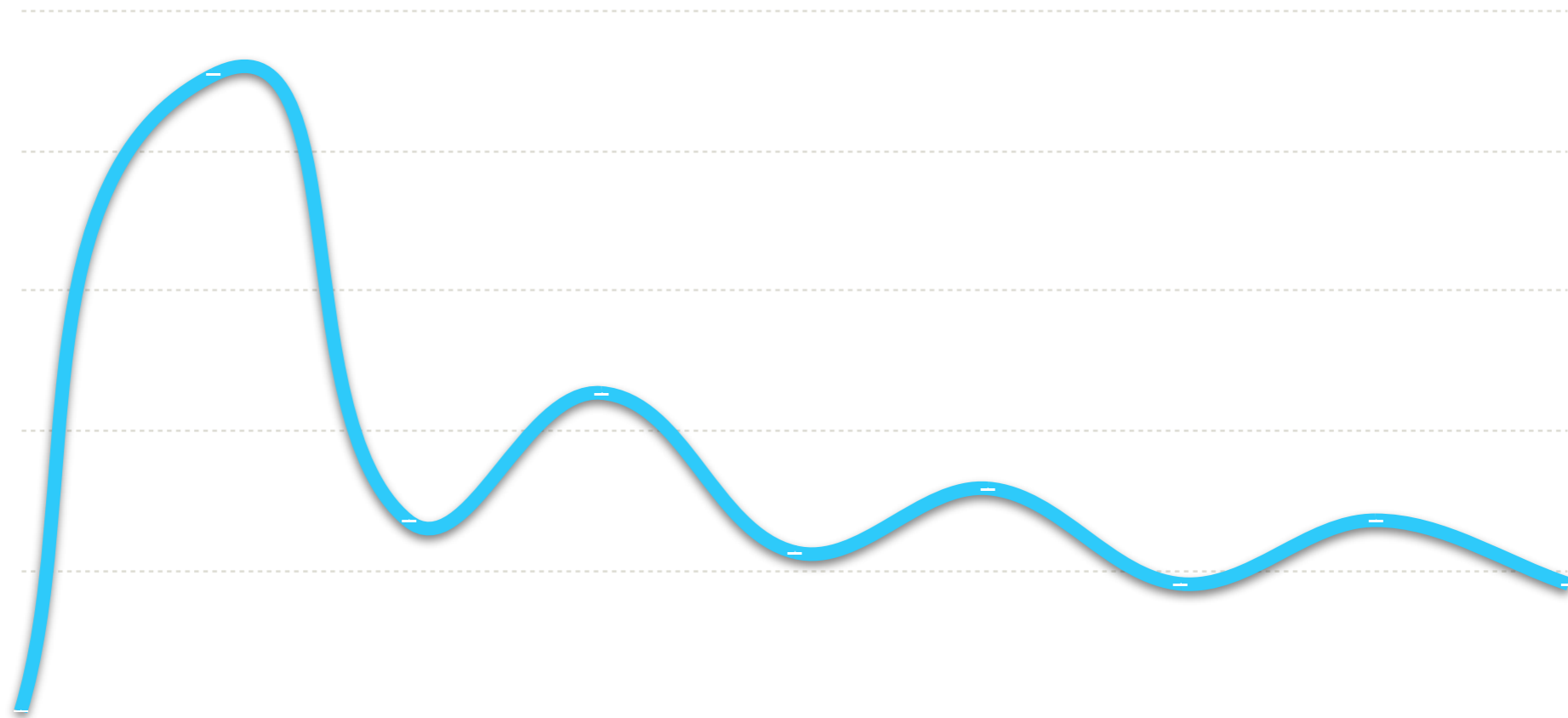
Tales From Production

DevOps

noun

1. The Decisions You Make Now Will Affect the Quality of Sleep You Get Later

Load Patterns



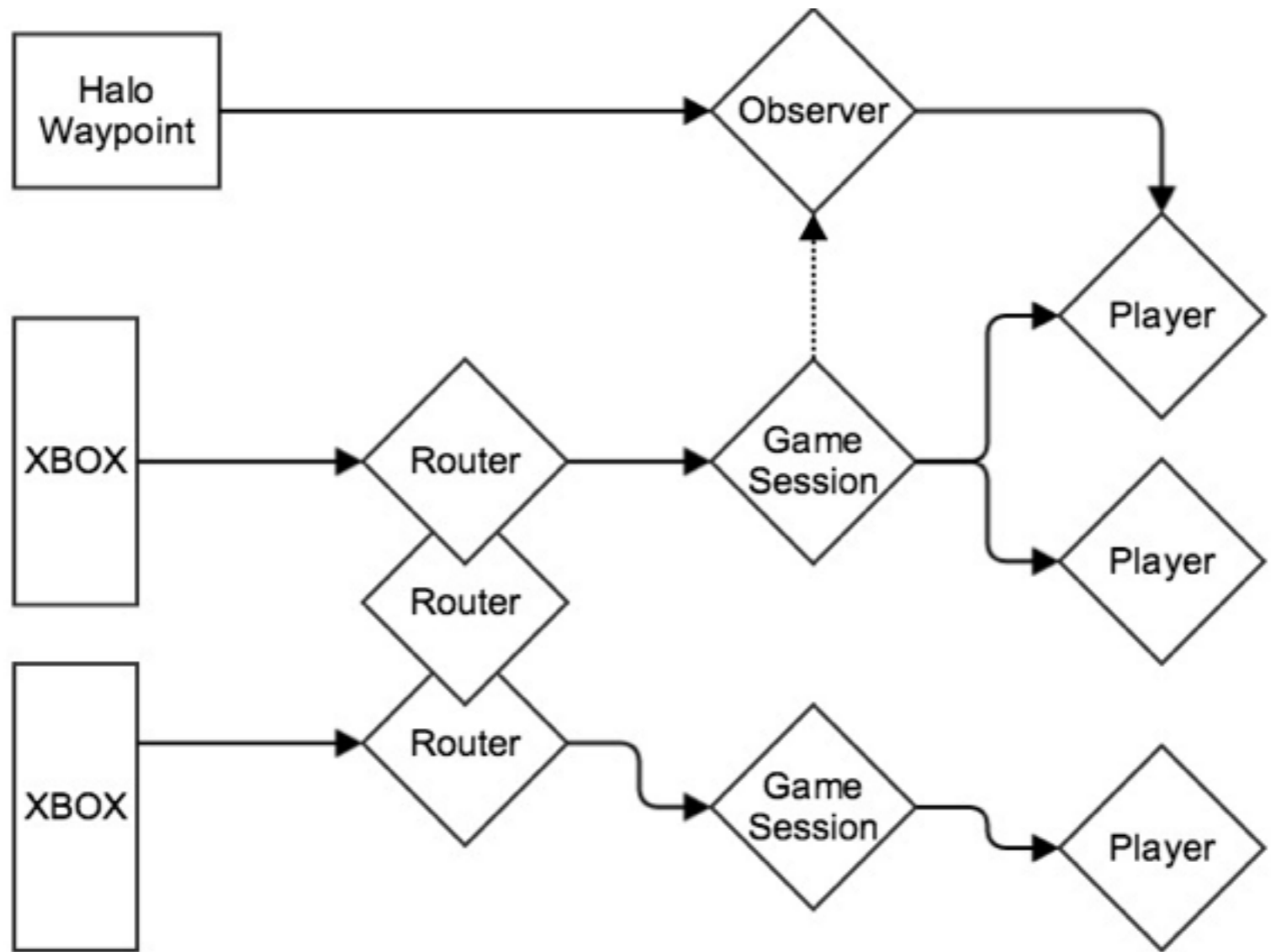
Story: No Data Like Prod Data

aka Halo 4 launch night was not the first time Azure & Orleans saw
Production Data

New Technology

- Orleans: MSR
Technology
- Azure
- Dispatcher

Halo Reach: Presence Service



Memory Leak

Practice DevOps

Story: Validate Dependencies

aka the time we broke Azure Service Bus

STOP WHAT YOU'RE
DOING!!!!

WHAT WERE YOU
DOING???



Jeff, Fun At Parties

@jmhodges



Following

"Who owns my availability" as a service.
whoownsmyavailability.com

(You're a dum dum if you put all the blame for an outage on your provider.)



RETWEETS

48

FAVORITES

13



12:22 PM - 22 Oct 2012

YOU

Recommended reading from selected authors:

Human Error, by James Reason

This reminder is brought to you by [@jmhodges](#) and [@tnm](#).

Backup the Backup

Story: Clients are Jerks

aka remember that time the game DOS'd us at Launch

Different Priorities

Release Valves

Back Pressure

Protect Your Services

Let's Wrap it Up

Distributed Systems

is hard

CAP Theorem

aka why we can't have nice things

Know You're Tradeoffs

hint: you are making one whether you know it or not

Consistency or
Availability

Questions



@Caitie