



Ruimteschepper KennisKring

GIS MET LOCATIE IN DE ZORG

ruimteschepper

Emil Zegers
Senior Solutions Architect
emil.zegers@mongodb.com
20211209

Agenda

My (spatial) history

MongoDB

Use cases

What is ~~next~~ now?

Q&A

MAP OF THE PLANET MONGO

MONGO IS APPROXIMATELY ONE HALF THE DIAMETER OF EARTH BUT HAS A GRAVITATIONAL DENSITY THAT IS ONLY SLIGHTLY LESS. IT IS A RELATIVELY YOUNG WORLD WITH TOWERING MOUNTAINS NOT YET WORN SMOOTH BY TIME AND MANY AREAS OF VOLCANIC ACTIVITY. ITS VEGETATION IS STILL LIMITED TO ISOLATED AREAS OF BOTANICAL GIANTS. BIOLOGICALLY, IT IS STILL IN THE ERA OF REPTILIAN GIANTS. MAN EVOLVED FAST INTO DIVERSE RACES, MANY OF WHICH POSSESS AMAZINGLY ADVANCED TECHNOLOGY WHILE OTHERS STILL LIVE IN PRIMITIVE AND UNEXPLORED REGIONS.



My (spatial) history so far

IAH Larenstein - Remote Sensing and GIS research in Negros, Philippines

provincie Zuid-Holland - Bureau Kartografie & GIS, from ArcInfo7 on AS400 to Windows NT, first Esri IMS-es

Esri - Rijkswaterstaat Waterst@t, Waterschappen (INTWIS), first WMS and WFS implementation in ArcIMS

De Straat Milieuadviseurs/Syncera - OSGIS like UMN MapServer, developing on StraBIS, StraGIS, Globis

PBBI MapInfo - Supported site location analysis for IKEA worldwide, lots of retail, OOV and logistics cases

MarkLogic - Kadaster, Defensie, PLDN, mixing the spatial world with real time operational dimensions

Sensing Clues - Operational wildlife conservation, check out <https://sensingclues.org/> and join as a volunteer!

MongoDB - TomTom, Picnic, ... *more on that in a minute*





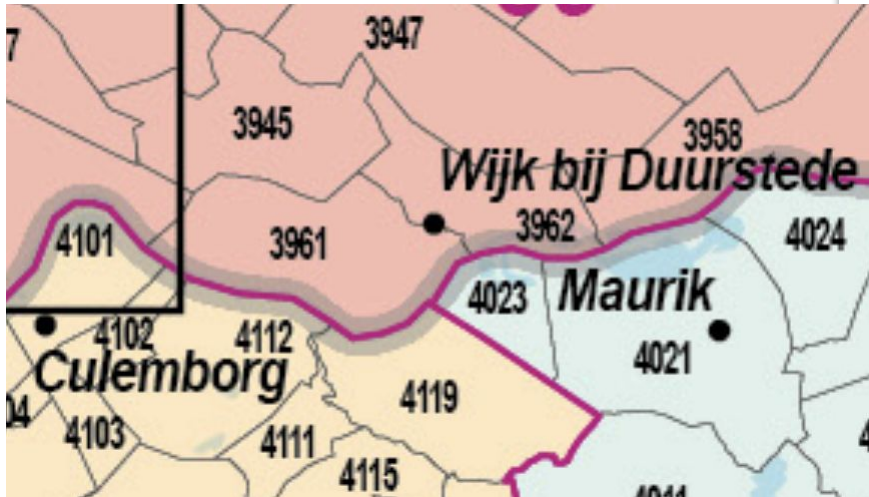
Sensing Clues

TURNING WILD SPACES INTO SAFE HAVENS



Been there: find closest zipcode / shortest route to location

$(4119 - 3961) < (3961 - 3958)$



De Telegraaf

NIEUWS

SPORT

ENTERTAINMENT

FINANCIËEL

VROUW

LIFESTYLE

WAT U ZEGT

Hulpdiensten werden naar de verkeerde locatie gestuurd.



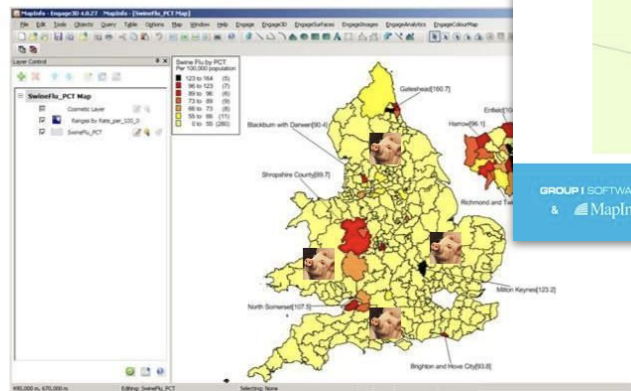
© PETER SHOTNEWS

LI in de gezondheidszorg
UMC St Radboud Ziekenhuis

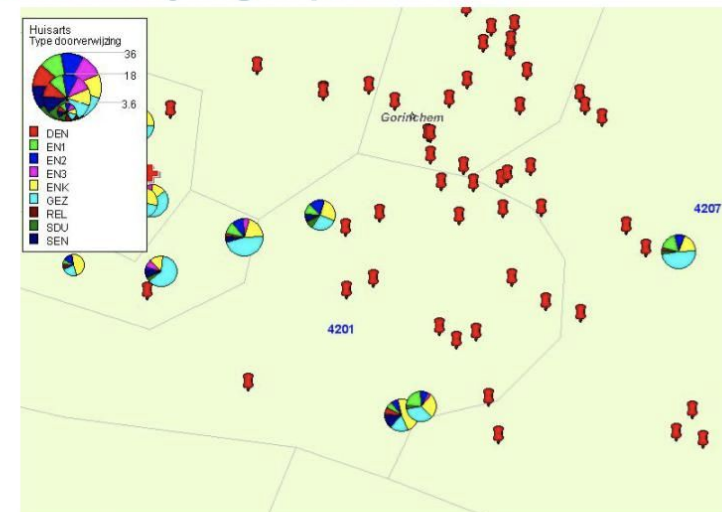
Emil Zegers, Systems Engineer
PBBI Benelux
emil.zegers@pb.com



Mexicaanse griep - Ver van huis?



Doorverwijzingen per huisarts

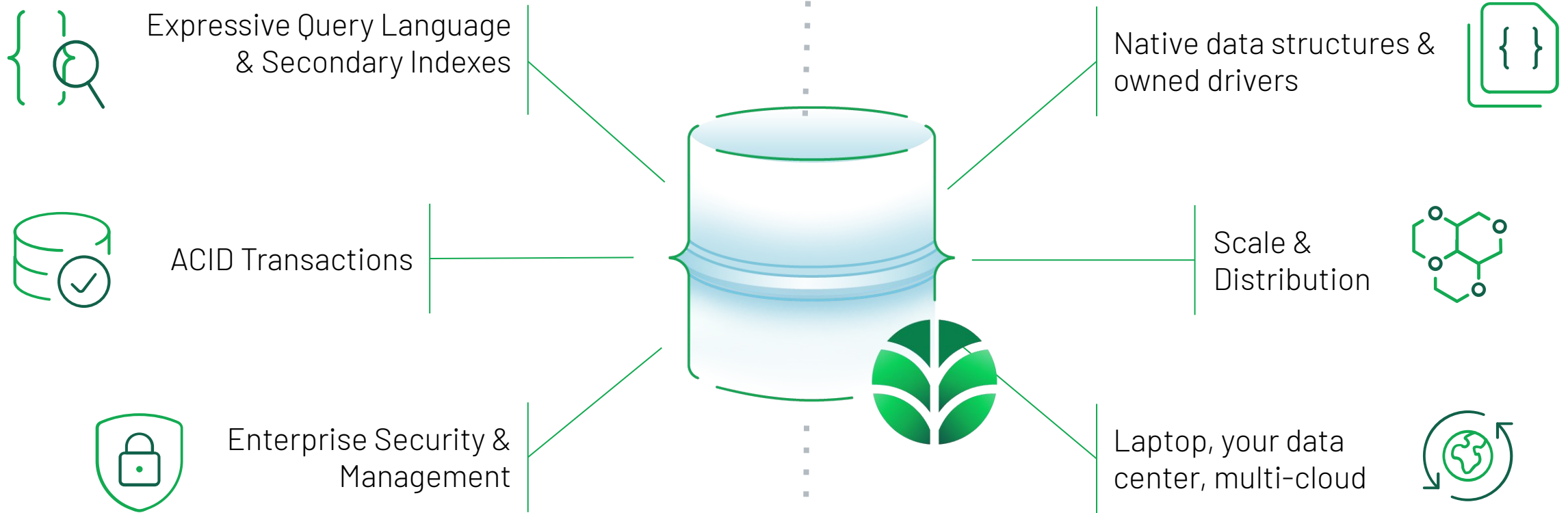




MongoDB

MongoDB is a business critical general purpose operational application data platform

