

Neo4j Introduction No Sql Search Roadshow

Dirk Möller dirk.moeller@neotechnology.com

Neo Technology, Inc Confidential



Graphs are everywhere









Early Adopters of Graph Tech



facebook.





The Knowledge Graph

Learn more about one of the key breakthroughs behind the future of search.

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Survival of the Fittest



Evolution of Web Search

Pre-1999 WWW Indexing

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Discrete Data

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<u> 1999 - 2012</u>

Google Invents PageRank





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1999 - 2012

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Connected Data (Simple)

<u>2012-?</u>

Google Knowledge Graph, Facebook Graph Search





Survival of the Fittest Evolution of Online Job Search

2010-11 Resume Searching &

Scoring bright résunate



Get Your Bright Scores

The Bright Score instantly scores jobs relative to your experience. The higher the score, the better the fit.



Discrete Data

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Discrete Data





2011-12

Social Job Search

careerbuilder[®]

Creative Director

From: Experteer - 8 days ago

U.S. NAVY - Fremont, CA

From: Monster - 14 days ago

frog design - San Francisco, CA

EMERGENCY MEDICAL TECH

Career Arc Group

3,882 companies

glassdoor.com

friends on

glassdoor

Jobs with Connections

Netflix - Los Gatos, CA

From: Job.com - 1 days ago

From: Experteer - 3 days ago

Innovation

Sr. Statistical Analyst, Product

Java Server Software Engineer

Electronic Arts - Redwood City, CA

Want better jobs? Tell us your current job title

夷 bright

Invite more friends — ask them to share their connections

Most jobs are found through an inside connection

3,905 inside connections

Each friend that joins Glassdoor allows you to see more connections at m



(Actual Neo4j Graphs)

Organizational Hierarchy



Social Networks



CMDB (Network Inventory)





(Actual Neo4j Graphs)



(Actual Neo4j Graphs)

Entitlements & Identity

Management



(Actual Neo4j Graphs)

Entitlements & Identity

Management



Insurance Risk Analysis

graphs are everywhen



(Actual Neo4j Graphs)



Entitlements & Identity

Management



Geo Routing

(Public Transport)



Insurance Risk Analysis



(Actual Neo4j Graphs)



Entitlements & Identity Management Principals SECURI flags: +1 Post IS MEMBER/OF GROUP SECURITY All principals NTENT PRINCIPAL OF GROU PRIVETAL 💫 Regular user user1 Hom SECURD mode: bus A HAS CH duration: 7 mi oost: \$2 Challenge 1

Network Cell Analysis



Geo Routing

(Public Transport)



Insurance Risk Analysis



(Actual Neo4j Graphs)





(Actual Neo4j Graphs)







About Neo Technology

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Four Categories of NoSQL

Key-Value



Column-family / BigTable



Document









Our Mission:

Help the world to make sense of data





- Commercial sponsor of Neo4j
- 50 people / Ten countries / Four continents
- \$25M in venture funding from Fidelity, Sunstone & Conor
- 100+ Customers, incl. 30+ of the Global 2000.





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Neo4j The Product

- Development started in 2000 in Sweden
- 10+ years of mission-critical 24x7 deployments (since 2003)
- Open sourced in 2007
- **40,000+** downloads per month. Over half a million downloads.
- Today the leading graph database



Graph Connect Konferenz





GraphConnect 2013 graphs are everywhere

Boston | Chicago San Francisco | New York | London



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 Order-of-magnitude improvements in query performance for complex, connected data



- I. Order-of-magnitude improvements in **query performance** for complex, connected data
- 2. Drastically accelerated application development cycles



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- 3. Maintainability and extensibility of the data model



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- 2. Drastically accelerated application development cycles
- 3. Maintainability and extensibility of the data model
- 4. Relative **maturity** of the community and product























