



WELCOME

From RDBMS to NoSQL at Enterprise Scale



Rick Houlihan
Field CTO - Strategic Accounts

Agenda

The Great Migration - Why did Amazon choose NoSQL?

Blazing a New Trail - Finding the path to database freedom.

Making it Work - Modeling relationships in NoSQL

Executing the Plan - Managing a technology transformation at enterprise scale.



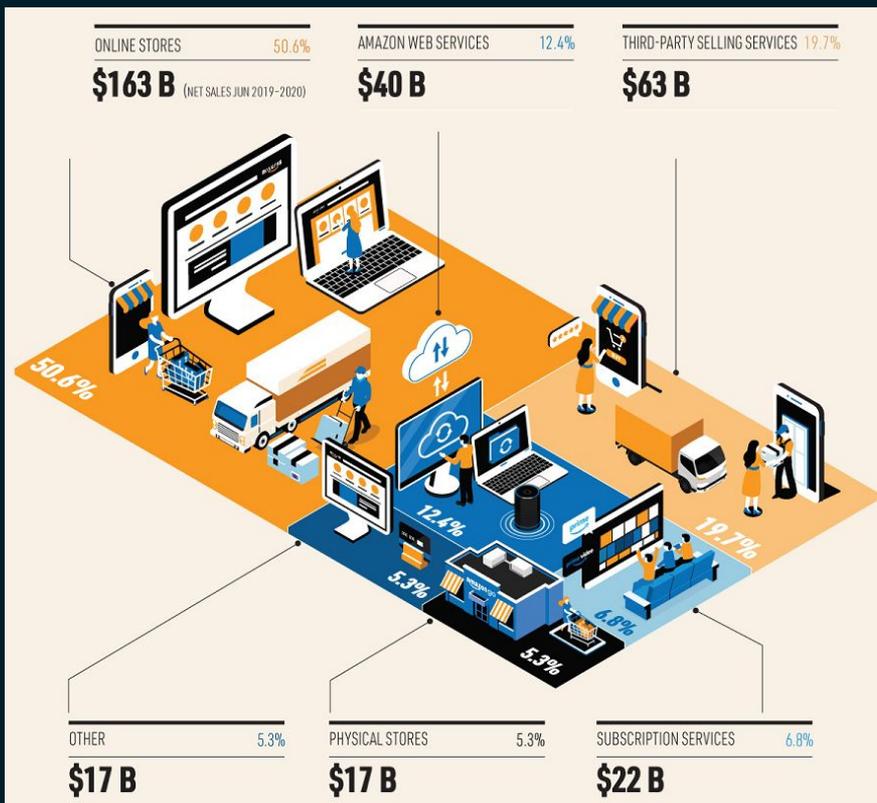
ALL CAPS

The Great Migration - Why NoSQL?

“Change begins at the end of your
comfort zone.”

- Roy T. Bennet

Not really “Born in the Cloud”...



Amazon was founded in 1995 and built on monolithic services.

\$5B company when SOA became an internal standard in 2005.

By 2018 scale was breaking many things

- 3K Oracle instances
- 10K Application Services
- 25K Developers

Cost of RDBMS was a big line item

- Largest Oracle license in the world
- High infrastructure TCO

Maybe a better way?