The ultimate combination of all data paradigms



Traditional Relational Strengths

Additional NoSQL and Big Data Strengths and Innovations

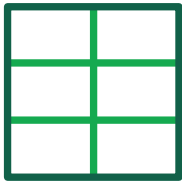


Documents are Universal

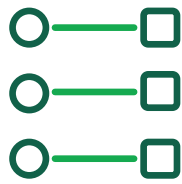
JSON Documents are the modern standard in today's application stacks



*JSON
Documents*



Tabular



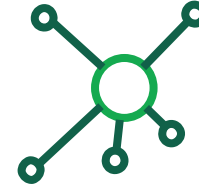
Key-Value



Text



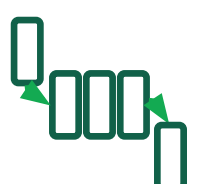
Geospatial



Graph



File Storage



Events

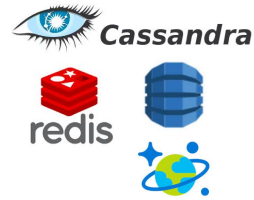
Model and Query Data Any Way You Need

Point | Range | Geospatial | Rich Search | Aggregations | JOINS & UNIONS | Graph Traversals

All wrapped in a single API, giving a consistent experience for any workload



Reduce Complexity



JSON Documents

Relational

Key-Value

Search

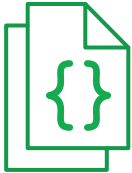
Data Lake

Graph

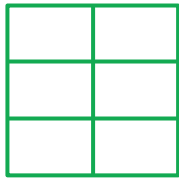
Time Series



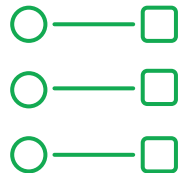
Geospatial



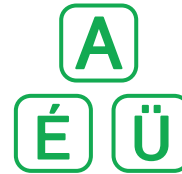
JSON Documents



Joins



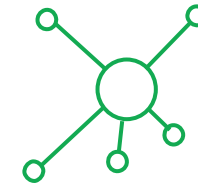
Key-Value



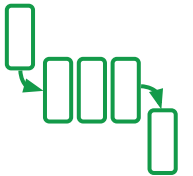
Search



Data Lake



Graph



Events

MongoDB Cloud Data Platform



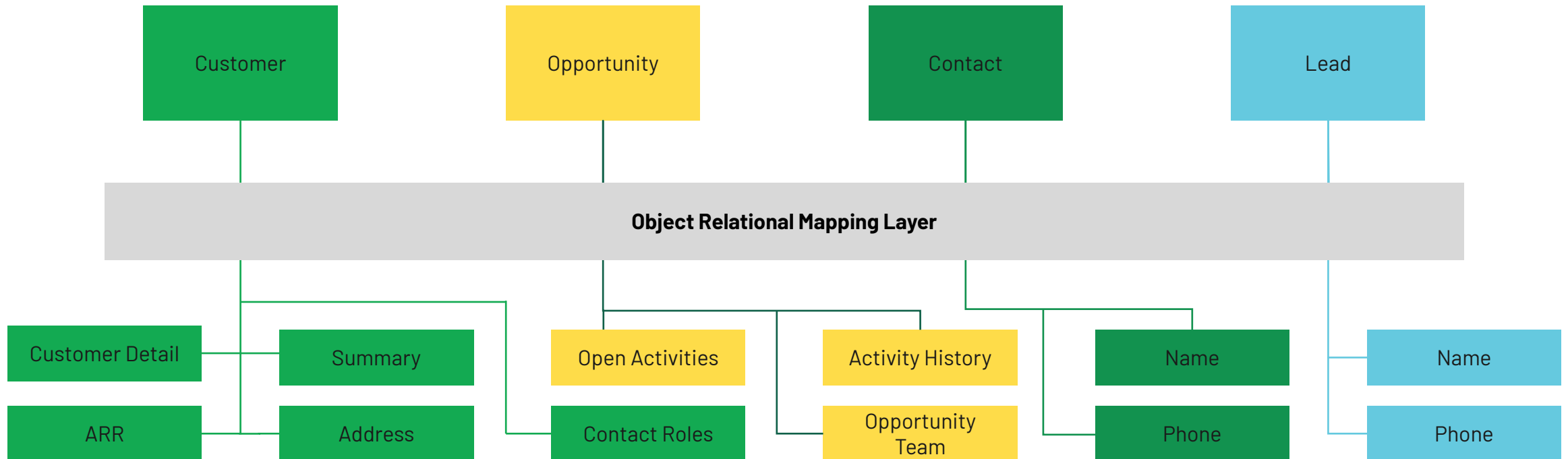


The document model



Go from this....

