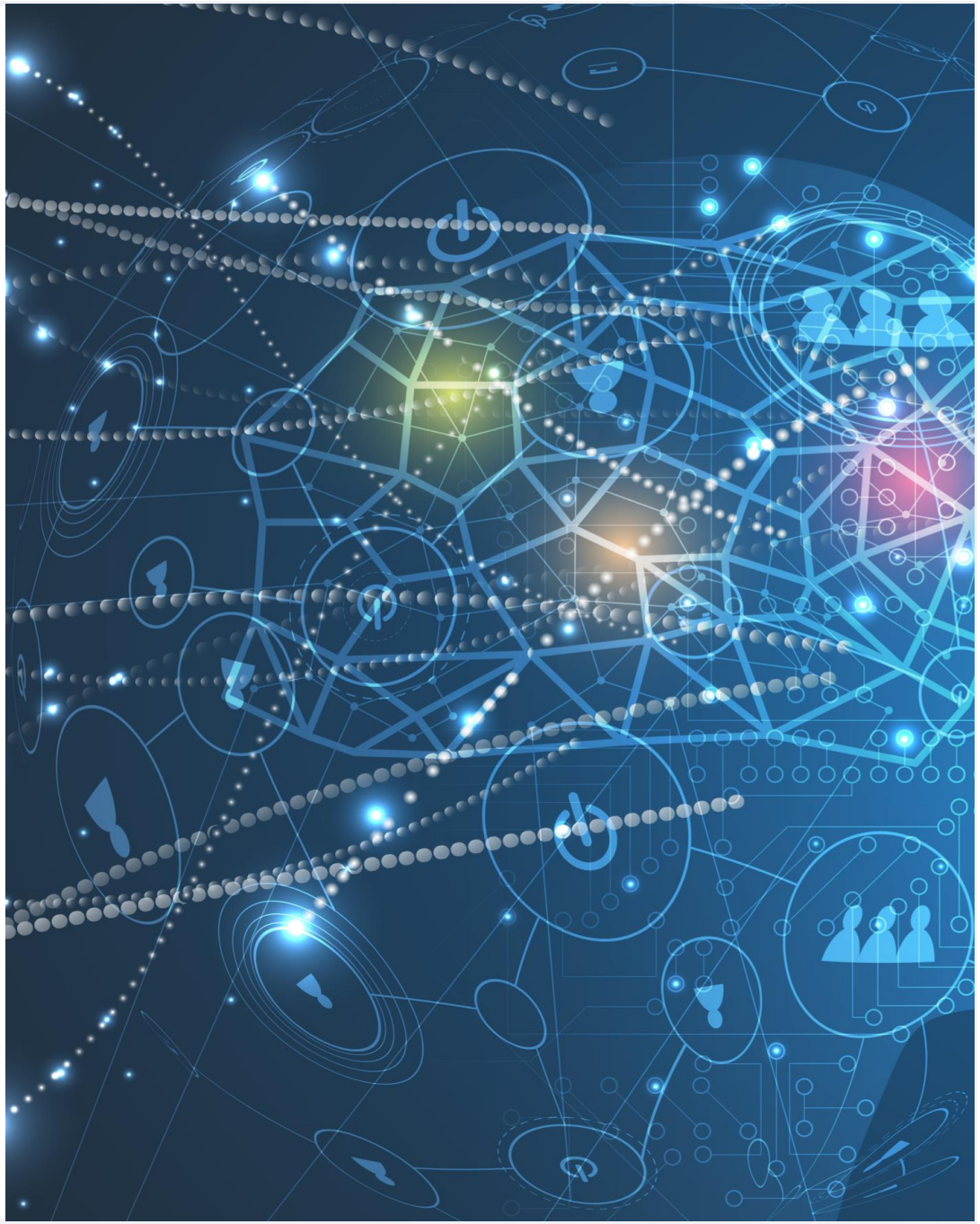
# How W3C Drives Innovation: What's Next for the Web



**J. Alan Bird**

**WMO Future Technology Workshop**

**20 March 2019**

# Who is W3C

The World Wide Web Consortium (W3C) is an international community that, since 1994, develops open standards to ensure the long-term growth of the Web.

# Key Facts

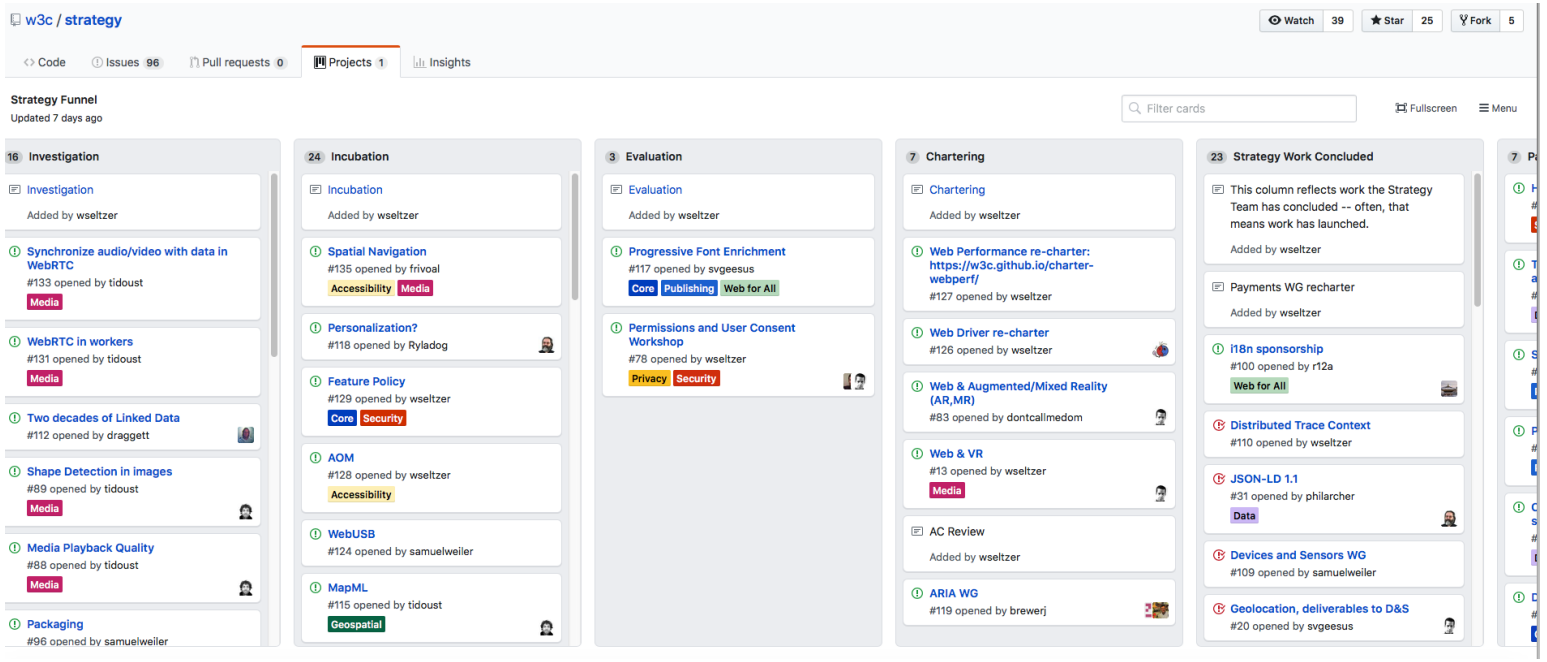
- Founded in 1994 by Web inventor Tim Berners-Lee
- ~460 Members; full-time staff ~70
- Community of 10,000
- Liaisons to drive interoperability
  - ISO TC 68, ISO 20022, IETF, …
- Hundreds of specifications, royalty-free

