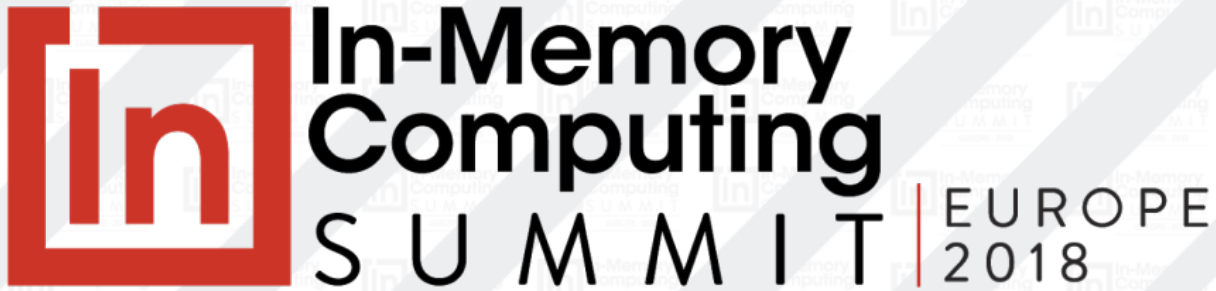


In-memory Computing and Sports Betting

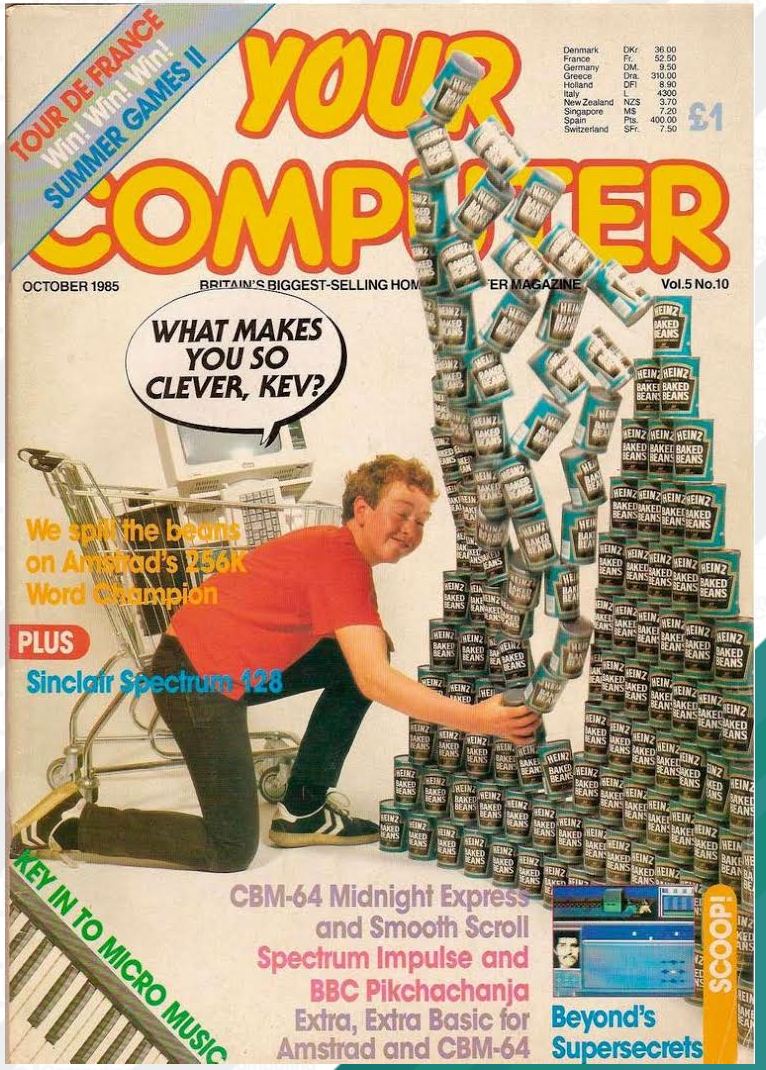
Sam Lawrence
CTO at FSB Technology

Keynote Abstract

- Competition, innovation, regulation and improved data collection have grown the complexity of Sports Betting systems at an unprecedented rate. Coupled with a massive growth in transaction volumes, Sports Betting provides a great case study for considering the relationship between technological advance and business need.
- This presentation is a personal look at the technical challenges the industry has faced, the solutions implemented by FSB Tech and some best guesses of likely crunch points in the future.