ALL CAPS

Blazing a New Trail

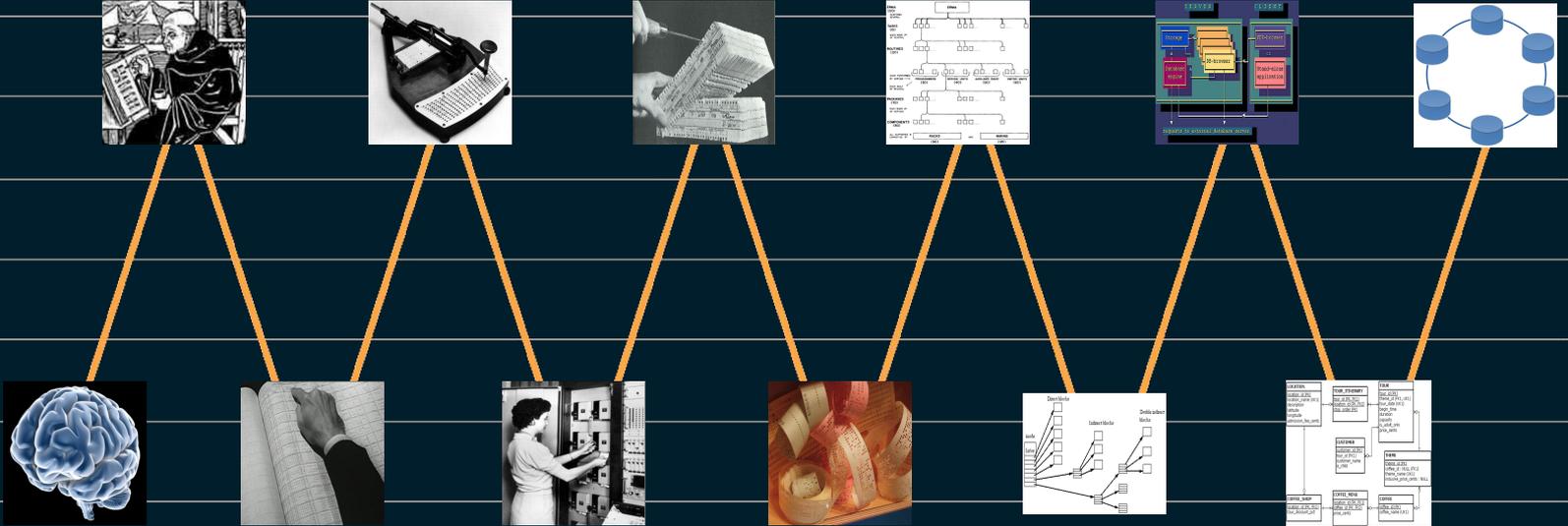
“History repeats itself because nobody listens the first time.”

- Erik Qualman

Timeline of Database Technology



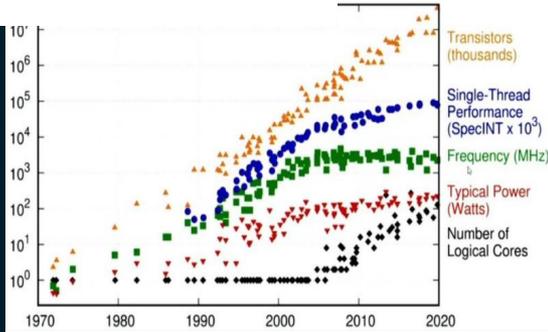
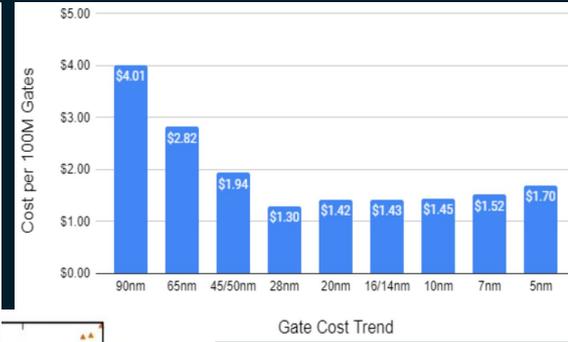
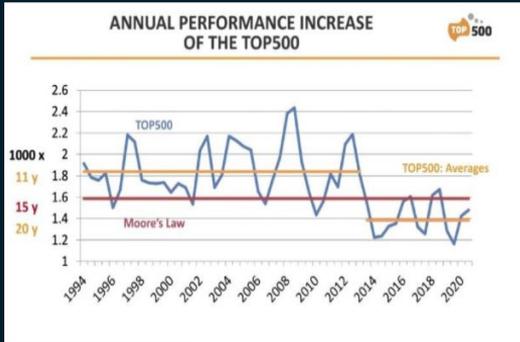
Data Pressure