*In 2016, Tim Berners-Lee received the*

***Turing Award** for his invention of the Web.*

# W3C Community:  Focus on Innovation

- W3C is an open innovation community
- As more technology platforms migrate to the Web, W3C is broadening its focus to provide collaboration, facilitation, and technical guidance to a growing set of stakeholders.

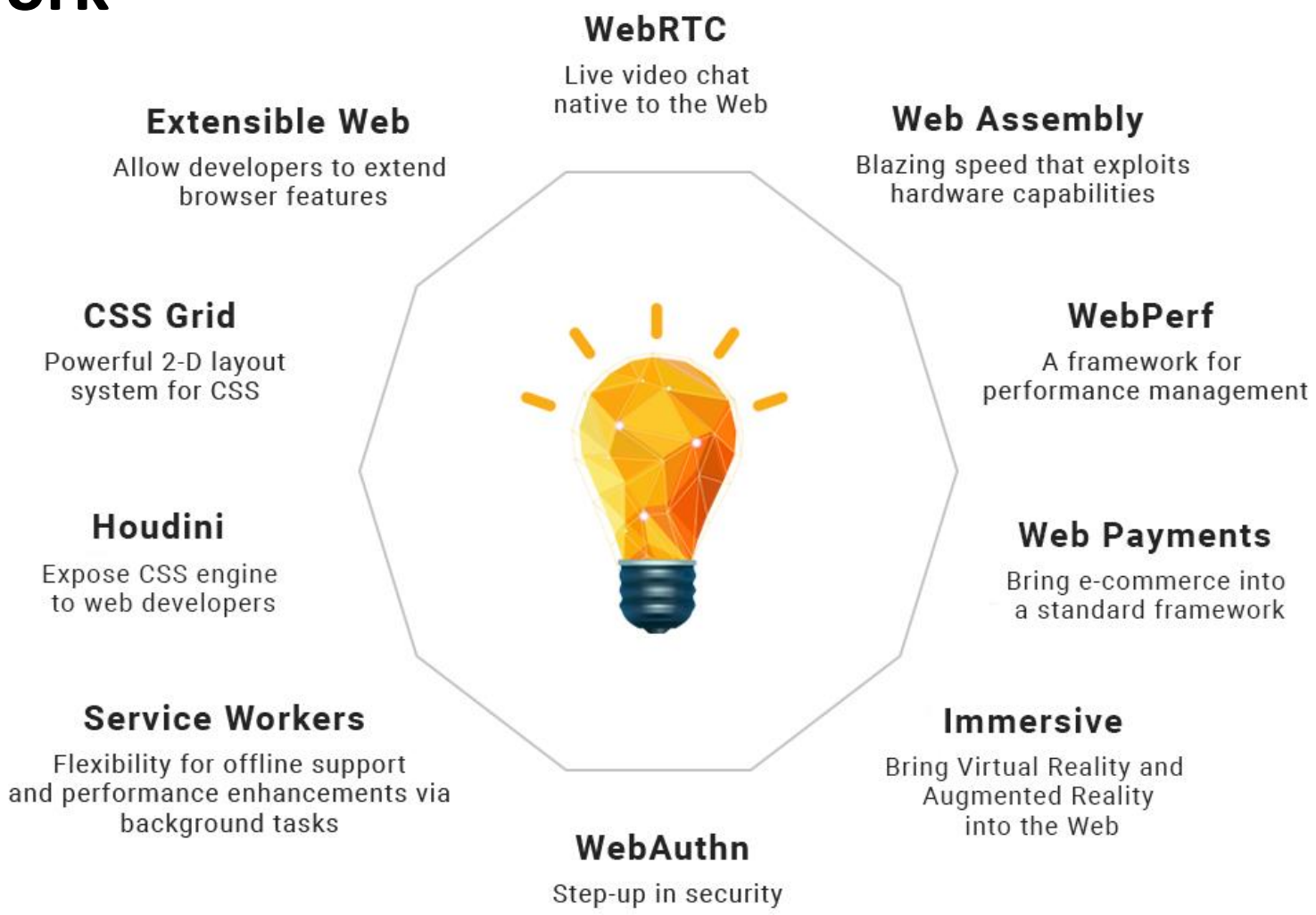


# Core Web: Stewards of the Open Web Platform

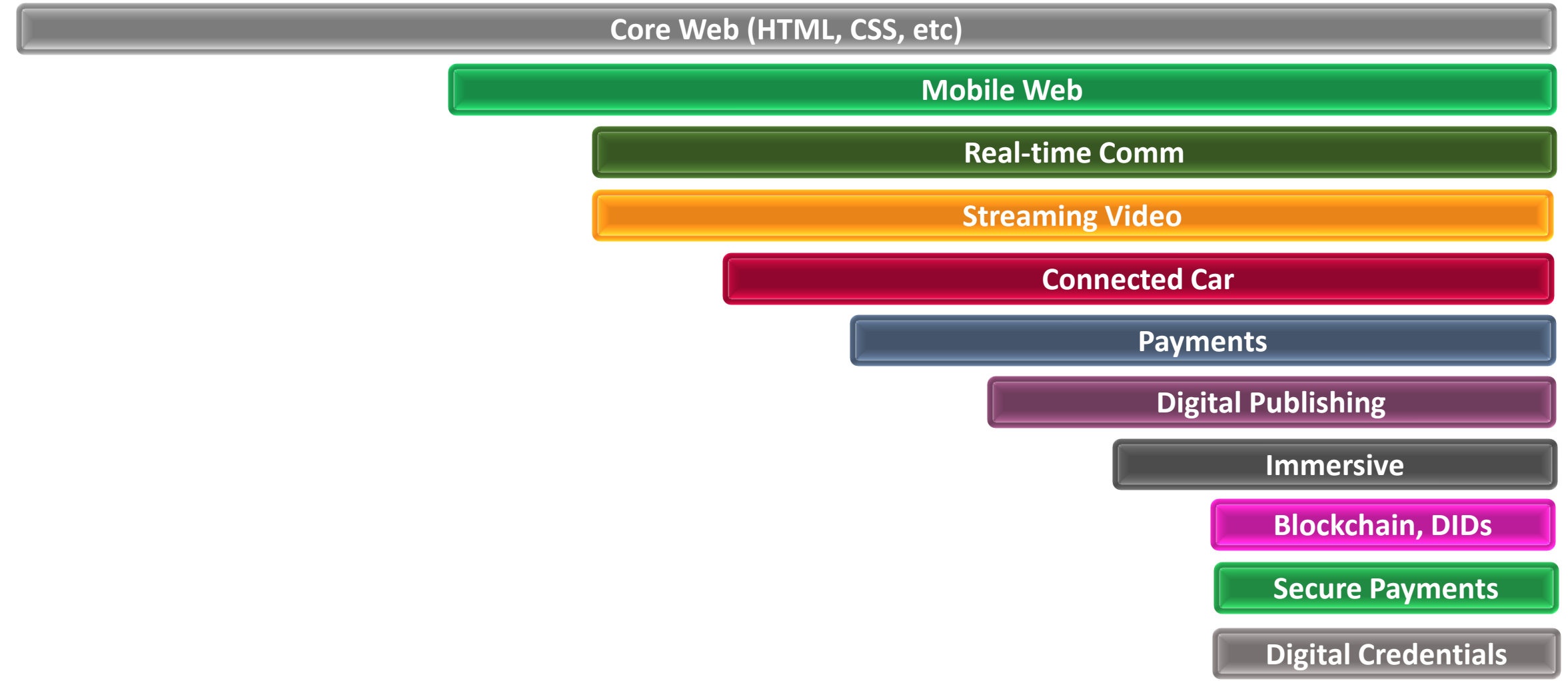
- The Open Web Platform is a full-fledged programming environment for cross-device, cross-platform applications
- HTML5, W3C standard, is the cornerstone
- Most interoperable platform in history
- A billion Web sites
- Millions of developers
- Constant demand for new capabilities and greater security
- An open platform for all: accessibility and internationalization are core to the mission