Introduction - Sam Lawrence

- CTO and co-founder at FSB Technology, previously CTO at GAN
- 18 years in gaming industry
- Started programming as 9 year old on Sinclair ZX81
- Still fairly “hands-on”, but happily more hazy on the details as the company grows
- Appeared on the cover of “Your Computer” in 1985



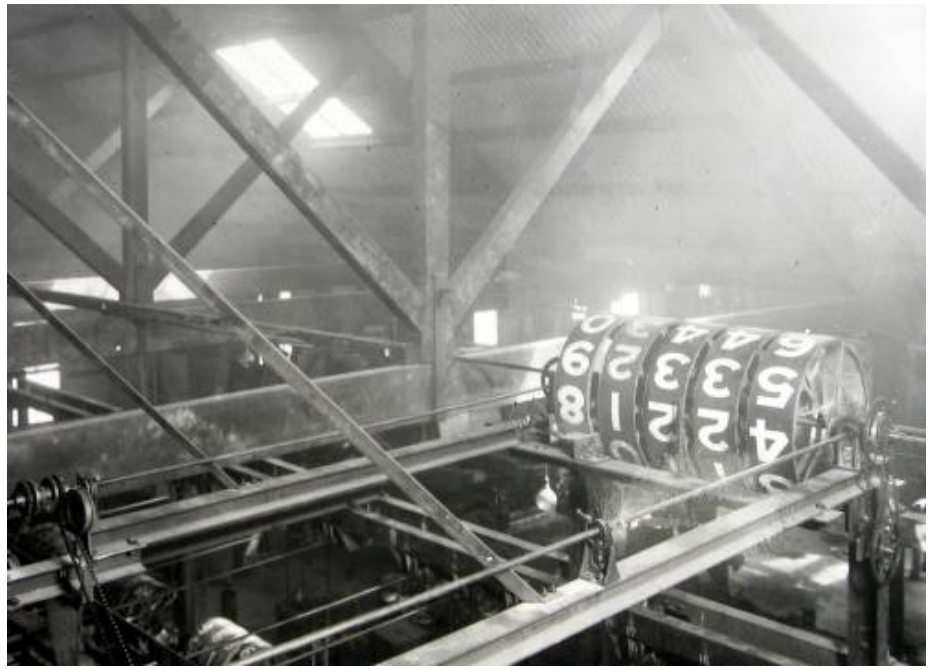
Presentation Summary

1. Sports Betting Technology - history and challenges
2. FSB's approach and experience
3. In-Memory Computing - what I've learnt
4. Wrapping up

1. Sports Betting Technology - history and challenges

A blend of maths, finance, sport and technology

- Basic premise, money in a hat, winners share based on race or match result
- Parimutuel or Tote betting
- Early C. 20th used mechanical solutions
- Fixed odds provide more betting options without liquidity problems
- Online has transformed the industry - more bets taken, more sports covered, more ways to bet



The world's first parallel automatic totalisator - Ellerslie Racecourse New Zealand 1913 (http://rutherfordjournal.org/article020109.html)

Fixed odds betting needs accurate prediction models

- 1 / probability … but with margin or “overround”
- Complex Models, controlled by key parameters
- Faster / richer input data
  - live sports data
  - customer activity
  - other bookmakers - avoiding arbitrage
  - human traders
- Computing has given more techniques, but hasn't changed much of the underlying maths

$$P(k \text{ goals in a match}) = \frac{2.5^k e^{-2.5}}{k!}$$

$$P(k = 0 \text{ goals in a match}) = \frac{2.5^0 e^{-2.5}}{0!} = \frac{e^{-2.5}}{1} \approx 0.082$$