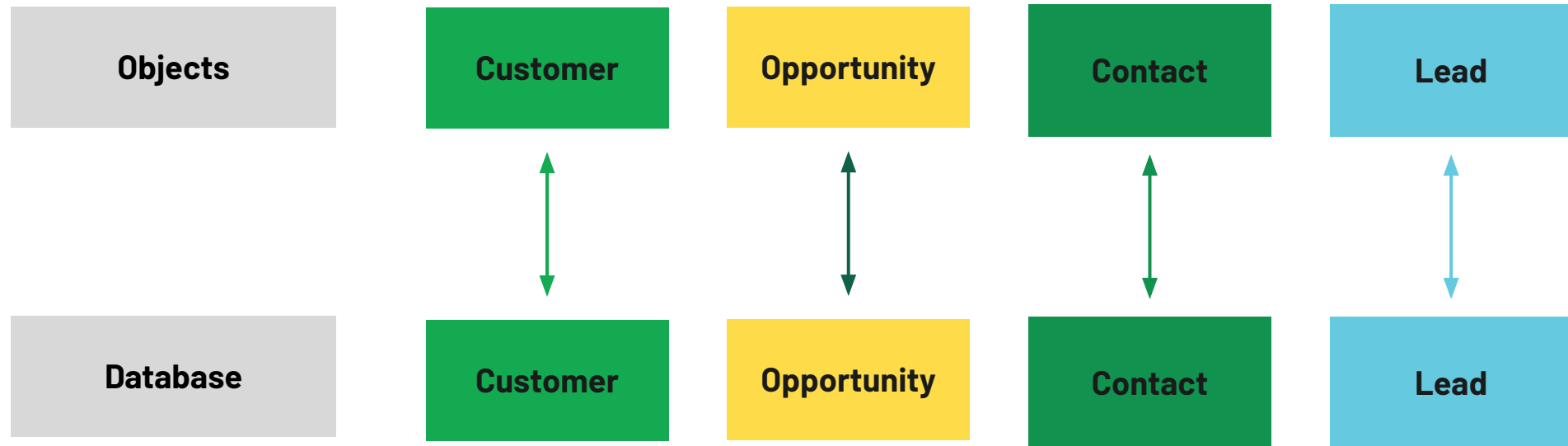
Objects



Tables

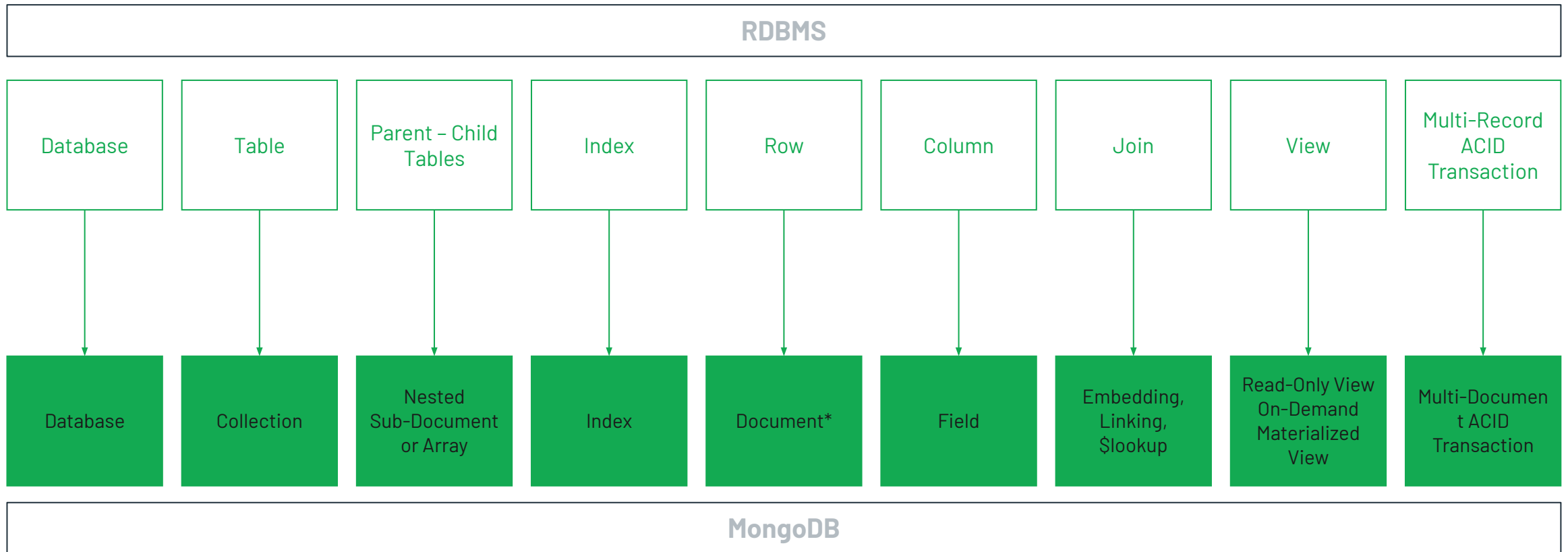


To this: store objects directly...



Some Terminology

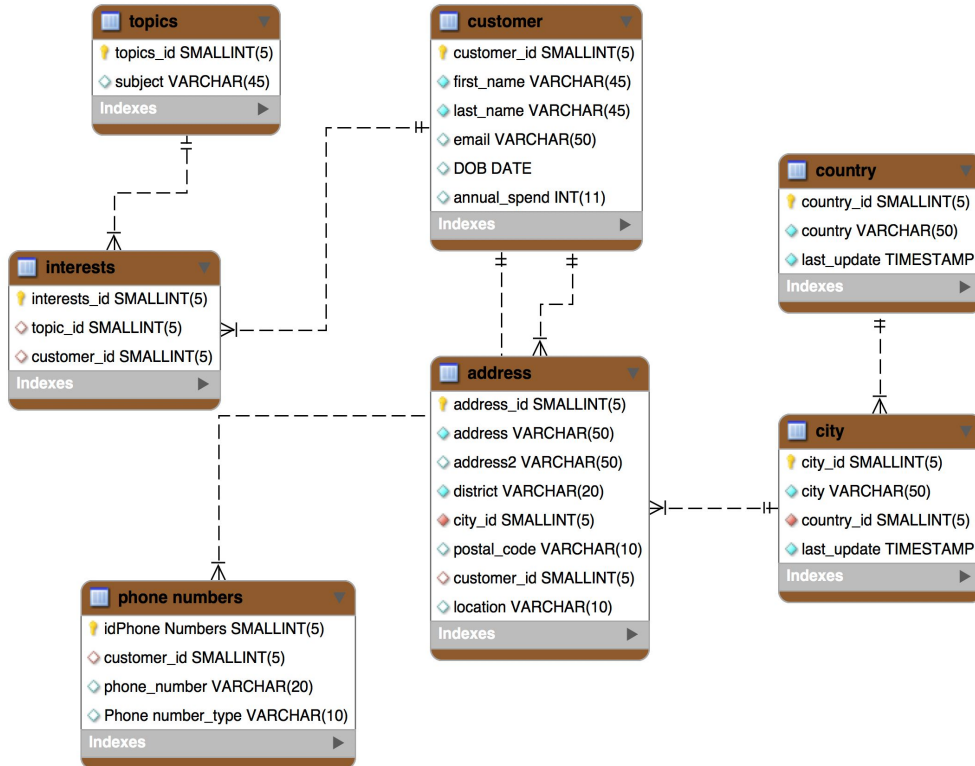
A comparison



* Proper document schema design yields more entity data per document than found in a relational database row



Intuitive: Contrasting data models



Tabular (Relational) Data Model

Related data split across multiple records and tables

```
{
  "_id" : ObjectId("5ad88534e3632e1a35a58d00"),
  "name" : {
    "first" : "John",
    "last" : "Doe" },
  "address" : [
    { "location" : "work",
      "address" : {
        "street" : "16 Hatfields",
        "city" : "London",
        "postal_code" : "SE1 8DJ" },
      "geo" : { "type" : "Point", "coord" : [
        51.5065752, -0.109081 ] } },
    { ... }
  ],
  "dob" : ISODate("1977-04-01T05:00:00Z"),
  "retirement_fund" : NumberDecimal("1292815.75")
}
```

Document Data Model

Related data contained in a single, rich document



Intuitive: Document data model

- Naturally maps to objects in code
 - Eliminates requirements to use ORMs
 - Breaks down complex interdependencies between developer and DBAs teams
- Represent data of any structure
 - Polymorphic: each document can contain different fields
 - Modify the schema at any time
- Strongly typed for ease of processing
 - Over 20 binary encoded JSON data types
- Access by idiomatic drivers in all major programming language

```
{
  "_id" : ObjectId("5ad88534e3632e1a35a58d00"),
  "name" : {
    "first" : "John",
    "last" : "Doe" },
  "address" : [
    { "location" : "work",
      "address" : {
        "street" : "16 Hatfields",
        "city" : "London",
        "postal_code" : "SE1 8DJ"},
      "geo" : { "type" : "Point", "coord" : [
        51.5065752,-0.109081]}}],
    + { ... }
  ],
  "dob" : ISODate("1977-04-01T05:00:00Z"),
  "retirement_fund" : NumberDecimal("1292815.75")
}
```



Flexible: Adapt to change

```
{
  "_id" : ObjectId("5ad88534e3632e1a35a58d00"),
  "name" : {
    "first" : "John",
    "last" : "Doe" },
  "address" : [
    { "location" : "work",
      "address" : {
        "street" : "16 Hatfields",
        "city" : "London",
        "postal_code" : "SE1 8DJ"},
      "geo" : { "type" : "Point", "coord" : [
        51.5065752,-0.109081]}}}
    + { ... }
  ],
  "dob" : ISODate("1977-04-01T05:00:00Z"),
  "retirement_fund" : NumberDecimal("1292815.75")
}
```

```
{
  "_id" : ObjectId("5ad88534e3632e1a35a58d00"),
  "name" : {
    "first" : "John",
    "last" : "Doe" },
  "address" : [
    { "location" : "work",
      "address" : {
        "street" : "16 Hatfields",
        "city" : "London",
        "postal_code" : "SE1 8DJ"},
      "geo" : { "type" : "Point", "coord" : [
        51.5065752,-0.109081]}}}
    + { ... }
  ],
  "phone" : [
    { "location" : "work",
      "number" : "+44-1234567890"},
    + { ... }
  ],
  "dob" : ISODate("1977-04-01T05:00:00Z"),
  "retirement_fund" : NumberDecimal("1292815.75")
}
```

Add new fields dynamically at runtime





MongoDB and Geospatial

Why the need for an application data platform?

Multi modal NoSQL operational data platforms including geospatial are an enabler for high value, high volume, high security, high performance business cases.

(Geo)data is a living thing that keeps on changing forever. Data is handled by more and more software every day. Software is created by developers. To enhance business value you need to improve developer productivity. For that flexibility and easy data integration, combined with working with short feedback cycles from customer to business to developer in short sprints is key.

That is where the traditional players lose ground because their platforms do not enable change and innovation fast enough.

Why I believe in using a data platform for spatial?

Because NoOps! The data is there, in larger volumes, complete and more up to date than ever. You can't afford to spend time on keeping it running.

The operational data platform is a must have, with additional specialized GIS tooling, it is the only way for flexible data integration while not getting behind real-time.

The data value itself is not in scalability/security/performance, but these non-functional requirements are essential for business critical environments.