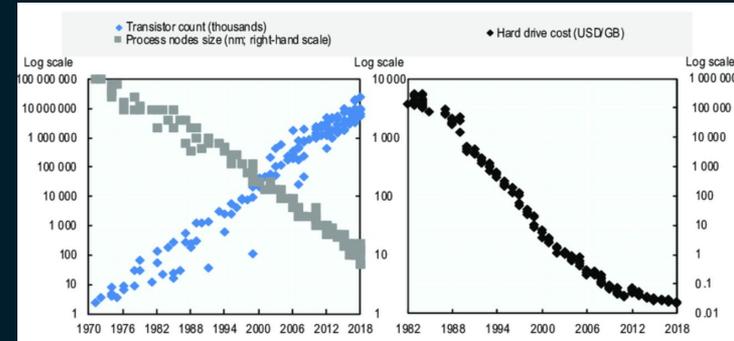
Moore's Law no longer an enabler



CPU performance is flattening



Cost of storage continues to fall



It's not new thinking...



On Normalization:

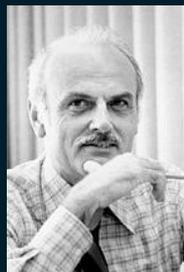
“The simplicity of the array representation which becomes feasible when all relations are cast in normal form is not only an **advantage for storage** purposes but also for **communication of bulk data** between systems which use widely different representations of the data.”

On defining an ERD:

“Ideally, the variety of permitted data representations should be just adequate to cover the spectrum of performance requirements of the total collection of installations. Too great a variety leads to **unnecessary overhead in storage and continual reinterpretation of descriptions** for the structures currently in effect.”

On Denormalization:

“If the strong redundancies in the named set are directly reflected in strong redundancies in the stored set (or if other strong redundancies are introduced into the stored set), then, generally speaking, **extra storage space and update time are consumed with a potential drop in query time for some queries and in load on the central processing units.**”



A Relational Model of Data for Large Shared Data Banks

Edgar Frank "Ted" Codd

19 August 1923 – 18 April 2003

When NoSQL?



SQL

NoSQL

Optimized for storage

Optimized for compute

Normalized/relational

De-normalized/hierarchical

Ad hoc queries

Instantiated views

Scale vertically

Scale horizontally

Good for OLAP

Built for OLTP at scale



ALL CAPS

Making it Work

“Data is like garbage. You’d better know what you are going to do with it before you collect it.”

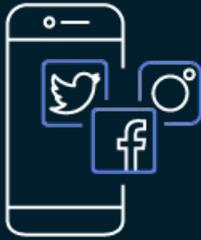
- Mark Twain

But access patterns drive cost



- At Amazon in 2017, 70% of queries accessed a single row of data
- 20% more accessed a range of rows from a single table
- 50% of the infrastructure supported the last 10%