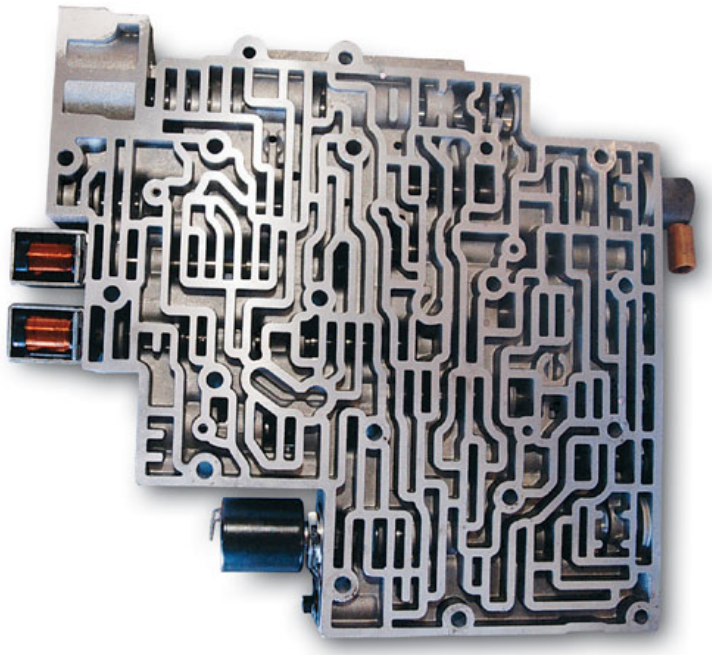
$$P(k = 1 \text{ goal in a match}) = \frac{2.5^1 e^{-2.5}}{1!} = \frac{2.5 e^{-2.5}}{1} \approx 0.205$$

$$P(k = 2 \text{ goals in a match}) = \frac{2.5^2 e^{-2.5}}{2!} = \frac{6.25 e^{-2.5}}{2} \approx 0.257$$

From the “Poisson distribution” page on Wikipedia

Challenges for building a Sports Betting Platform

- Volatility
  - one-off sporting events
  - Saturday afternoon
- Regulation
  - protecting customers
  - data protection
  - spotting money laundering
  - maintaining integrity in sport
- New Products
  - e.g. Cash Out and Request a Bet
- Competition
  - Welcome offers
  - Odds Comparison