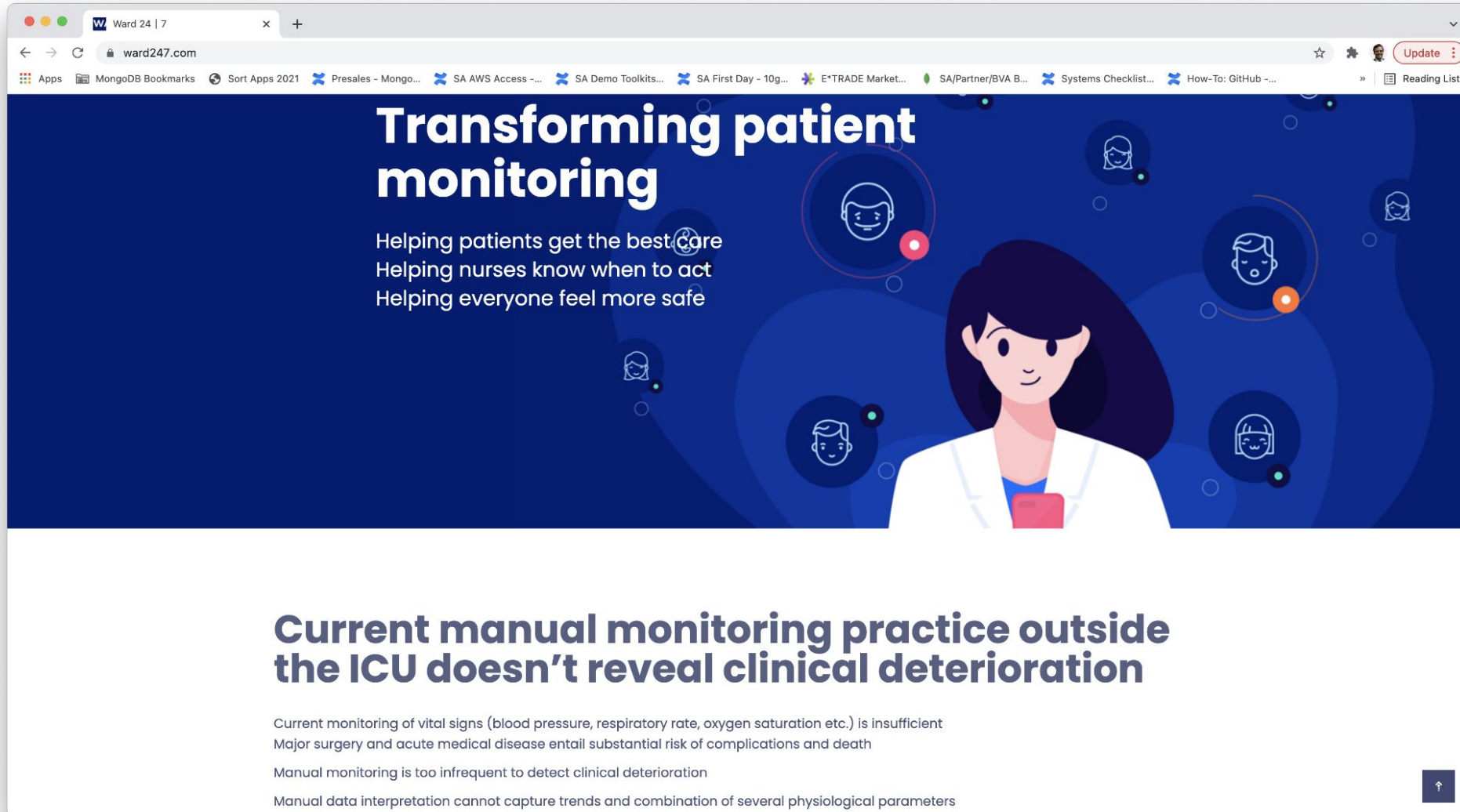
Esri states “The science of where”, I support that by adding “the **business value** of location”, it is (literally) another dimension on your data your daily operations need.



Use cases

Ward 24/7

(Health)care becomes location and time independent

A screenshot of a web browser displaying the 'Ward 24/7' website. The browser's address bar shows 'ward247.com'. The website has a dark blue header with the title 'Transforming patient monitoring' in white. Below the title, three bullet points are listed: 'Helping patients get the best care', 'Helping nurses know when to act', and 'Helping everyone feel more safe'. The background of the header features a stylized illustration of a nurse in a white coat holding a red smartphone, surrounded by several circular icons containing faces with different expressions. The main content area has a white background and contains the heading 'Current manual monitoring practice outside the ICU doesn't reveal clinical deterioration' in bold. Below this heading, four lines of text describe the limitations of current manual monitoring: 'Current monitoring of vital signs (blood pressure, respiratory rate, oxygen saturation etc.) is insufficient', 'Major surgery and acute medical disease entail substantial risk of complications and death', 'Manual monitoring is too infrequent to detect clinical deterioration', and 'Manual data interpretation cannot capture trends and combination of several physiological parameters'. A small upward-pointing arrow icon is located in the bottom right corner of the website's content area.

Transforming patient monitoring

Helping patients get the best care
Helping nurses know when to act
Helping everyone feel more safe

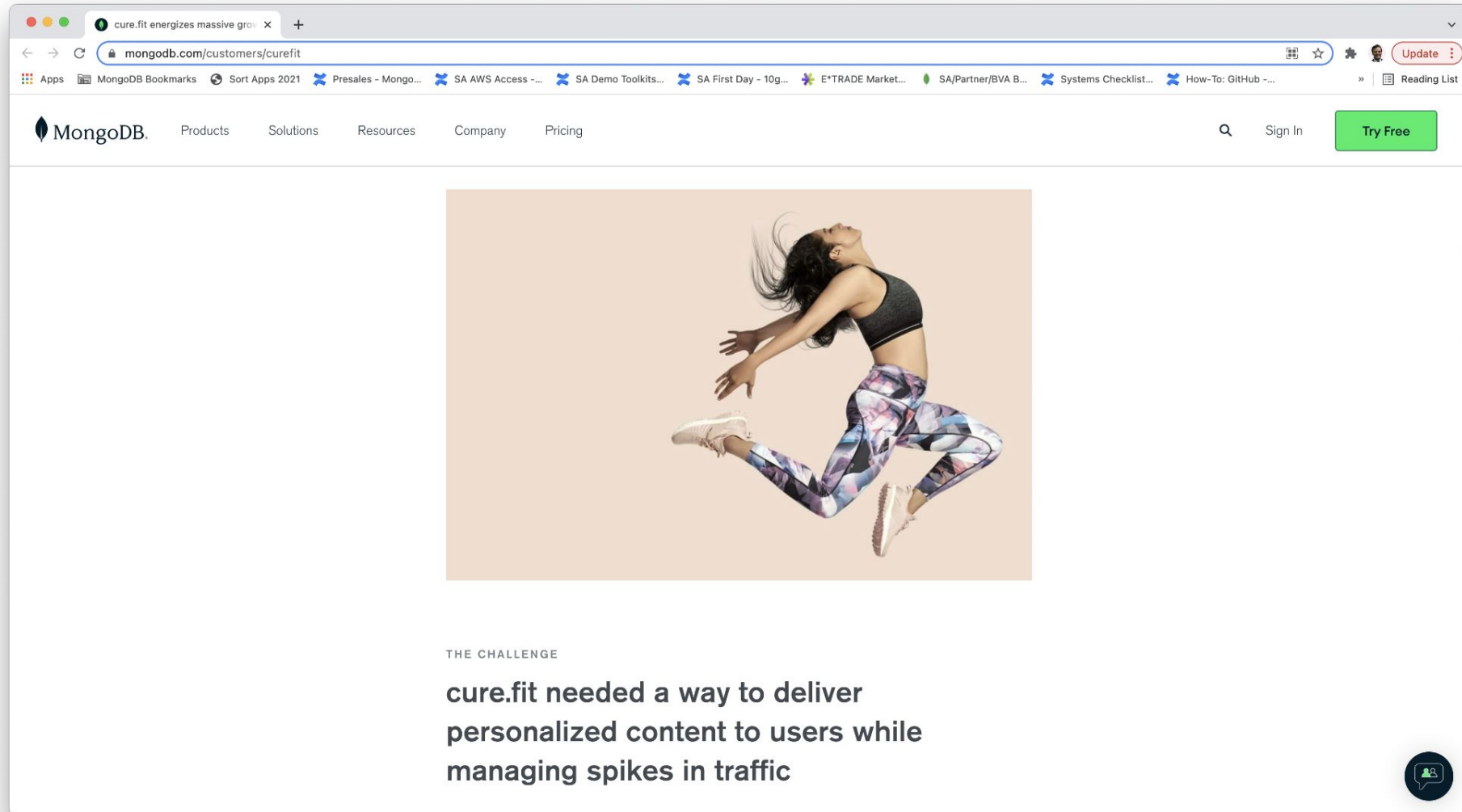
Current manual monitoring practice outside the ICU doesn't reveal clinical deterioration