It's all about relationships



Social network



Document management



Process control

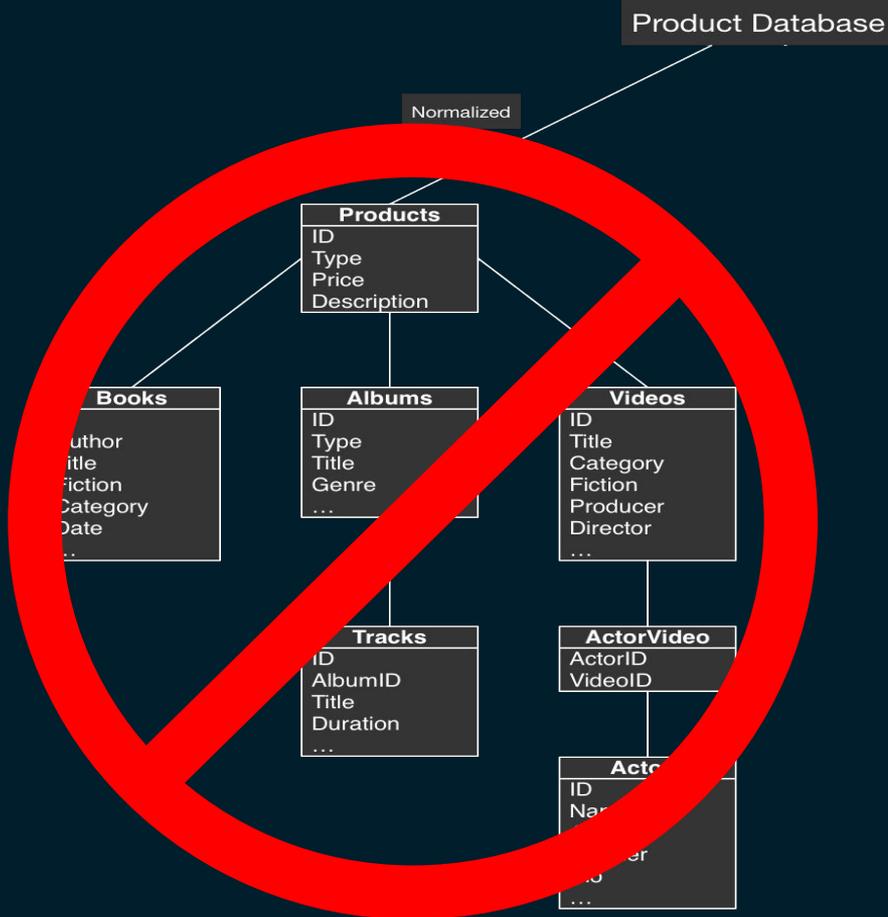


IT monitoring



Data lake

SQL vs. NoSQL design pattern



Ad hoc “joins” in SQL



SELECT * FROM PRODUCTS
INNER JOIN BOOKS ON
productId = productId
WHERE name = “Book Title”

productId	name	type	price
1	Frankenstein	Book	11.99
2	Dire Straits	Album	17.49
3	Big	Video	14.99
4	Jane Eyre	Book	10.99
5	The Dark Side of the Moon	Album	17.49
6	Saving Private Ryan	Video	18.99

SELECT * FROM PRODUCTS
INNER JOIN ALBUMS ON
productId = productId
INNER JOIN TRACKS ON
albumId = albumId
WHERE name = “Album Title”

bookId	productId	author	publisher	ISBN-10
1	1	Mary Shelley	Bantam	553212478
2	4	Charlotte Brontë	Wordsworth	1853260207

albumId	productId	artist	producer	releaseDate
1	2	Dire Straits	Muff Winwood	10/7/78
2	5	Pink Floyd	Pink Floyd	3/1/73

videoId	productId	writer	director	releaseDate
1	3	Ann Spielberg	Penny Marshall	6/5/88
2	6	Robert Rodat	Steven Spielberg	7/21/98

trackId	albumId	song	duration
1	1	Down to the Waterline	3:55
2	1	Water of Love	5:23
3	1	Setting Me Up	3:18
4	1	Six Blade Knife	4:10
5	1	Southbound Again	2:58
6	1	Sultans of Swing	5:47
7	1	In the Gallery	6:16
8	1	Wild West End	4:42
9	1	Lions	5:05
10	2	Speak to Me	1:13
11	2	Breathe	2:43
12	2	On the Run	3:36
13	2	Time	4:36
14	2	The Great Gig in the Sky	19:27
15	2	Money	6:23
16	2	Us and Them	7:49
17	2	Any Colour You Like	3:26
18	2	Brain Damage	3:49
19	2	Eclipse	2:03

SELECT * FROM PRODUCTS
INNER JOIN VIDEOS ON
productId = productId
INNER JOIN ACTORVIDEO ON
videoId = videoId
INNER JOIN ACTORS ON
actorId = actorId
WHERE name = “Movie Title”

actorVideoId	videoId	actorId	character
1	1	1	Josh
2	2	1	Captain Miller
3	1	2	Susan
4	1	3	MacMillan

actorId	gender	name	birthDate
1	M	Tom Hanks	7/9/56
2	F	Elizabeth Perki	11/18/60
3	M	Robert Loggia	1/3/30