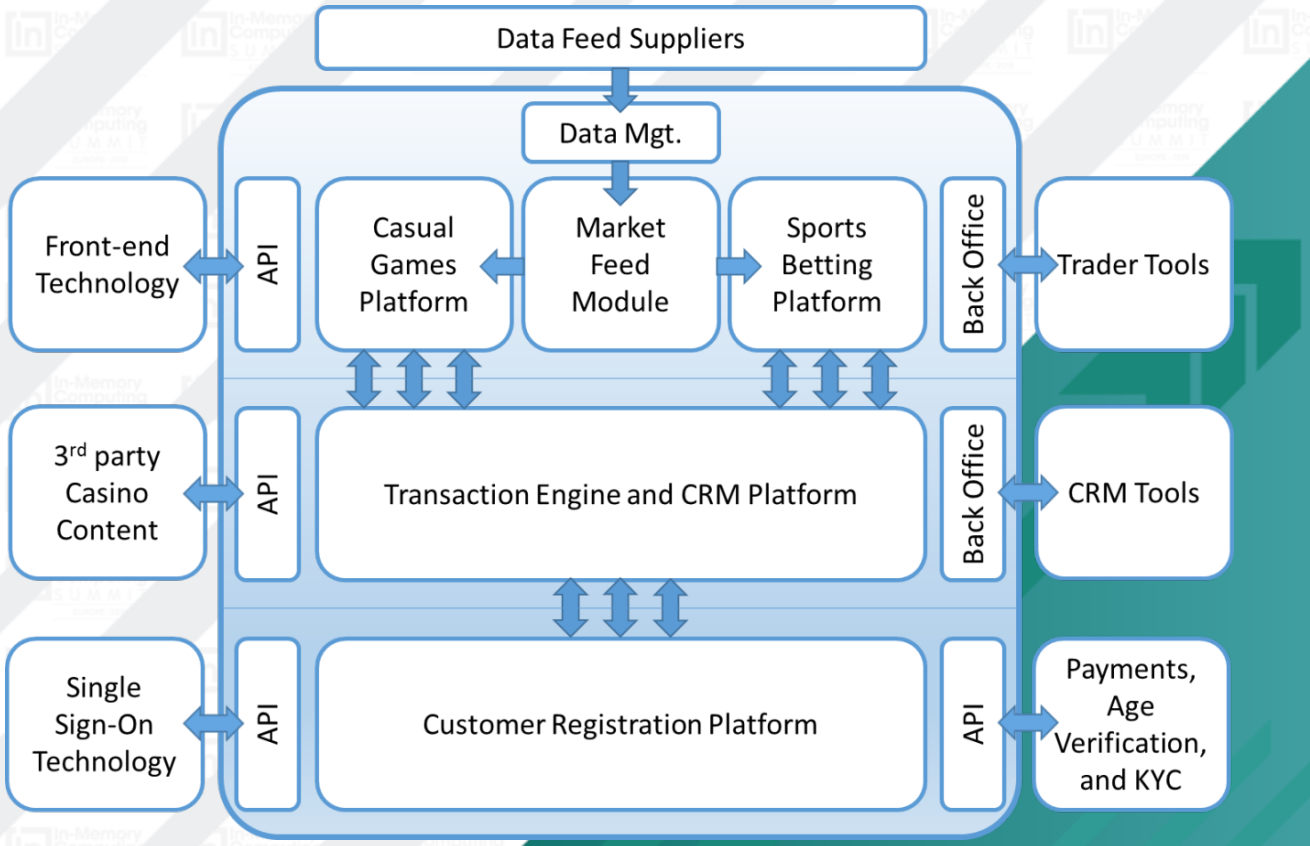
Picture of an automatic transmission valve body

Why is this relevant?

- Rapid change created opportunity
- Also presented many problems to solve
- Same problems faced by other industries
- Still need to innovate, not just react
- Because it’s the World Cup

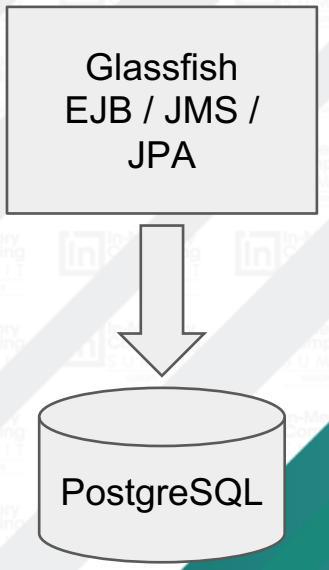
2. FSB's Approach and Experience

- Provides sports betting as a service
  - White label websites
  - Bespoke implementations
- Developer and Operator
- Founded in 2007, originally focused on providing Fantasy Sports
- Launched first fully responsive site in 2014
- Now run 36 branded sites in 11 different countries in 4 continents