# W3C Expands Core Capabilities of the Web

## Current Work

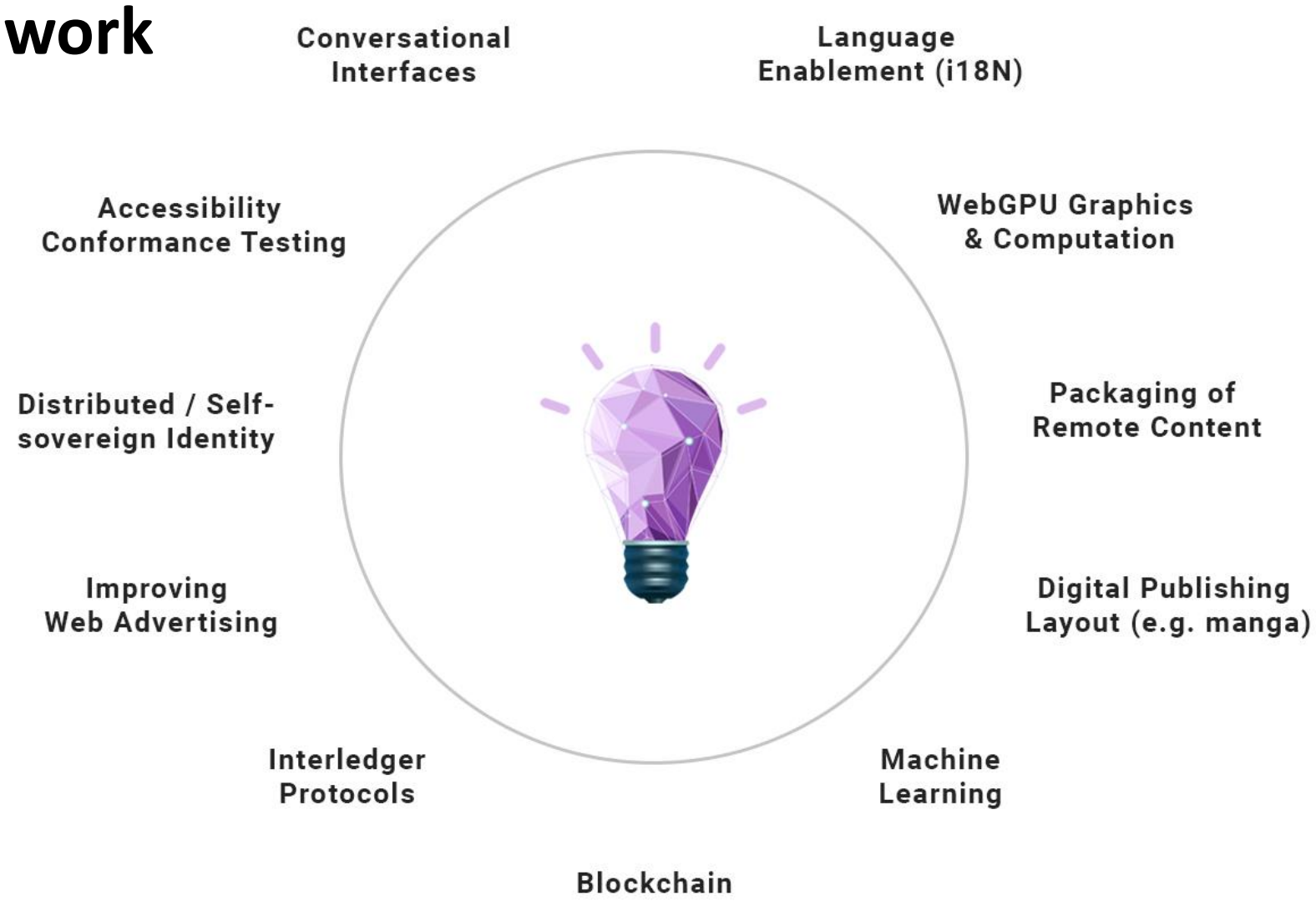


# Focus Areas of Innovation

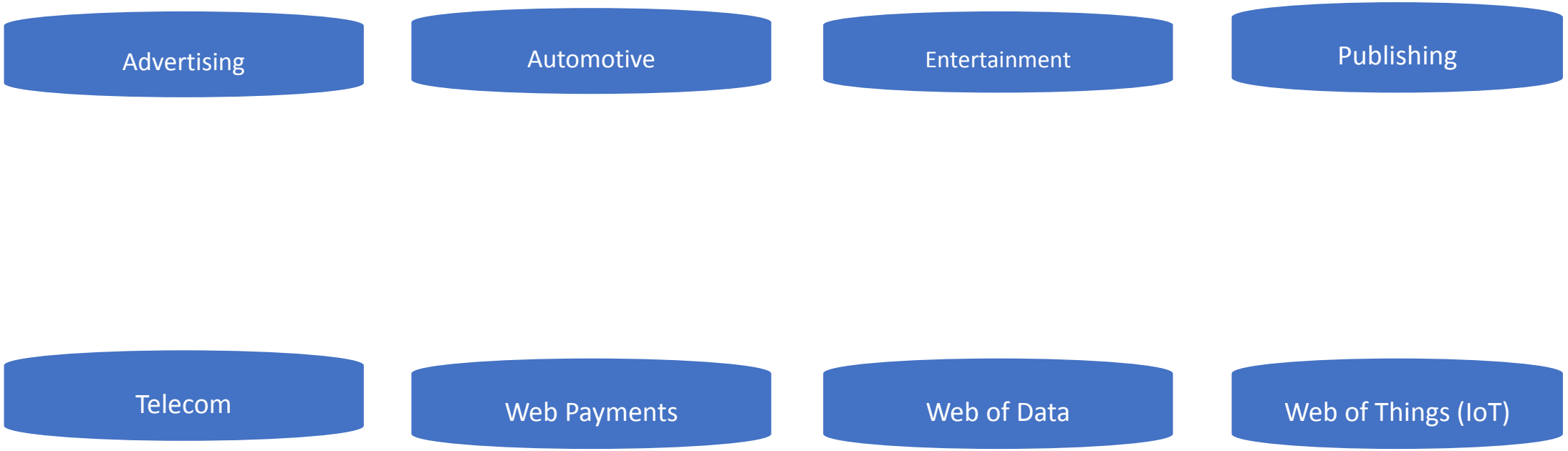


# Core Web Capabilities: Future Innovations

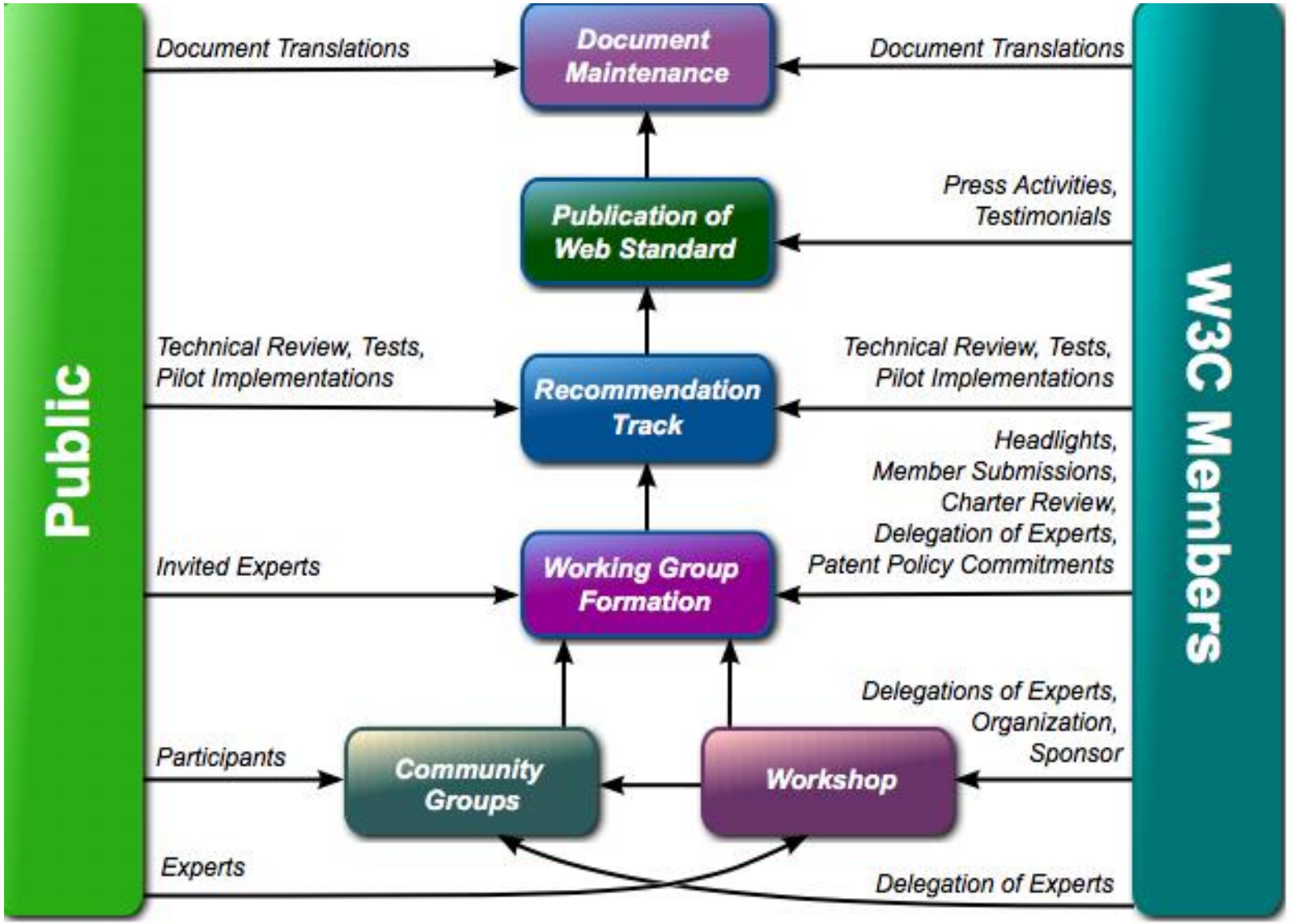
## Future work



# Innovation in Industry Vertical Segments



# W3C Standards Process




W3C & Web of Data

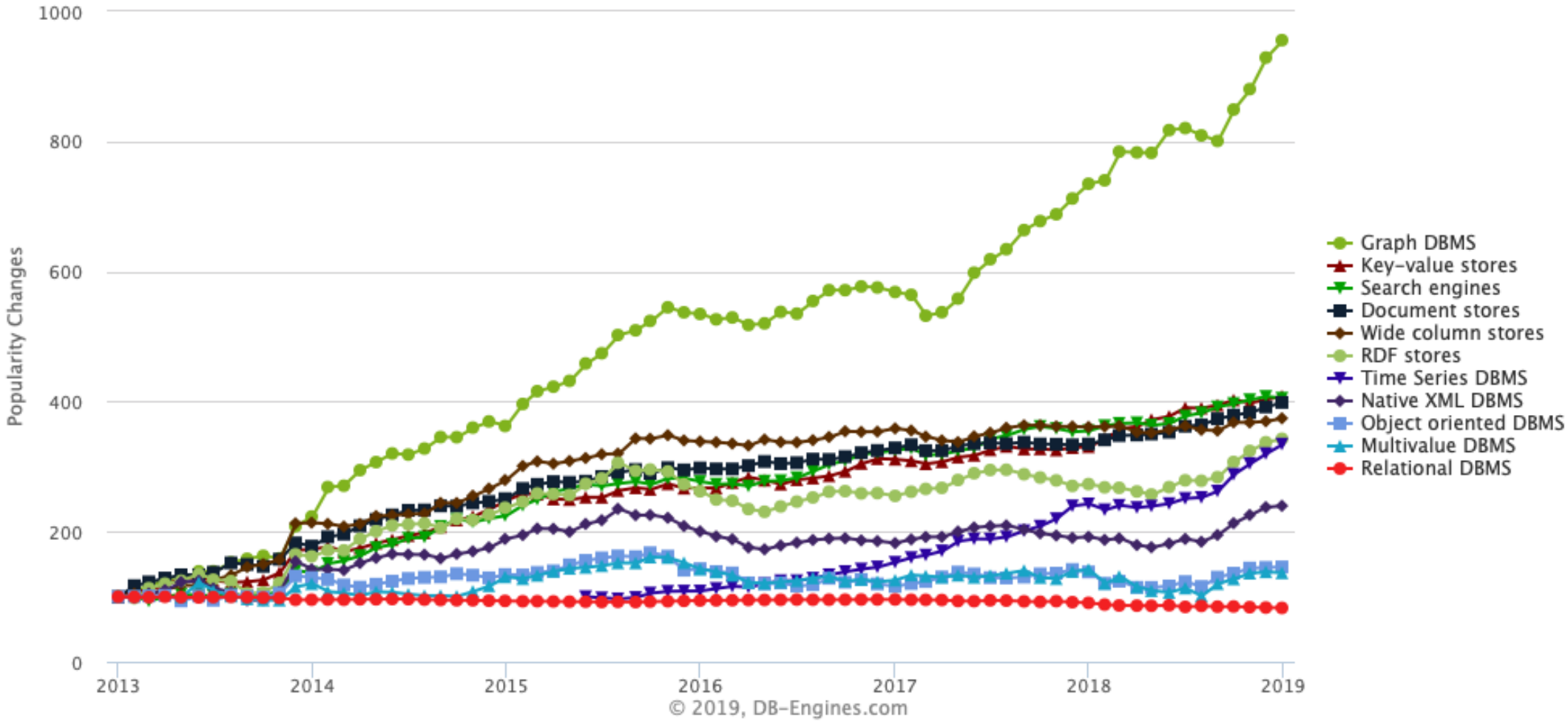
# The Web makes data easy to share

- Faster Internet speeds, cheaper storage and faster computers are making it easier to share data, ***lots of data****!*
- Machine Learning is making it easier to extract value from data
- Greater value from combining many different kinds of data sets
- But we need to know what the data ***means*** as well as its format and how to access it
- Metadata is thus key to semantic interoperability as well as to the terms and conditions under which data is shared.

# Different Data Systems

- Tabular data (SQL/RDBMS) is awkward for combining heterogeneous data sources
- Graph data is much easier and faster to process
- Graphs can be used for both data and metadata
- Rapid uptake and growth in commercial solutions
- But there is a lack of standards and interoperability across many commercial graph database solutions
- W3C by contrast has a mature suite of standards for RDF & Linked Data
- Moreover, W3C's standards makes it easy to support the decentralized Web