Time Complexity

$$O(\log(N) + \log(M) + \log(M) + \log(M) + \log(M))$$

Adding more dimensions...



```
{
  "_id": "Penny Marshall",
  "data": {
    "birthdate": "1943-10-15",
    "deceased": "12-17-2018"
  },
  "target": [
    {"id": "Penny Marshall"},
    {"id": "Big", "type": "movie"}
  ]
},
```

```
{
  "_id": "Tom Hanks",
  "data": {
    "birthdate": "1956-07-09"
  },
  "target": [
    {"id": "Tom Hanks"},
    {"id": "Big", "type": "movie"},
    {"id": "Rita Wilson", "type": "spouse"}
  ]
},
```

```
{
  "_id": "Mary Shelley",
  "data": {
    "birthdate": "1797-08-30",
    "deceased": "1851-02-01"
  },
  "target": [
    {"id": "Mary Shelley"},
    {"id": "Percy Bysshe Shelley", "type": "spouse"},
    {"id": "Frankenstein", "type": "author"}
  ]
},
```

```
{
  "_id": "Sultans of Swing",
  "data": {
    "released": {
      "UK": "1978-19-05",
      "US": "1979-01-01"
    },
    "length": "5:47"
  },
  "target": [
    {"id": "Sultans of Swing"},
    {"id": "Mark Knopfler", "type": "writer"},
    {"id": "Muff Winwood", "type": "producer"},
    {"id": "Basing Street", "type": "studio"},
    {"id": "Vertigo - Warner Bros.", "type": "label"},
    {"id": "Pub rock", "type": "genre"},
    {"id": "Dire Straits", "type": "album"},
    {"id": "Dire Straits", "type": "artist"}
  ]
},
```

Index “joins” in NoSQL



SELECT * WHERE target.id = “Mary Shelley”

SELECT * WHERE target.id = “Sultans of Swing”

SELECT * WHERE target.id = “Tom Hanks”

SELECT * WHERE target.id = “Penny Marshall”

SELECT * WHERE target.id = “musician”: “Dire Straits”

SELECT * WHERE target.id = “Big”

Target Index		
target.id	target.type	_id
“Mary Shelley”	“author”	“Frankenstein”
	“person”	“Mary Shelley”
“Sultans of Swing”	“album”	“Dire Straits”
	“album”	“Best of Dire Straits”
	“artist”	“Dire Straits”
	“song”	“Sultans of Swing”
“Tom Hanks”	“actor”	“Big”
	“actor”	“Saving Private Ryan”
	“person”	“Tom Hanks”
“Penny Marshall”	“director”	“Big”
	“person”	“Penny Marshall”
“Dire Straits”	“album”	“Dire Straits”
	“album”	“Best of Dire Straits”
	“artist”	“Dire Straits”
	“artist”	“Sultans of Swing”
“Big”	“actor”	“Tom Hanks”
	“actor”	“Elizabeth Perkins”
	“actor”	“Robert Loggia”
	“director”	“Penny Marshall”
	“movie”	“Big”