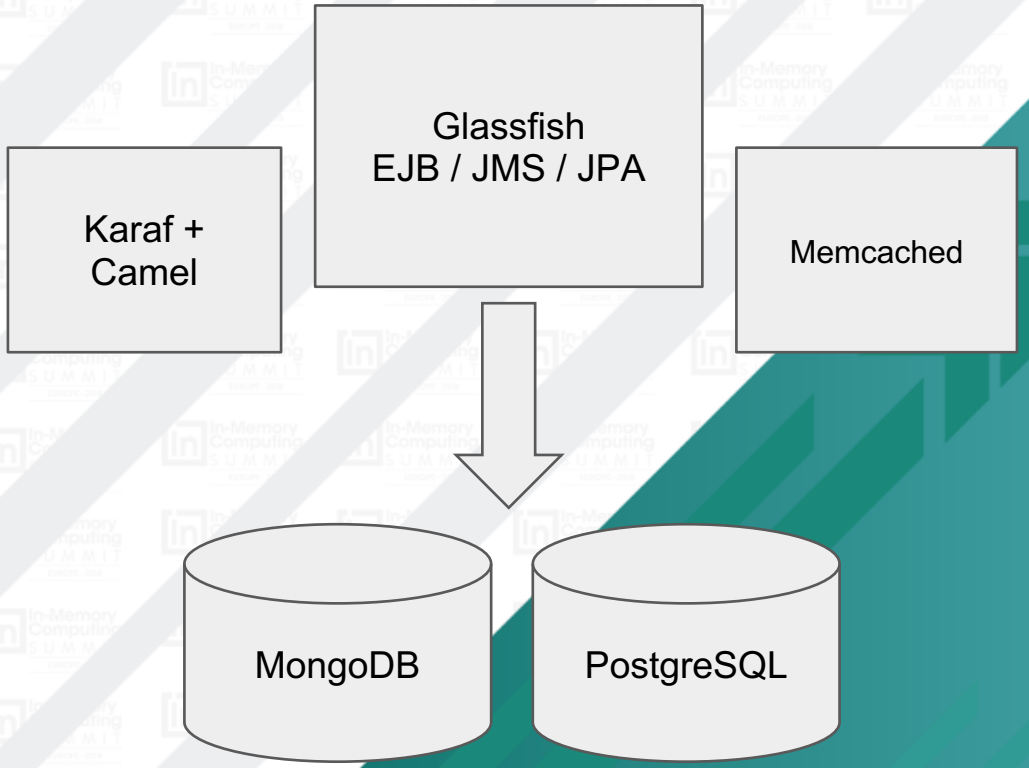
Simple beginnings 2008 - 2010

- Proof of concept platform
- PostgreSQL database
- GlassFish application server
- Lots of JMS
- Choice of open-source technologies with route to enterprise support
- Caching and distribution of data with JPA