Donnerstag, 19. September 13





Donnerstag, 19. September 13





Donnerstag, 19. September 13






Neo4j Ecosystem





Donnerstag, 19. September 13

Neo4j Ecosystem

eo technology

















Selected Neo4j Case Studies





Early Adopter Segments (What we expected to happen - view from several years ago)

Core Industries & Use Cases:	Web / ISV	Finance & Insurance	Datacom / Telecom
Network & Data Center Management			
MDM			
Social			
Geo			

Neo4j Adoption Snapshot

Select Commercial Customers* Across Anticipated Segments graphs are everywhere



*Community Users Not Included

Neo4j Adoption Snapshot

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5 Graphs of Telco

- Network Graph (e.g. Network Dependency Analysis, Network Inventory, etc.)
- Social Graph • Trelekom **magin** (mobile apps, social recommendations, collaboration)

• Call Graph

(creating inferred social graph, churn reduction, etc.)

 Master Data Graph felenor Global 500 CISCO.
(org & product hierarchy, data governance, IAM)

• Help Desk Graph (enterprise collaboration)

5 Graphs of Finance



- Payment Graph 🔀 First Data. Intuit. (e.g. Fraud Detection, Credit Risk Analysis, Chargebacks...)
- **Customer Graph** opencorporates (org drillthru, product recommendations, mobile payments, etc.)
- Entitlement Graph Global 500 Finance (identity & access management, authorization)

• Portfolio Graph

(portfolio analytics, risk analysis, trading, compliance)

• Master Data Graph

(enterprise collaboration, corporate hierarchy, data governance)

5 Graphs of Health Care







Selected Case Studies

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• Online jobs and career community, providing anonymized inside information to job seekers



Neo Technology Gonfidential ntial





• Online jobs and career community, providing anonymized inside information to job seekers





Business problem

- Wanted to leverage known fact that most jobs are found through personal & professional connections
- Needed to rely on an existing source of social network data. Facebook was the ideal choice.
- End users needed to get instant gratification
- Aiming to have the best job search service, in a very competitive market





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Solution & Benefits

- First-to-market with a product that let users find jobs through their network of Facebook friends
- Job recommendations served real-time from Neo4j
- Individual Facebook graphs imported real-time into Neo4j
- Glassdoor now stores > 50% of the entire Facebook social graph
- Neo4j cluster has grown seamlessly, with new instances being brought online as graph size and load have increased





- One of the world's largest logistics carriers
- Projected to outgrow capacity of old system
- New parcel routing system
 - Single source of truth for entire network
 - B2C & B2B parcel tracking
 - Real-time routing: up to 5M parcels per day







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Business problem

- 24x7 availability, year round
- Peak loads of 2500+ parcels per second
- Complex and diverse software stack
- Need predictable performance & linear scalability
- Daily changes to logistics network: route from any point, to any point





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Solution & Benefits

- Neo4j provides the ideal domain fit:
 - a logistics network is a graph
- Extreme availability & performance with Neo4j clustering
- Hugely simplified queries, vs. relational for complex routing
- Flexible data model can reflect real-world data variance much better than relational

• "Whiteboard friendly" model easy to understand

Large Investment Bank

Industry: Financial Services Use case: Entitlements/IAM London



Background

- Top investment bank: over \$IT in total assets
- Using a relational database coupled with Gemfire for managing employee permissions to research resources (documents and application services)



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Business problem

- When a new investment manager was onboarded, permissions were manually provisioned via a complex manual process. Traders lost an average of 5 days of trading, waiting for the permissions to be granted
- Competitor had implemented a project to accelerate the onboarding process. Needed to respond quickly.
- High stakes: Regulations leave no room for error.
- High complexity: Granular permissions mean each trader needed access to hundreds of resources.