Time Complexity

$O(\log(N))$



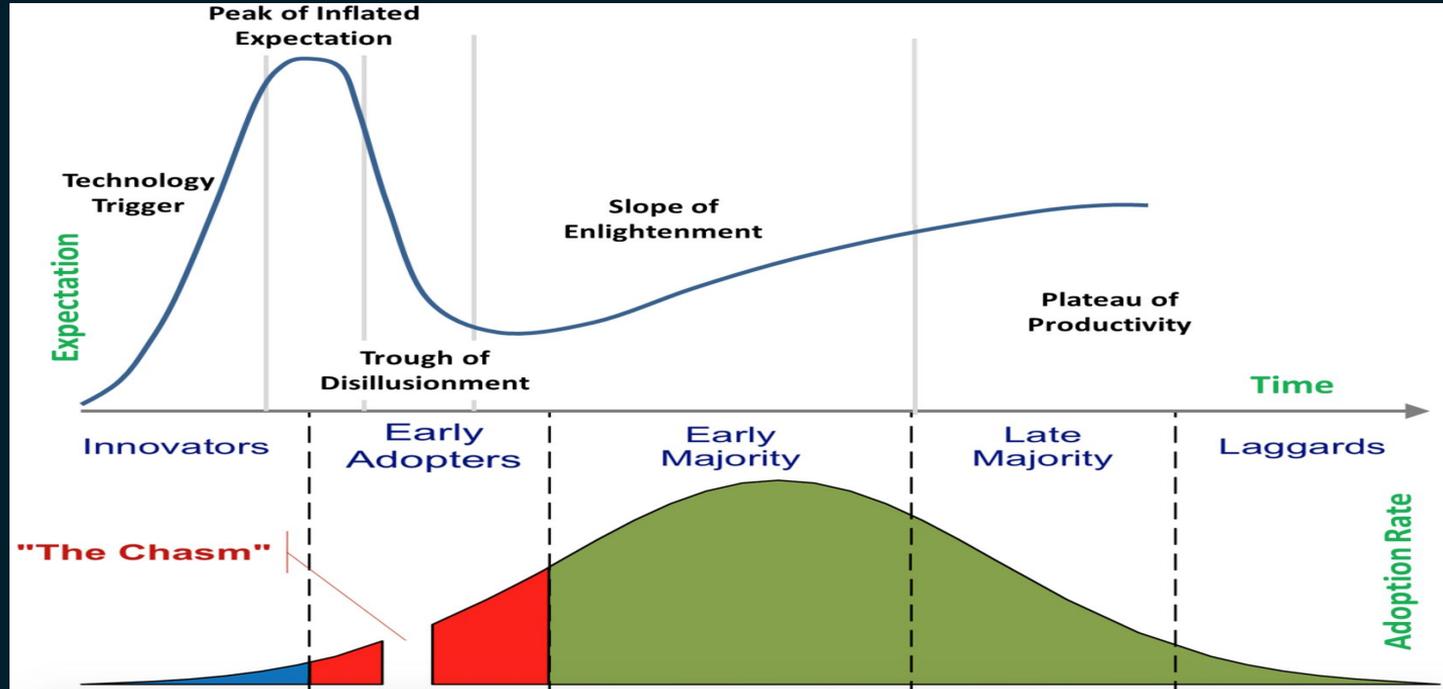
ALL CAPS

Executing the Plan

“Plans are only good intentions unless they immediately degenerate into hard work.”

- Peter Drucker

Technology Adoption and the Hype Cycle



Making the Amazon shopping cart work



amazon prime Deliver to Rick Round Rock 78681 All

All Amazon Basics Best Sellers Buy Again Books Pet Supplies Health & Household Amazon Business Kindle Books Handmade Personal Shopper

Hi Rick, add a **debit card** to your Amazon account today.

Shopping Cart

[Deselect all items](#)

		Price
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro Intelligent Flight Battery Plus In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: 47-min max flight time Qty: 1 <input type="button" value="Delete"/> <input type="button" value="Save for later"/></p>	\$94.99
<input checked="" type="checkbox"/>	 <p>Freewell All Day ND Filters 6Pack Compatible with Mini 3 Pro In Stock prime & FREE Returns <input type="checkbox"/> This is a gift Learn more Qty: 1 <input type="button" value="Delete"/> <input type="button" value="Save for later"/> <input type="button" value="Compare with similar items"/></p>	\$49.99
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro (DJI RC) - Lightweight and Foldable Camera Drone with 4K/60fps Video, 48MP Photo, 34-min Flight Time, Tri-Directional Obstacle Sensing, Ideal for Aerial Photo... In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: DJI Mini 3 Pro (DJI RC) Qty: 1 <input type="button" value="Delete"/> <input type="button" value="Save for later"/> <input type="button" value="Compare with similar items"/></p>	\$909.00
Subtotal (3 items): \$1,053.98		

Making the Amazon shopping cart work



amazon prime Deliver to Rick Round Rock 78681 All

Hi Rick, add a debit card to your Amazon account today. Add a Card

Shopping Cart

Deselect all items

		Price
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro Intelligent Flight Battery Plus In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: 47-min max flight time Qty: 1 Delete Save for later</p>	\$94.99
<input checked="" type="checkbox"/>	 <p>Freewell All Day ND Filters 6Pack Compatible with Mini 3 Pro In Stock prime & FREE Returns <input type="checkbox"/> This is a gift Learn more Qty: 1 Delete Save for later Compare with similar items</p>	\$49.99
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro (DJI RC) - Lightweight and Foldable Camera Drone with 4K/60fps Video, 48MP Photo, 34-min Flight Time, Tri-Directional Obstacle Sensing, Ideal for Aerial Photo... In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: DJI Mini 3 Pro (DJI RC) Qty: 1 Delete Save for later Compare with similar items</p>	\$909.00
Subtotal (3 items):		\$1,053.98