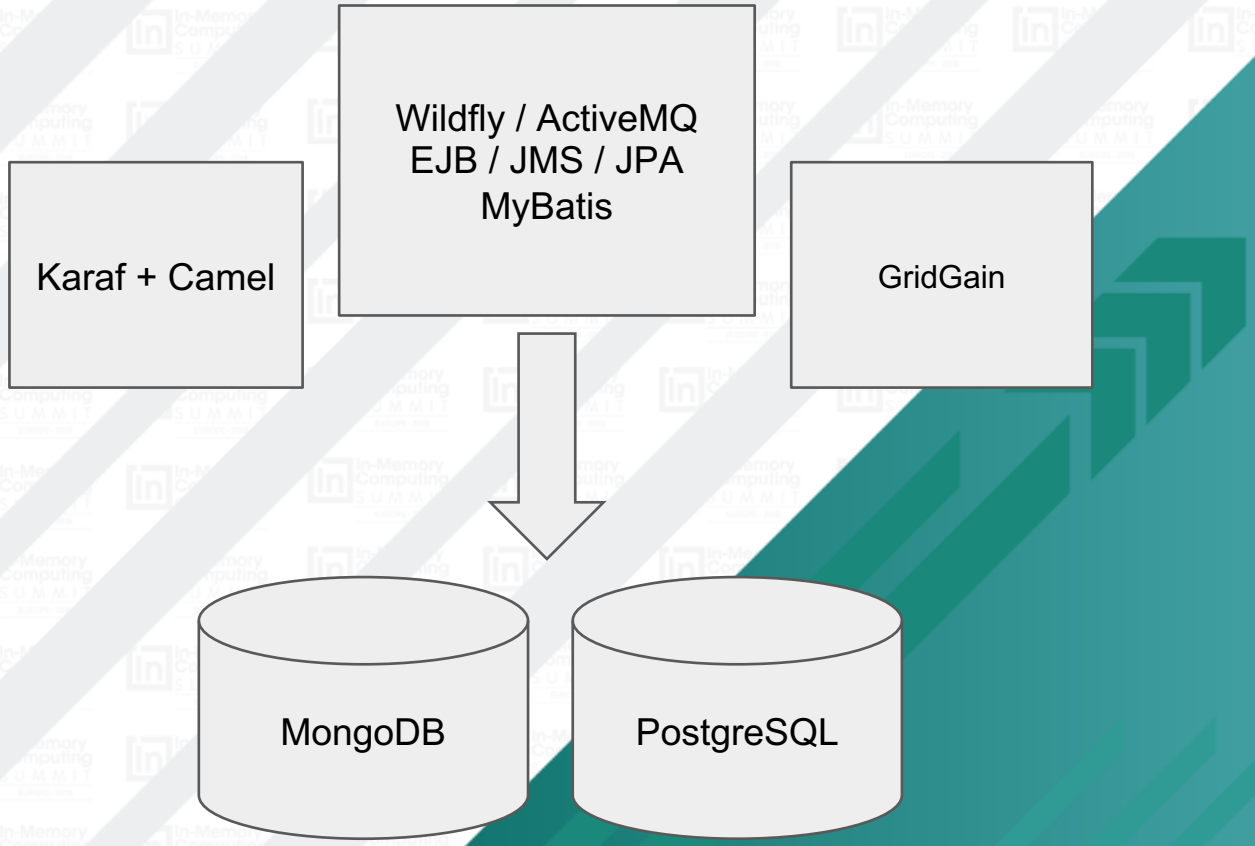
Growing pains and patches c. 2010 - 2014

- OpenJMS replaced with ActiveMQ
- Scope of JPA restricted - buggy and slow at high volumes
- Caching of sports data via memcached
- MongoDB for document based data structures
- Added ESB with karaf / camel for external data interfacing



Ready for growth c. 2014 - present

- GridGain caching and processing bespoke data
  - sports data - more reads than writes
  - fast risk and liability calculations
- GridGain for distributed locks
- PostgreSQL still “master” - final safeguard for data integrity
- Scale horizontally adding VMs
- Now run 9 different instance of platform



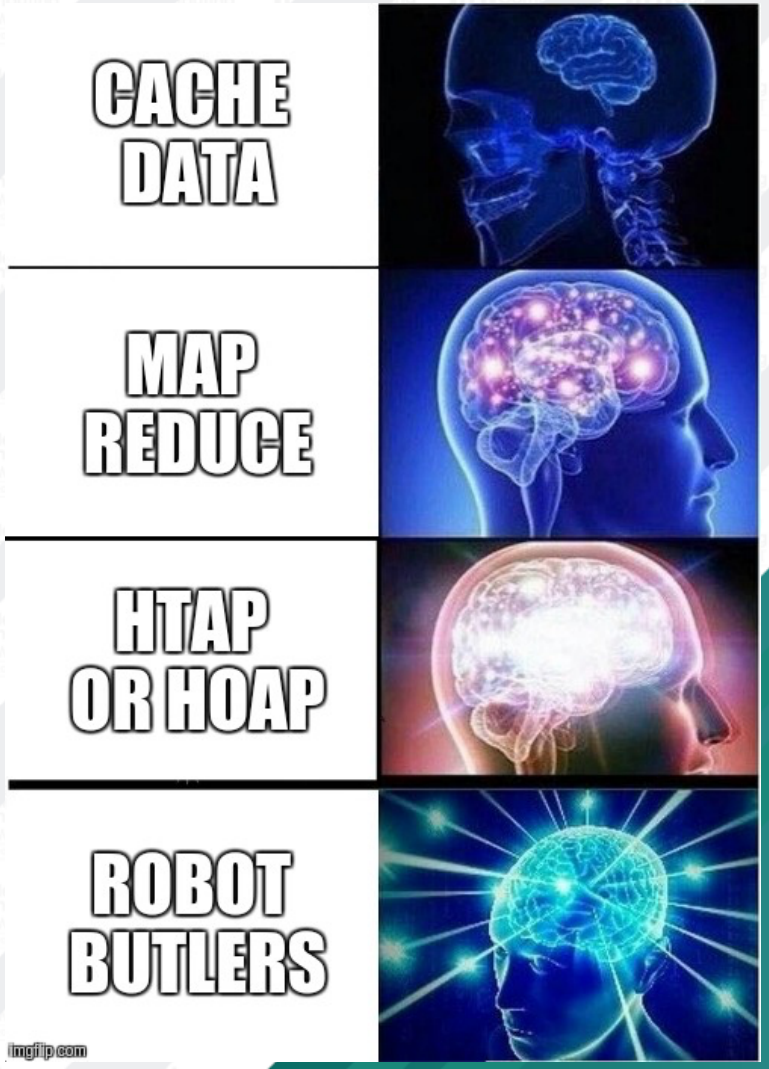
Where does FSB's Technology go next?