Current monitoring of vital signs (blood pressure, respiratory rate, oxygen saturation etc.) is insufficient
Major surgery and acute medical disease entail substantial risk of complications and death
Manual monitoring is too infrequent to detect clinical deterioration
Manual data interpretation cannot capture trends and combination of several physiological parameters



Cure.fit

Focus moves from cure to care, and welfare*

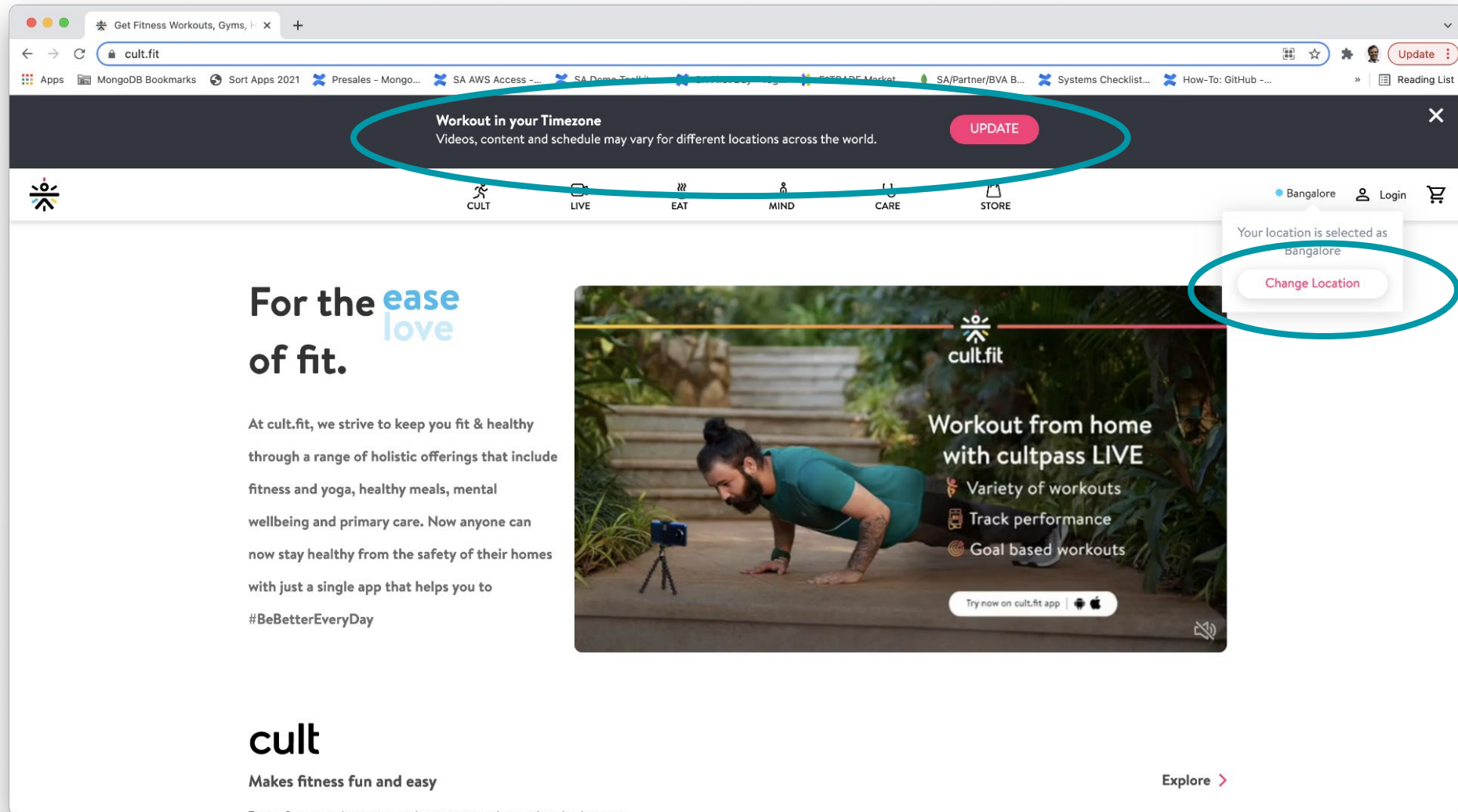


**) I stole borrowed this tagline... added welfare*



Cure.fit

So IT becomes even more location and person aware



Genomics UK

... even at microscopic level

The 100,000 Genomes Project in numbers



100,000 genomes



70,000 patients and family members

110001010101001010100101010000101
110110111010101010001011101000101
110101010001001101010001010100010
001001001110010001000010101010100
10011101100101010110101111001101

21 Petabytes of data.
1 Petabyte of music would take 2,000 years to play on an MP3 player.



13 Genomic Medicine Centres, and
85 NHS Trusts within them are involved in recruiting participants



1,500 NHS staff
(doctors, nurses, pathologists, laboratory staff, genetic counsellors)

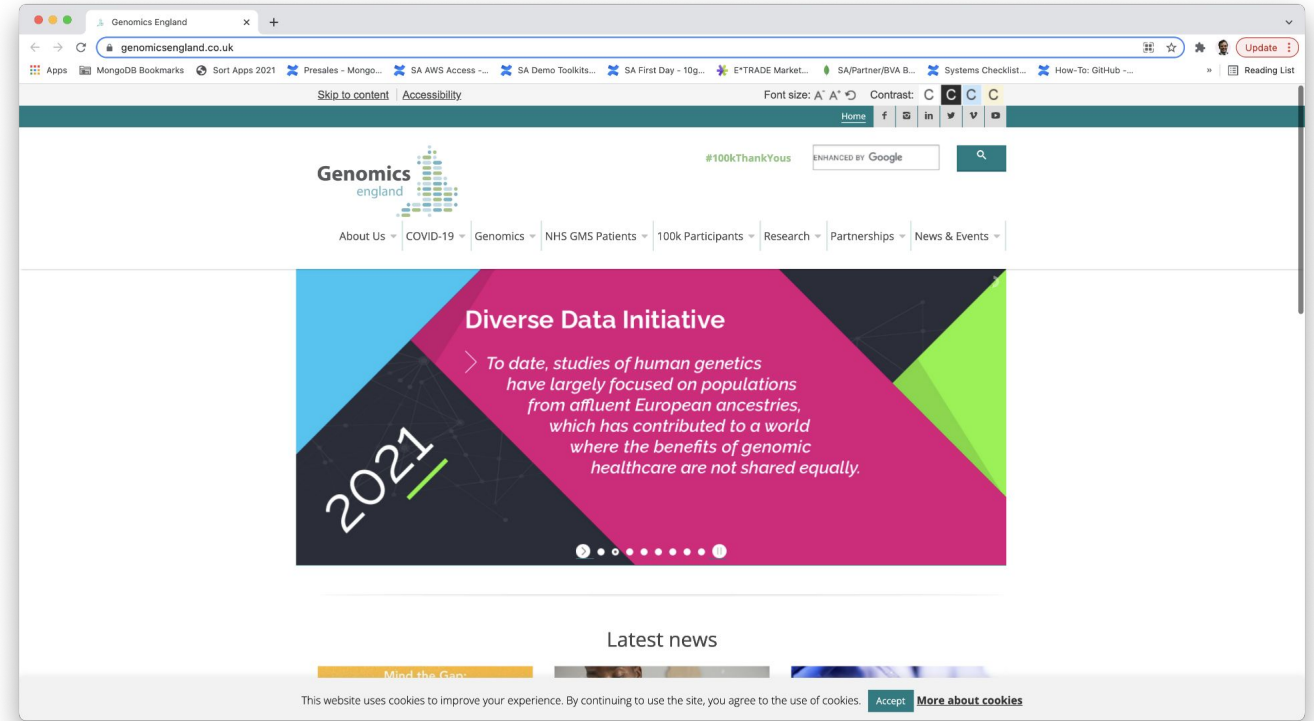


2,500 researchers and trainees from around the world

Industry Insight


How Will Genome UK Securely Handle 150 Petabytes of Genomic Data?