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Solution & Benefits

- Organizational model, groups, and entitlements stored in Neo4j
- Very happy with the performance of the solution, and the productivity advantage of a domain fit
- Graph visualization makes it easier for the business to provision permissions themselves
- Moving to Neo4j meant "fewer compromises" than a relational data store



Industry: Communications Use case: Network Management **Paris, France**



Background

- Second largest communications company in France
- Part of Vivendi Group, partnering with Vodafone



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Business problem

- Infrastructure maintenance took one full week to plan, because of the need to model network impacts
- Needed rapid, automated "what if" analysis to ensure resilience during unplanned network outages
- Identify weaknesses in the network to uncover the need for additional redundancy
- Network information spread across > 30 systems, with daily changes to network infrastructure
- Business needs sometimes changed very rapidly



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Solution & Benefits

- Flexible network inventory management system, to support modeling, aggregation & troubleshooting
- Single source of truth (Neo4j) representing the entire network
- Dynamic system loads data from 30+ systems, and allows new applications to access network data
- Modeling efforts greatly reduced because of the near I:I mapping between the real world and the graph
- Flexible schema highly adaptable to changing business



Telekom Industry: Communications Use case: Social gaming Frankfurt, Germany



Background

- Europe's largest communications company
- Provider of mobile & land telephone lines to consumers and businesses, as well as internet services, television, and other services









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Interactive Television Programming





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Interactive Television Programming



Business problem

- The Fanorakel application allows fans to have an interactive experience while watching sports
- Fans can vote for referee decisions and interact with other fans watching the game
- Highly connected dataset with real-time updates
- Queries need to be served real-time on rapidly changing data
- One technical challenge is to handle the very high spikes of activity during popular games



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Solution & Benefits

- Interactive, social offering gives fans a way to experience the game more closely
- Increased customer stickiness for Deutsche Telekom
- A completely new channel for reaching customers with information, promotions, and ads
- Clear competitive advantage



Industry: Web/ISV, Communications Use case: Network Management Global (U.S., France)



Background

- World's largest provider of IT infrastructure, software & services
- HP's Unified Correlation Analyzer (UCA) application is a key application inside HP's OSS Assurance portfolio
- Carrier-class resource & service management, problem determination, root cause & service impact analysis
- Helps communications operators manage large, complex and fast changing networks




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- Use network topology information to identify root problems causes on the network
- Simplify alarm handling by human operators
- Automate handling of certain types of alarms Help operators respond rapidly to network issues
- Filter/group/eliminate redundant Network Management System alarms by event correlation





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- Accelerated product development time
- Extremely fast querying of network topology
- Graph representation a perfect domain fit
- 24x7 carrier-grade reliability with Neo4j HA clustering
- Met objective in under 6 months





Background

- 10th largest Telco provider in the world, leading in the Nordics
- Online self-serve system where large business admins manage employee subscriptions and plans
- Mission-critical system whose availability and responsiveness is critical to customer satisfaction

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telenor Industry: Communications Use case: Resource Authorization & Access Control Oslo, Norway

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- Degrading relational performance. User login taking minutes while system retrieved access rights
- Millions of plans, customers, admins, groups. Highly interconnected data set w/massive joins
- Nightly batch workaround solved the performance problem, but meant data was no longer current
- Primary system was Sybase. Batch pre-compute workaround projected to reach 9 hours by 2014: longer than the nightly batch window

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- Moved authorization functionality from Sybase to Neo4j
- Modeling the resource graph in Neo4j was straightforward, as the domain is inherently a graph
- Able to retire the batch process, and move to real-time responses: measured in milliseconds
- Users able to see fresh data, not yesterday's snapshot
- Customer retention risks fully mitigated



Industry: Communications Use case: Recommendations San Jose, CA Cisco.com

Background

- Cisco.com serves customer and business customers with Support Services
- Needed real-time recommendations, to encourage use of online knowledge base
- Cisco had been successfully using Neo4j for its internal master data management solution.
 - Identified a strong fit for online recommendations







Industry: Communications Use case: Recommendations San Jose, CA

Cisco.com

Background

- Cisco.com serves customer and business customers with Support Services
- Needed real-time recommendations, to encourage use of online knowledge base
- Cisco had been successfully using Neo4j for its internal master data management solution.
 - Identified a strong fit for online recommendations