- Platform stable and scalable - much new development driven by customers
- The need to keep innovating
  - Entrepreneur's / CTO's mindset?
  - But how to measure value?
- Bigger customers want more "Enterprise" guarantees
  - Security, DR, minimal downtime

Growing a business takes patience

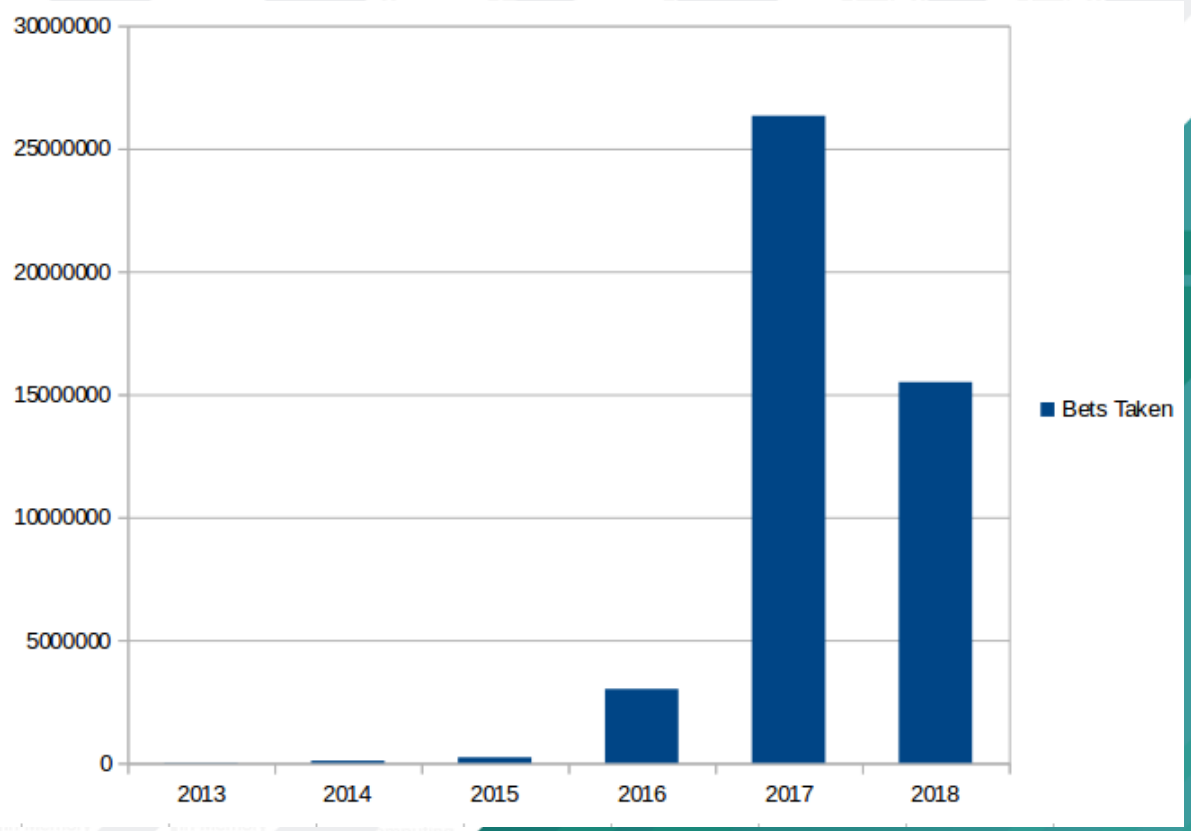
3. In-Memory Computing - what I've learnt