Published: December 4, 2020 | Ruairi Mackenzie & Molly Campbell



MongoDB for Healthcare

FHIR Today, Interoperability Tomorrow
With The Right Data Platform



Release 4

Home

Getting Started

Documentation


Resources


Profiles

Extensions

Operations

Terminologies

 Administration > Location

This page is part of the FHIR Specification (v4.0.1: R4 - Mixed Normative and STU). This is the current published version. For a full list of available versions, see the [Directory of published versions](#) 

Content	Examples	Detailed Descriptions	Mappings	Profiles & Extensions	R3 Conversions
---------	----------	-----------------------	----------	-----------------------	----------------

8.7 Resource Location - Content

Patient Administration 	Work Group	Maturity Level: 3	Trial Use	Security Category: Business	Compartments: Not linked to any defined compartments
--	------------	-------------------	-----------	-----------------------------	--

Details and position information for a physical place where services are provided and resources and participants may be stored, found, contained, or accommodated.

8.7.1 Scope and Usage

A Location includes both incidental locations (a place which is used for healthcare without prior designation or authorization) and dedicated, formally appointed locations. Locations may be private, public, mobile or fixed and scale from small freezers to full hospital buildings or parking garages.

Examples of Locations are:


- Building, ward, corridor, room or bed
- Mobile Clinic
- Freezer, incubator
- Vehicle or lift
- Home, shed, or a garage
- Road, parking place, a park
- Ambulance (generic)
- Ambulance (specific)
- Patient's Home (generic)
- Jurisdiction

These locations are not intended to cover locations on a patient where something occurred (i.e. a patient's broken leg), but can happily cover the location where the patient broke the leg (the playground)

8.7.2 Boundaries and Relationships

Locations and Organizations are very closely related resources and can often be mixed/matched/confused. The Location is intended to describe the more physical structures managed/operated by an organization, whereas the Organization is intended to represent the more conceptual





Release 5 Preview #1

Home

Getting Started

Documentation

Patterns


Resource Types


Profiles

Extensions


Operations


Terminologies

 Foundation > Coming Challenges

This page is part of the FHIR Specification (v4.2.0: R5 Draft). The current version which supercedes this version is 4.0.1. For a full list of available versions, see the [Directory of published versions](#) 

2.23 Appendix: The Role of Informatics in the Shift from Reactive to Proactive Healthcare

FHIR Infrastructure 	Work Group	Maturity Level: N/A	Standards Status: Informative
---	------------	---------------------	-------------------------------

FHIR offers more than a standard solving existing problems in interoperability, it provides a platform for the future. Interoperability is "all about the people"; in order to get past the peak of inflated expectations to the plateau of productivity on [the hype cycle](#)  it is imperative that there is a shared vision of what is trying to be achieved. Healthcare is in the midst of a transformation driven by the convergence of biological and information revolutions, by economic imperative and social change. FHIR's strength lies in it being grounded in the real world which is changing rapidly. This appendix offers a high-level view of the disruption underway and helps place FHIR into a wider context.

Just as John Snow used a branch of informatics and geospatial analysis to identify the source of cholera in London and so prove the germ theory and revolutionize medicine in 1854, so too will the application of informatics and associated technology be instrumental in the next big change in healthcare.

In countries with advanced economies, health systems are facing increased demand from aging populations and increased incidence of chronic disease. In many of these countries, there is also a shortage of skilled workers. Mounting evidence points to avoidable errors causing serious harm to patients. Indeed, optimal care only occurs about half the time in even the best performing health systems (1). Small incremental improvements will not be enough to address the looming crisis in sustainable healthcare.

Convergence of trends in health care, biology, informatics and technology together with the associated social changes and economic imperative is driving a paradigm shift (2) that may be the answer. Informatics has a role in most aspects of this. The figure below provides a summary of the convergence of these trends and the likely results of disruption that will move us from reactive to proactive healthcare.



About Firely | Bring FHIR to Life

fire.ly/company/

AppsMongoDB BookmarksSort Apps 2021Presales - Mongo...SA AWS Access ~...SA Demo Toolkits...SA First Day - 10g...E*TRADE Market...SA/Partner/BVA B...Systems Checklist...How-To: GitHub ~...Reading List

firely

PRODUCTS ▾SOLUTIONS ▾TRAINING ▾RESOURCESBLOGCOMPANY ▾

Contact us


Firely makes FHIR
even simpler

We are the nerds helping other nerds improve
the healthcare industry

Get in touch →

firely

100% FHIR dedicated




Who we are

We are a group of software engineers, support engineers and FHIR consultants committed to Health Interoperability. We are based in Amsterdam, the Netherlands and we also have an office in Boston, USA.

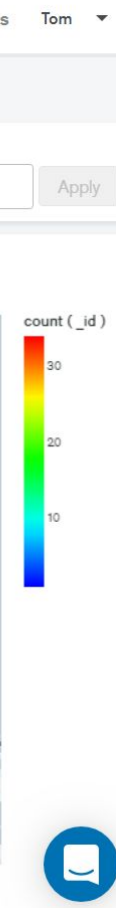
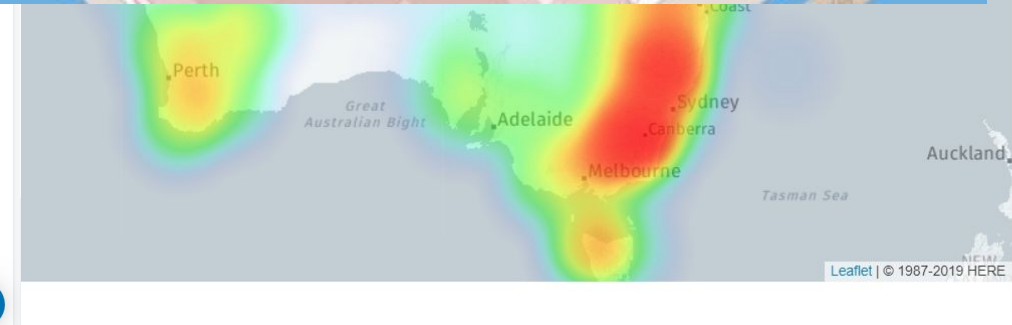
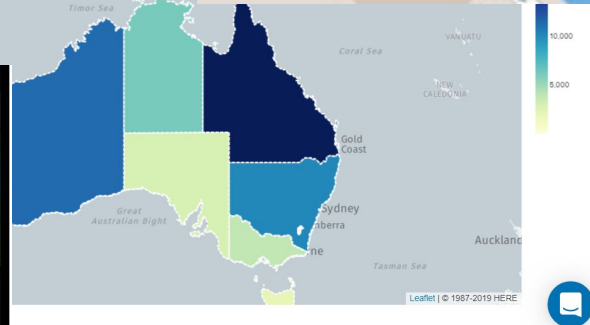
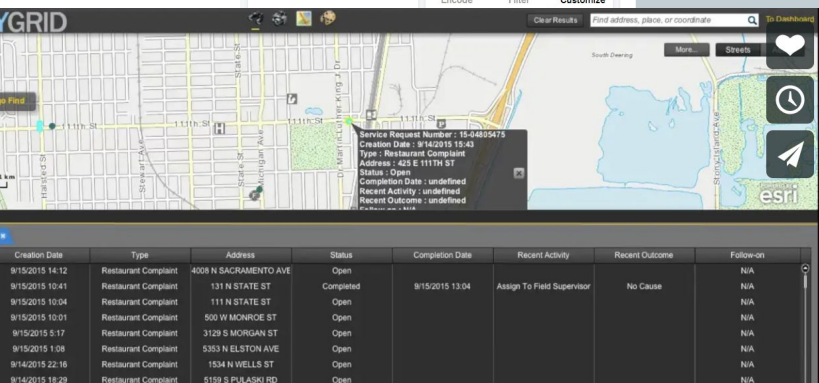
We live and breathe FHIR

The Firely team has been involved in FHIR since the beginning and we are continuously contributing to the standard. Firely is the driving force behind [FHIR DevDays](#) and a founding member of the [FHIR Business Alliance](#).



The screenshot displays the MongoDB Charts interface, which is used for creating and managing data visualizations. The interface is divided into several sections:

- Top Bar:** Includes the MongoDB logo, the title "Dashboards", and a "Save and Close" button.
- Data Source:** A dropdown menu showing "tomsapps.abc.Transmissions".
- Fields:** A list of fields available for visualization, including "id", "band", "frequency", "location", "name", "network", and "stateName".
- Chart Type:** A dropdown menu showing "Geospatial".
- General C:** A section for configuring the chart, including "Opacity" (set to 47%) and "Stroke Thickness" (set to 2).
- Charts:** A collection of charts created from the data source:
 - Critics vs User ratings by genre:** A bar chart showing the relationship between critics and user ratings across different genres.
 - Music length over time:** A line chart showing the average music length over time.
 - Average movie score by country:** A map showing the average movie score by country.
 - Movie critic score over time:** A line chart showing the average movie critic score over time.
 - Runlines vs Metacritic:** A scatter plot showing the relationship between runlines and Metacritic scores.
- Table:** A table titled "Directors' Award Success" showing the number of awards won by various directors. The table has columns for "Director", "Awards", and "Wins".