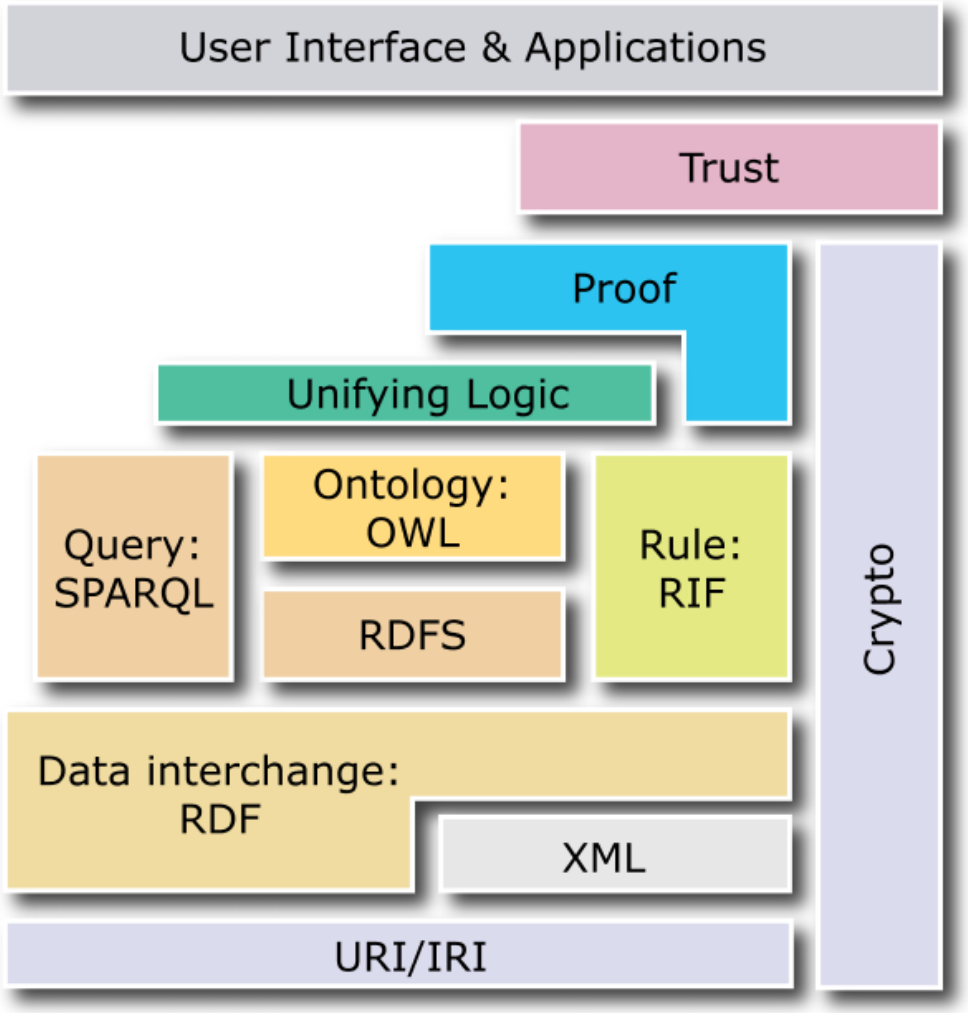
# Rapid Growth in Graph Databases




Courtesy of dbengines.com

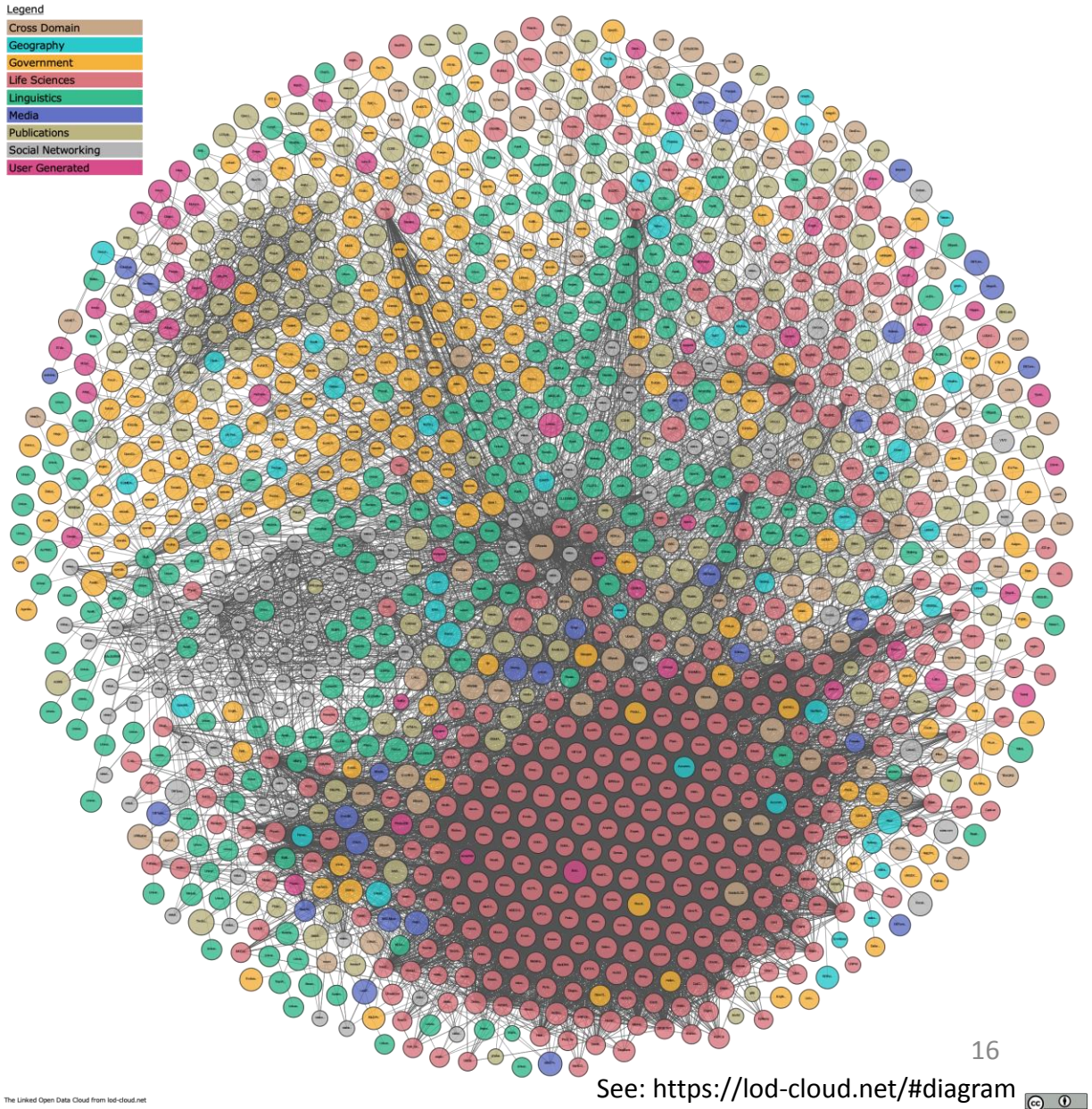
# Mature Suite of Standards

- RDF Core with binary relationships
  - <Subject, Predicate, Object>
- Ontologies with OWL and RDFS
- Shape Constraints with SHACL
- Queries with SPARQL
- Rules with RIF
- Serialization formats such as
  - Turtle, N3, JSON-LD, XML
- R2RML: RDB to RDF Mapping Language
- CSV: Generating RDF from Tabular Data on the Web
- Underpinned by Description Logic and associated Reasoners



# Linked Data

- RDF uses URIs for identifiers
- HTTP identifiers can be dereferenced to get further metadata
- Rapidly expanding set of Open Linked Datasets
- W3C DCAT standard for datasets