1 KB = 1 WCU

Making the Amazon shopping cart work



amazon prime Deliver to Rick Round Rock 78681 All

Hi Rick, add a debit card to your Amazon account today. Add a Card

Shopping Cart

Deselect all items

		Price
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro Intelligent Flight Battery Plus In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: 47-min max flight time Qty: 1 Delete Save for later</p>	\$94.99
<input checked="" type="checkbox"/>	 <p>Freewell All Day ND Filters 6Pack Compatible with Mini 3 Pro In Stock prime & FREE Returns <input type="checkbox"/> This is a gift Learn more Qty: 1 Delete Save for later Compare with similar items</p>	\$49.99
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro (DJI RC) - Lightweight and Foldable Camera Drone with 4K/60fps Video, 48MP Photo, 34-min Flight Time, Tri-Directional Obstacle Sensing, Ideal for Aerial Photo... In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: DJI Mini 3 Pro (DJI RC) Qty: 1 Delete Save for later Compare with similar items</p>	\$909.00
Subtotal (3 items):		\$1,053.98

2 KB = 2 WCU

Making the Amazon shopping cart work



amazon prime Deliver to Rick Round Rock 78681 All

Hi Rick, add a debit card to your Amazon account today. Add a Card

Shopping Cart

Deselect all items

		Price
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro Intelligent Flight Battery Plus In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: 47-min max flight time Qty: 1 Delete Save for later</p>	\$94.99
<input checked="" type="checkbox"/>	 <p>Freewell All Day ND Filters 6Pack Compatible with Mini 3 Pro In Stock prime & FREE Returns <input type="checkbox"/> This is a gift Learn more Qty: 1 Delete Save for later Compare with similar items</p>	\$49.99
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro (DJI RC) - Lightweight and Foldable Camera Drone with 4K/60fps Video, 48MP Photo, 34-min Flight Time, Tri-Directional Obstacle Sensing, Ideal for Aerial Photo... In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: DJI Mini 3 Pro (DJI RC) Qty: 1 Delete Save for later Compare with similar items</p>	\$909.00