- The key drivers
  - Increase performance
  - Handle richer / faster data
  - Allow horizontal scaling
  - Redundancy
- Relationship with storage
  - Faster / cheaper
  - Data that needs to be kept
  - Data that can't be kept too long
  - Persistent memory



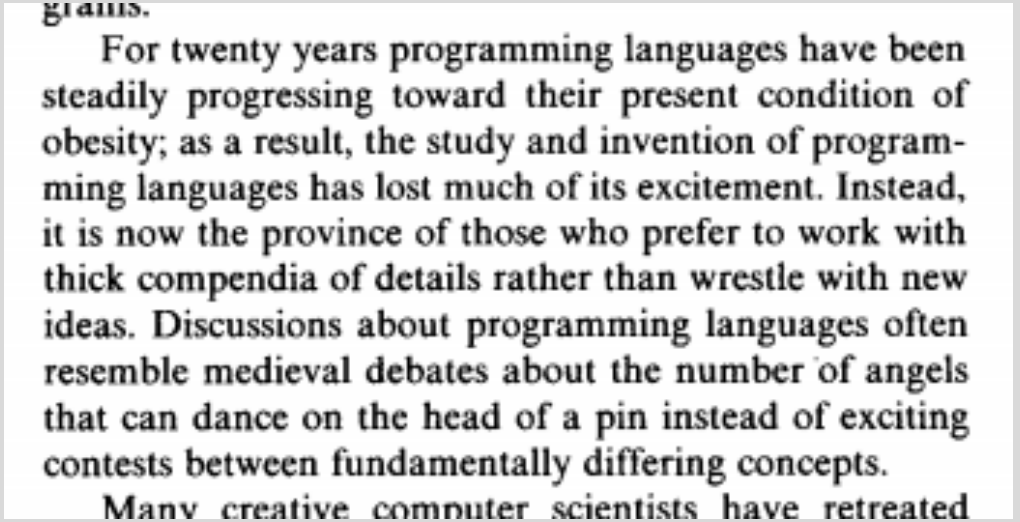
What questions did I ask when looking for a solution?

- Performance
- Redundancy
- Scale with needs / volume
- Cost / benefits
- Community
- Support
- Development



What about the developers?

- Okay, you want to do In Memory computing
  - Do you need a different mindset?
  - What framework should you use?
    - ...Events
    - ...Streams
    - ...Services
    - ...Big data
  - How do you develop?
    - Use DevOps tools - ansible, VirtualBox
  - How do you test?
    - Concurrency issues are hard!



grams.

For twenty years programming languages have been steadily progressing toward their present condition of obesity; as a result, the study and invention of programming languages has lost much of its excitement. Instead, it is now the province of those who prefer to work with thick compendia of details rather than wrestle with new ideas. Discussions about programming languages often resemble medieval debates about the number of angels that can dance on the head of a pin instead of exciting contests between fundamentally differing concepts.

Many creative computer scientists have retreated

John Backus 1978 - “Can Programming Be Liberated from the von Neumann Style? A Functional Style and Its Algebra of Programs”

4. Wrapping up

- Sports Betting is an exciting industry for tech
- In-Memory computing was essential to enable scale
- Relieved to have a firm foundation, but still many problems to solve
- Excited about the future

Thank you!

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