See: https://lod-cloud.net/#diagram

# Do you mean what I mean?

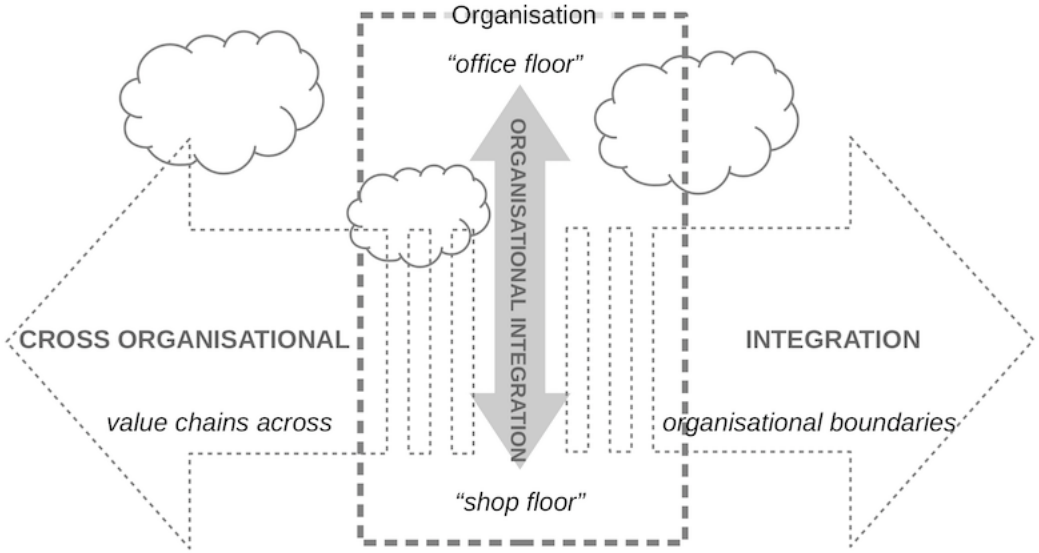
- How do we know we agree on the meaning of data?
- Different communities will have different requirements and come up with different vocabularies of terms
- Ideally, communities will reuse existing vocabularies where available
- But this may not always be practical
- This requires work on mapping data between different vocabularies
- Challenge of different systems of identifiers

# W3C Graph Data Workshop

- 4-6 March 2019, Berlin, hosted by Neo4J
- Building bridges across SQL, Property Graphs, RDF and AI/ML
- We now plan to launch a ***Business Group to focus on Graph Data and the Digital Transformation of Industry***
- “Digital transformation is no longer optional for industrial companies. The problem is it’s really, really hard”
  - *Vijay Govindarajan and Jeffrey Immelt, MIT Sloan Management Review, Spring 2019*
- Graph Data as key to Data Management and Governance

# Ecosystems of Digital Services

- Web Hubs as platforms for applications that supply or consume services across the Internet
- Semantic search based upon rich descriptions
- Semantic compositions for value added services
- Data exposed through object oriented interfaces
- Enabler for the Digital Transformation of Industry – horizontal and vertical integration as well as across product lifecycles



# Sentient Web as successor to Semantic Web

- Semantic Web focused on logic and deduction – this is limited and fails to address real world data that is uncertain, incomplete, inconsistent and includes errors
- Sentient Web focuses on **rational belief** combining symbolic information with statistics based upon prior knowledge and past experience
  - Reduced computational requirements compared to Deep Learning
- Building upon extensive work in Cognitive Psychology*
  - Mimicking human memory and reasoning for transparent explanations
  - Large range of reasoning techniques
    - Deductive, inductive, abductive, causal, counterfactual, temporal, spatial, etc.
    - Together with efficient graph algorithms
  - Continuous learning
    - Heuristics, simulated annealing, reinforcement learning
- Contact Dave Raggett <dsr@w3.org> if you want to know more

* A big debt to John R. Anderson for his many years of work at CMU on the ACT-R cognitive architecture

# The Sentient Web: *IoT + graphs + AI/ML*

**Ecosystems** of services with ***awareness*** of the world through sensors, and ***reasoning*** based upon graph data & rules together with graph algorithms and machine learning

- The Sentient Web embeds the Web of Things
  - Tackling the fragmentation of the IoT with an abstraction layer we call the Web of Things
    - Things as digital twins for physical and virtual devices
    - Things have RDF URIs as the basis for describing their capabilities and the relationship to the context in which they reside
    - Things are exposed to applications as local software objects with properties, actions and events, decoupling applications from network details and device location

# Value of Web Standards

Having a standards-based, open platform for applications will increase the market and enable apps to run on all vehicles.