- Call center volumes needed to be lowered by improving the efficacy of online self service
- Leverage large amounts of knowledge stored in service cases, solutions, articles, forums, etc.
- Problem resolution times, as well as support costs, needed to be lowered







Industry: Communications Use case: Recommendations San Jose, CA

Cisco.com

Background

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Business problem

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- Cases, solutions, articles, etc. continuously scraped for cross-reference links, and represented in Neo4j
- Real-time reading recommendations via Neo4j
- Neo4j Enterprise with HA cluster
- The result: customers obtain help faster, with decreased reliance on customer support



Viadeo Industry: Professional Social Network Use case: Social, Recommendations **Silicon Valley & France**



Background

- World's second-largest professional network (after LinkedIn)
- 50M members. 30K+ new members daily.
- Over 400 staff with offices in 12 countries



Viadeo Industry: Professional Social Network Use case: Social, Recommendations **Silicon Valley & France**



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- Business imperative for real-time recommendations: to attract new users and retain existing ones
- Key differentiator: show members how they are connected to any other member
- Real-time traversals of social graph not feasible with MySQL cluster. Batch precompute meant stale data.
- Process taking longer & longer: > I week!

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Industry: Professional Social Network Use case: Social, Recommendations Silicon Valley & France



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- Neo4j solution implemented in 8 weeks with 3 parttime programmers
- Able to move from batch to real-time: improved responsiveness with up-to-date data.
- Viadeo (at the time) had 8M members and 35M relationships.
- Neo4j cluster now sits at the heart of Viadeo's professional network, connecting 50M+ professionals





- One of the ten largest software companies globally
- \$4B+ in revenue. Over 11,000 employees.
- Launched Creative Cloud in 2012, allowing its Creative Suite users to collaborate via the Cloud



Adobe Industry: Web/ISV Use case: Content Management, Social, Access Control San Jose, CA



Background

- One of the ten largest software companies globally
- \$4B+ in revenue. Over 11,000 employees.
- Launched Creative Cloud in 2012, allowing its Creative Suite users to collaborate via the Cloud



Business problem

- Adobe needed a highly robust and available, 24x7 distributed global system, supporting collaboration for users of its highest revenue product line
- Storing creative artifacts in the cloud meant managing access rights for (eventually) millions of users, groups, collections, and pieces of content
- Complex access control rules controlling who was connected to whom, and who could see or edit what, proved a significant technical challenge

User-Content-Access Graph



Adobe Industry: Web/ISV Use case: Content Management, Social, Access Control San Jose, CA



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User-Content-Access Graph



Solution & Benefits

- Selected Neo4j to meet very aggressive project deadlines. The flexibility of the graph model, and performance, were the two major selection factors.
- Easily evolve the system to meet tomorrow's needs
- Extremely high availability and transactional performance requirements. 24x7 with no downtime.
- Neo4j allows consistently fast response times with complex queries, even as the system grows
- First (and possibly still only) database cluster to run across three Amazon EC2 regions: U.S., Europe, Asia

Neo Technology, Inc Confidential

What Customers Have to Say



Research by TechValidate

Research by **TechValidate**

Relational to Graph

We love Neo4j. It is hard to fathom that 6 months ago, we were doing graphy things inside of relational databases, and in application layers on top of NoSQL document databases.

There was a slight learning curve, but once we were up and running, Neo4j become a central part of our offering.

Source: 👤 Huston Hedinger, CEO, Wikisway

www.techvalidate.com/product-research/neo-technology-neo4j

TVID: F28-83B-A74

99



Social Recommendations with Neo4j



Source: 🚨 Craig Follett, CEO, Uniiverse

www.techvalidate.com/product-research/neo-technology-neo4j

TVID: 8E1-AF9-F93



www.techvalidate.com/product-research/neo-technology-neo4j

TVD: 3E4-4E4-985

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