TomTom - Hazard Warnings

TOMTOM,
the leading
independent
location
technology
specialist

<https://www.tomtom.com/blog/connected-car/anticipate-road-ahead-with-tomtom-hazard-warnings/>

<https://www.tomtom.com/products/hazard-warnings/>

<https://www.tomtom.com/events/webinar/introducing-hazard-warnings/>



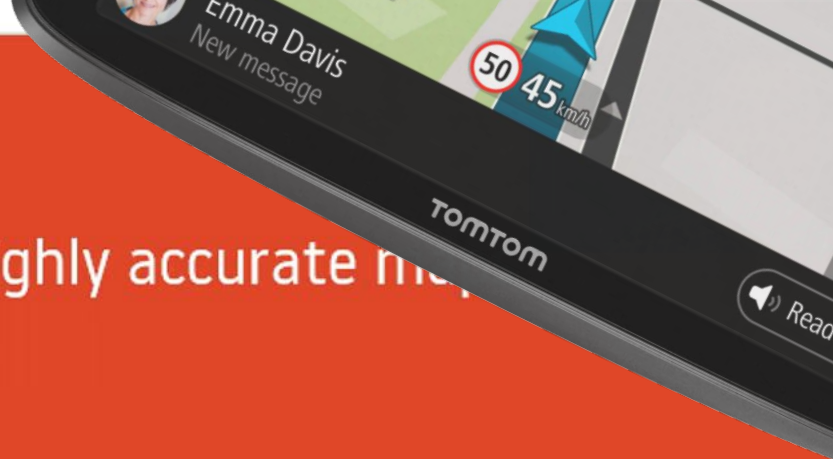
Highly accurate maps



Navigation software



Real-time traffic and services



TomTom - Map Making

How MongoDB Powers a Strategic Development for the Future of Source Handling in TomTom Maps

"Map-making is at the very core of TomTom and keeping them up-to-date require handling and processing a myriad of source data in the most efficient way – i.e., highly automated processes. A good strategy for that is focusing on processes to intake, standardize and expose the data at the most granular level with all the relevant metadata that can further enable automation downstream."

<https://app.swapcard.com/widget/event/mongodb-live-northern-europe/planning/UGxhbm5pbmdfMjA1NTQ5>

<https://vimeo.com/480757084>

Behind the map: how we keep our maps up to date

"With **61 billion GPS data points collected each** day, it is the hyper precision of TomTom data that enables us to create maps detailed enough that they can even be used to power safe autonomous driving."

<https://www.tomtom.com/blog/maps/continuous-map-processing/>



Customer references you will find online

TomTom

Cure.fit

Picnic

Fortnite (talk about high volume traffic!)

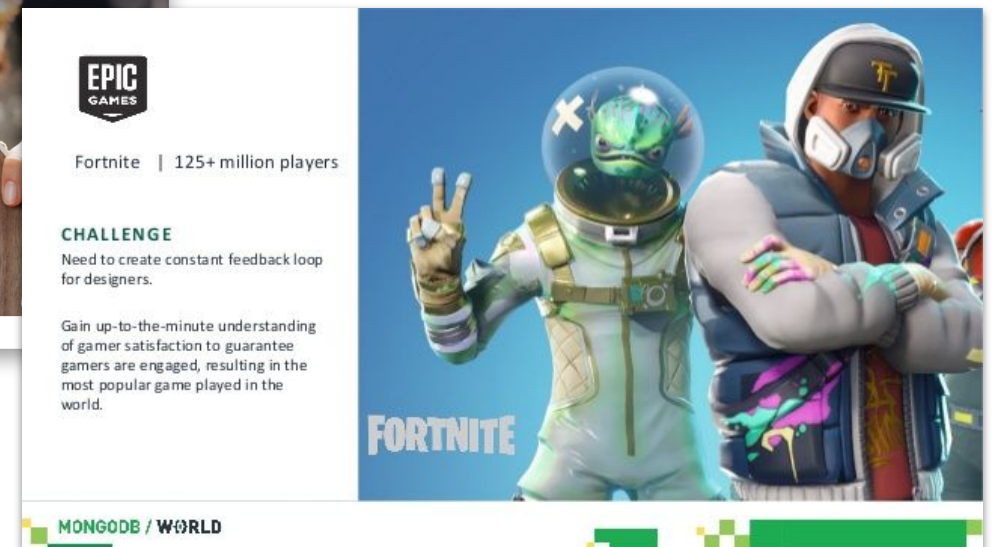
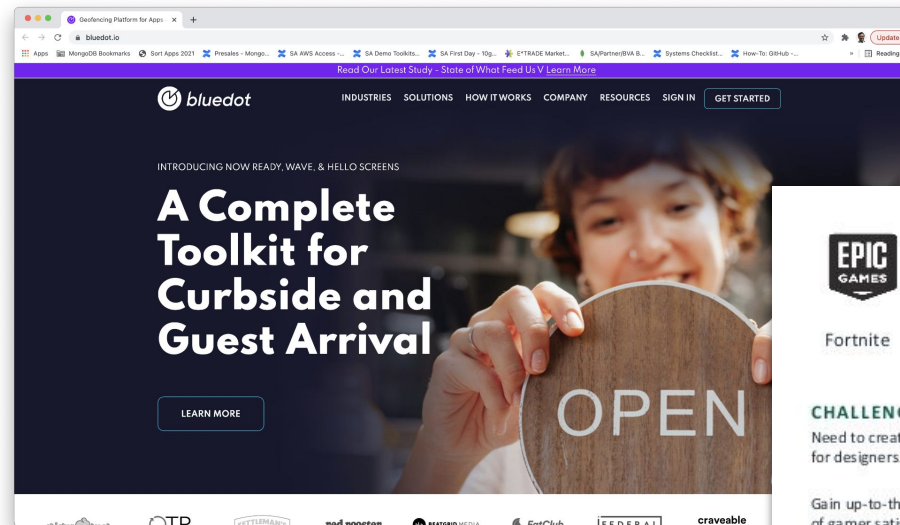
Transics

City of Rome

CoreLogic

Bluedot

Petro.ai/Ruths.ai





What is ~~next~~ now?

Who remembers importing CAD data?

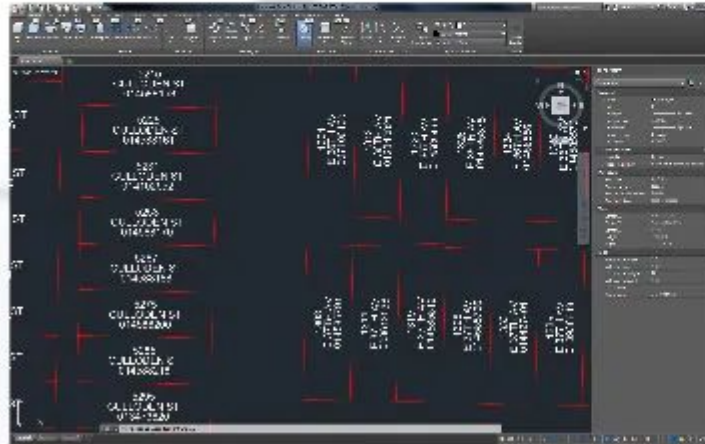
Spoiler: still happens today

CAD was drawing oriented, shapes not objects,
with data spread over multiple layers
including attributes as labels and
attached helper info using more lines

Jump to now:

- BIM is the new CAD + GIS
- 4D is the new 3D
- Digital twins are the new BIM
- Digital twins enable living data
- *Living data connects the operational digital and concrete and human worlds real time from day 1 on*

Your mission, should you chose to accept it:
————→ CAD to GIS (Basic)



Import Parcels

Extract attributes from labels



GIS moved beyond relational

From

Usually table (= map layer) oriented with one column containing (one type of) geometry