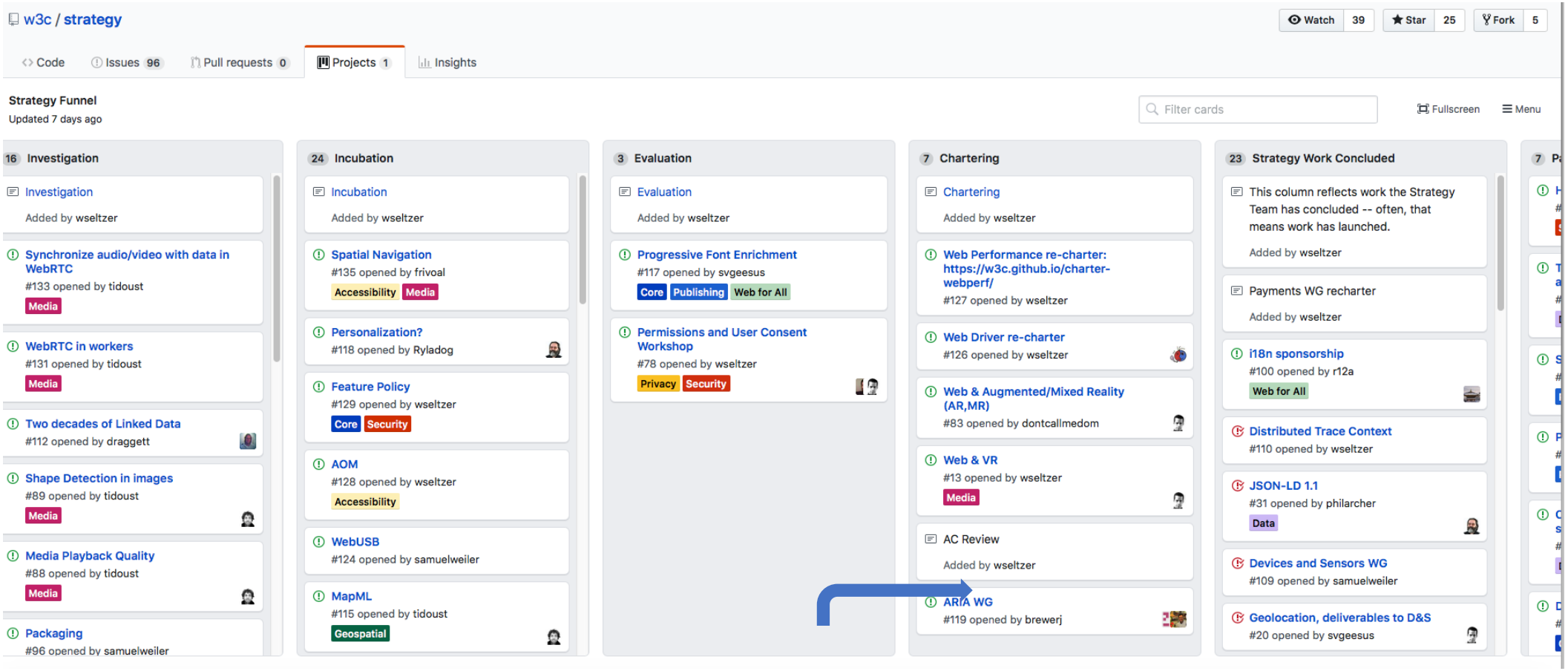
# Web for All


Tim Berners-Lee’s message at London Olympics that the Web is for Everyone

# How to Participate

# W3C Culture of Innovation and Collaboration

# W3C Strategy Funnel Identifies, Tracks new Work



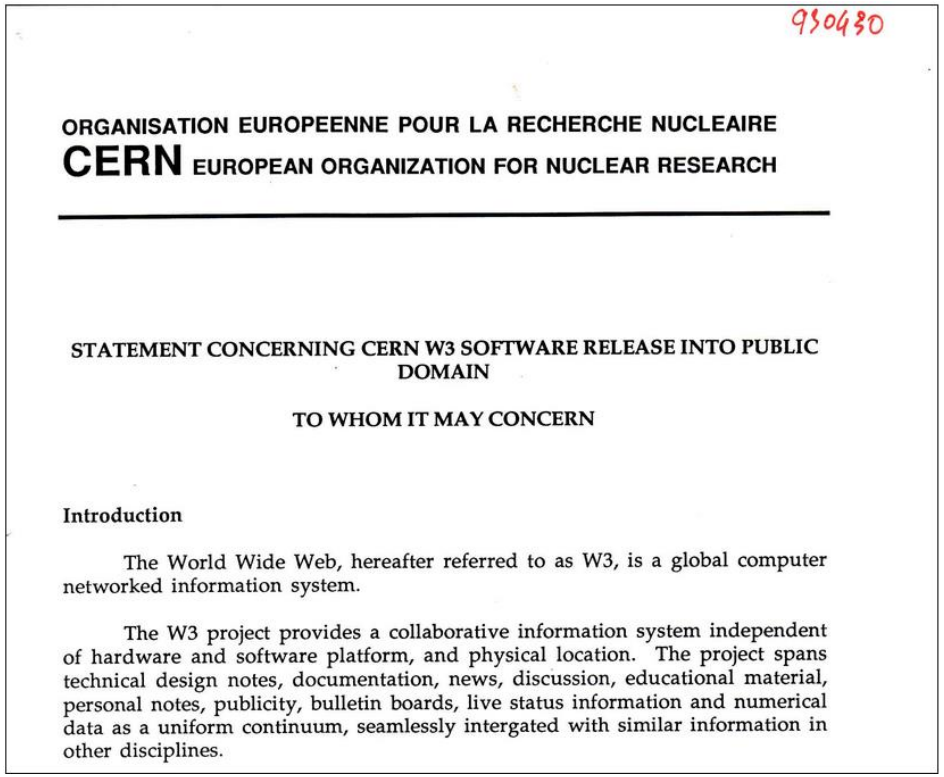

**Immersive Web Group Charter was a direct result of community group incubation**

# How W3C Works

- Royalty-Free Patent Policy.
- Member organizations set priorities for the work
- All employees from member organizations may join any W3C group.
- Advisory Board is elected by W3C membership and meets quarterly with W3C CEO.
- Technical Advisory Group (TAG) – architecture of the Web focus –is also elected by AC Rep votes.
- W3C Process Document and Patent Policy Governs the Work.

# Royalty-Free Standards

*In April 1993, Tim Berners-Lee arranged for CERN to license code for the Web royalty-free*



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ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

STATEMENT CONCERNING CERN W3 SOFTWARE RELEASE INTO PUBLIC DOMAIN

TO WHOM IT MAY CONCERN

**Introduction**

The World Wide Web, hereafter referred to as W3, is a global computer networked information system.

The W3 project provides a collaborative information system independent of hardware and software platform, and physical location. The project spans technical design notes, documentation, news, discussion, educational material, personal notes, publicity, bulletin boards, live status information and numerical data as a uniform continuum, seamlessly intergated with similar information in other disciplines.

*W3C has published more than 600 specifications (including 137 Recommendations) under a Royalty-Free Patent Policy*

# Horizontal Reviews Required for All W3C Working Groups

- Accessibility
- Internationalization (i18n)
- Privacy
- Security

# Membership Benefits

- Shape the future and prioritization of Web standards
- Network, develop expert resource contacts
- Create business partnerships with global technology leaders
- Provide strategic direction, new perspectives and your specific use cases to the Web community

# Membership Benefits

- Competitive advantage and compliance through early testing and adoption
- Leverage engineering resources of multiple organizations to establish and share best practices
- Reduce costs  and accelerate implementation times
- Stay connected and up-to-date through W3C staff briefings, events, and annual meetings

# Web Accessibility Emmy Award 2016

Photo credit: "Cashman Photo, Las Vegas, NV & The National Academy of Television Arts & Sciences"

*2016 Emmy ® Award from the National Academy of Television Arts & Sciences for making Web video content more accessible with text captioning and subtitles.*

# Thank you!


**J. Alan Bird**

@JAlanBirdW3C

alan.bird@w3.org



**@w3c**