Subtotal (3 items): \$1,053.98

3 KB = 3 WCU

Making the Amazon shopping cart work



amazon prime Deliver to Rick Round Rock 78681 All

Hi Rick, add a debit card to your Amazon account today. Add a Card

Shopping Cart

Deselect all items

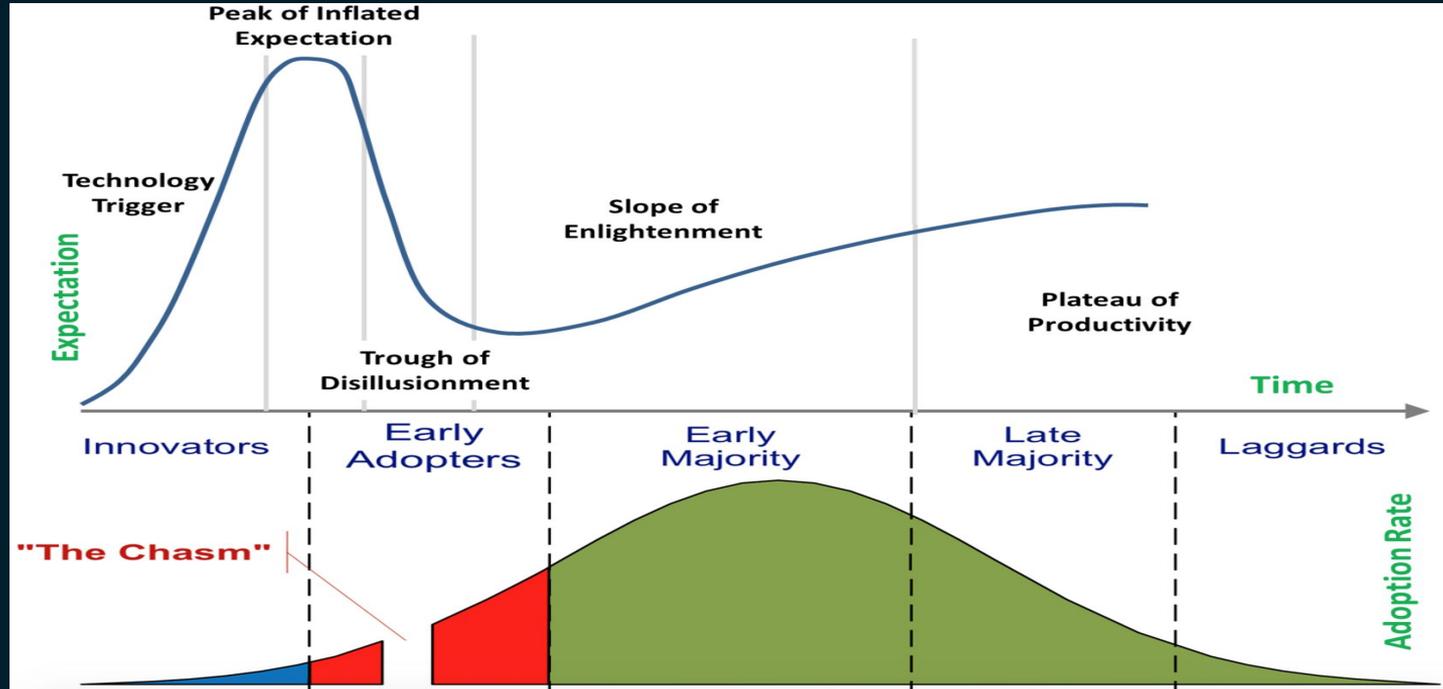
		Price
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro Intelligent Flight Battery Plus In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: 47-min max flight time Qty: 1 Delete Save for later</p>	\$94.99
<input checked="" type="checkbox"/>	 <p>Freewell All Day ND Filters 6Pack Compatible with Mini 3 Pro In Stock prime & FREE Returns <input type="checkbox"/> This is a gift Learn more Qty: 1 Delete Save for later Compare with similar items</p>	\$49.99
<input checked="" type="checkbox"/>	 <p>DJI Mini 3 Pro (DJI RC) - Lightweight and Foldable Camera Drone with 4K/60fps Video, 48MP Photo, 34-min Flight Time, Tri-Directional Obstacle Sensing, Ideal for Aerial Photo... In Stock prime Eligible for FREE Same-Day, Overnight or Tomorrow delivery & FREE Returns <input type="checkbox"/> This is a gift Learn more Style: DJI Mini 3 Pro (DJI RC) Qty: 1 Delete Save for later Compare with similar items</p>	\$909.00
Subtotal (3 items):		\$1,053.98

1 KB

1 KB

1 KB

Technology Adoption and the Hype Cycle



Dive Deep on NoSQL at MongoDB Day



Tailored engagements to accelerate projects

- Detailed exploration of NoSQL Data Modeling
- Breakout content covering specific areas of interest
- Whiteboard sessions with subject matter experts
- Reach out to your Account Rep today

MongoDB Design Reviews

A one hour whiteboard session with a MongoDB data modeler where individual development teams can explore how your own workloads might be supported by a NoSQL backend.

Value

Expertise

Our Developer Relations team has decades of experience that will benefit teams by preventing common mistakes that can significantly impact cost and performance.

Outcome

Design a data model in real time and leave the session with a documented data model and enough knowledge to iterate and optimise the design on your own.

Next Steps

What to expect

Discussions are focused on driving efficiency at the database layer. Logical data models will be discussed using generic entity relationship diagrams - no customer data will be reviewed.

How to book

Scan the QR Code

To book your one-hour session through the dedicated developer center for your company.



Conclusions

NoSQL does not mean non-relational

The ERD still matters

RDBMS efficiency is declining

NoSQL is a great fit for most OLTP workloads

The MongoDB API supports OLAP just as well

Thank you for
your time.