To

Multiple levels of detail

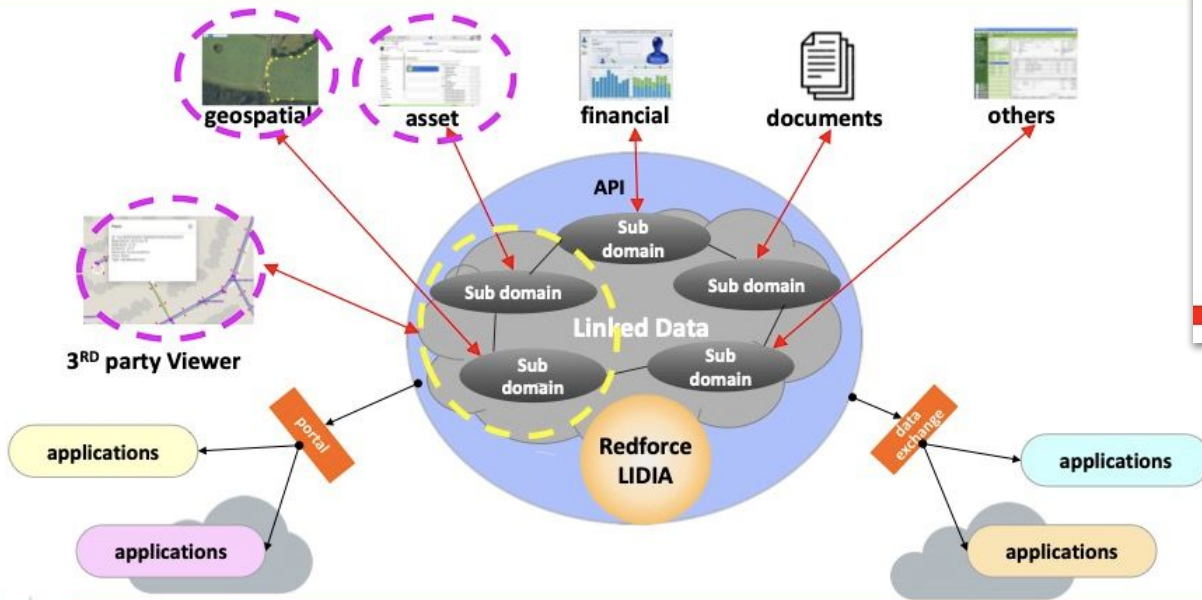
Multiple degrees of flexibility in geometry type(s) and properties

Current playing field = Relational ← → Document oriented ← → Triples

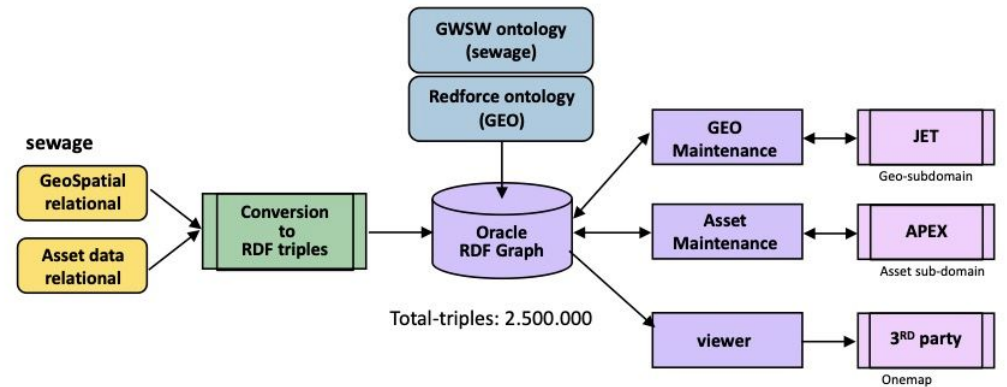


'free your gis from the format'

Demo – Lidia, Application View based on two 'sub-domains'



Demo ecosystem with 3 applications





Do it yourself: MongoDB Atlas free tier

Now it is your turn!

Create your own **Atlas Free Tier** <https://cloud.mongodb.com>

Start with the code from the demo at <https://github.com/taatuut/mongeoexperts>

Want to know more? Contact me at emil.zegers@mongodb.com

Webinars and events <https://www.mongodb.com/events-webinars-overview>

MongoDB University <https://university.mongodb.com/>



Go to <https://cloud.mongodb.com> register and start




MongoDB Atlas





The most innovative cloud database service on the market, with unmatched data distribution and mobility across AWS, Azure, and Google Cloud, built-in automation for resource and workload optimization, and so much more.

Start free

Already have an account? [Log in here](#) →
















Cloud Provider & Region AWS, N. Virginia (us-east-1) ▾




 **Multi-Cloud, Multi-Region & Workload Isolation** (M10+ clusters)
Distribute data across clouds    or regions for improved availability and local read performance, or introduce replicas for workload isolation. [Learn more](#) OFF

Create a **free tier cluster** by selecting a region with **FREE TIER AVAILABLE** and choosing the **M0** cluster tier below.

★ Recommended region ⓘ

NORTH AMERICA	EUROPE	ASIA
 N. Virginia (us-east-1) ★ FREE TIER AVAILABLE	 Stockholm (eu-north-1) ★	 Hong Kong (ap-east-1) ★
 Ohio (us-east-2) ★	 Ireland (eu-west-1) ★ FREE TIER AVAILABLE	 Tokyo (ap-northeast-1) ★
 N. California (us-west-1)	 London (eu-west-2) ★	 Seoul (ap-northeast-2)
 Oregon (us-west-2) ★ FREE TIER AVAILABLE	 Paris (eu-west-3) ★	 Singapore (ap-southeast-1) ★ FREE TIER AVAILABLE
 Montreal (ca-central-1)	 Frankfurt (eu-central-1) ★ FREE TIER AVAILABLE	 Mumbai (ap-south-1) FREE TIER AVAILABLE

 Pricing

 Getting started

 Migrate to MongoDB Atlas

 Frequently Asked Questions

ThermoFisher
SCIENTIFIC

inVISION

SEGA®

7-ELEVEN®

KPMG





Q&A

Contact information

```
{  
  "name": "Emil Zegers",  
  "title": "Senior Solutions Architect",  
  "phone": "+31 6 19929703",  
  "email": "emil.zegers@mongodb.com",  
  "location": "Amsterdam, Netherlands",  
  "twitter": ["@emilzegers", "@mongodb"],  
  "linkedin": "https://www.linkedin.com/in/emilzegers"  
}
```





Links on geospatial

More links...

The Comparison of Processing Efficiency of Spatial Data for PostGIS and MongoDB Databases

https://www.researchgate.net/publication/332921357_The_Comparison_of_Processing_Efficiency_of_Spatial_Data_for_PostGIS_and_MongoDB_Databases

https://www.researchgate.net/profile/Adam_Piorkowski/publication/332921357_The_Comparison_of_Processing_Efficiency_of_Spatial_Data_for_PostGIS_and_MongoDB_Databases/links/5cda7b93458515712ea95a6d/The-Comparison-of-Processing-Efficiency-of-Spatial-Data-for-PostGIS-and-MongoDB-Databases.pdf

Not about “*who is the best*” but offering a good overview of possibilities

MongoDB supports

JSON/BSON <http://bsonspec.org/>

GeoJSON <https://docs.mongodb.com/manual/reference/geojson/>

JSON-LD <https://docs.opengeospatial.org/wp/16-131r2/16-131r2.html>

2D planar en 3D sphere WGS84 <https://docs.mongodb.com/manual/geospatial-queries/>



Even more links...

Geotools/Geoserver MongoDB plugin

<https://docs.geotools.org/latest/userguide/library/data/mongodb.html>

<https://docs.geoserver.org/latest/en/user/extensions/mongodb/index.html>

Graph database integration with *GraphDB*, *Allegro*, *Apache Rya*, adding possibility to use linked data and SPARQL

<https://graphdb.ontotext.com/documentation/standard/mongodb-graphdb-connector.htm>

Geospatial visualization

<https://ngust.ca/articles/geospatial-mongodb>

<https://www.mongodb.com/blog/post/build-geospatial-visualizations-with-mongodb-charts>



Ok, last page

3D Repo White Paper - Digitising Health and Safety

<https://3drepo.com/health-and-safety-white-paper/>

Few more MongoDB links

<https://www.slideshare.net/mongodb/how-mongodb-is-transforming-healthcare-technology>

<https://www.mongodb.com/blog/post/built-mongodb-memora-health>

<https://www.mongodb.com/cloud/trust/compliance/hipaa>

<https://www.mongodb.com/mongodb-scale>

