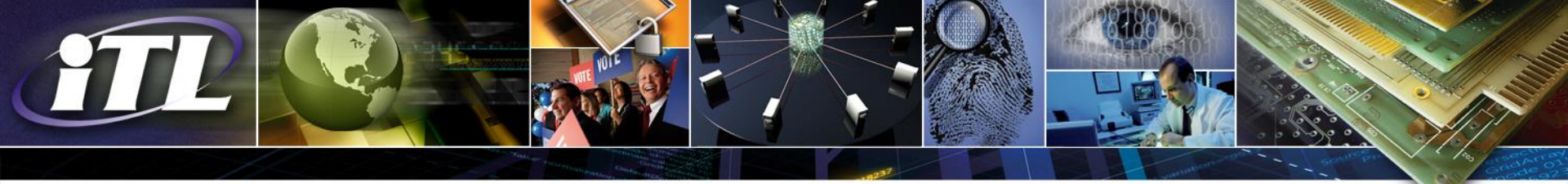
# Standard Big Data Architecture and Infrastructure


***Wo Chang***
**Digital Data Advisor**
**Information Technology Laboratory (ITL)**
**National Institute of Standards and Technology (NIST)**
**wchang@nist.gov**


**May 20, 2016**




## Agenda

- Brief Introduction – background, projects, interests
- Big Data Architecture and Infrastructure – challenges and opportunities
- Samples of Independent Big Data Activities
- Collaboration Focus Areas – Join Big Data international standards development
- Other Topics: Make application domains (Big Data, IoT, CPS, Smart Cities, etc.) available

## Brief Introduction: Wo Chang

**Mr. Wo Chang, Digital Data Advisor, NIST Information Tech. Lab. (ITL)**

- Responsibilities: Open data and big data interoperability. Mr. Chang currently the Convener of the ISO/IEC JTC 1/WG9 Working Group on Big Data, co-chairs the NIST Big Data Public Working Group, and chairs the ISO/IEC JTC/1 SC 29 WG11 (MPEG) Multimedia Preservation AHG.

- Prior to joining ITL Office, Mr. Chang was manager of the Digital Media Group in ITL and his duties included oversees several key projects including digital data archival and preservation, management of electronic health records, motion image quality, cloud computing, and multimedia standards. In the past, Chang was the Deputy Chair for the US INCITS L3.1, chaired several other key projects for MPEG, participated with the HL7 and ISO/IEC TC215 for health informatics, IETF for the protocols development, and was one of the original members of the W3C's SMIL and developed one of the SMIL reference software.

## Brief Introduction: Projects and Interests

- **NIST Big Data Public Working Group, Co-Chair**

  **ISO/IEC JTC 1/WG 9 Working Group on Big Data, Convener**

  Develop a reference architecture that is vendor-neutral, technology- and infrastructure-agnostic to enable any stakeholders to perform analytics processing for their given data sources without worrying about the underlying computing environment.

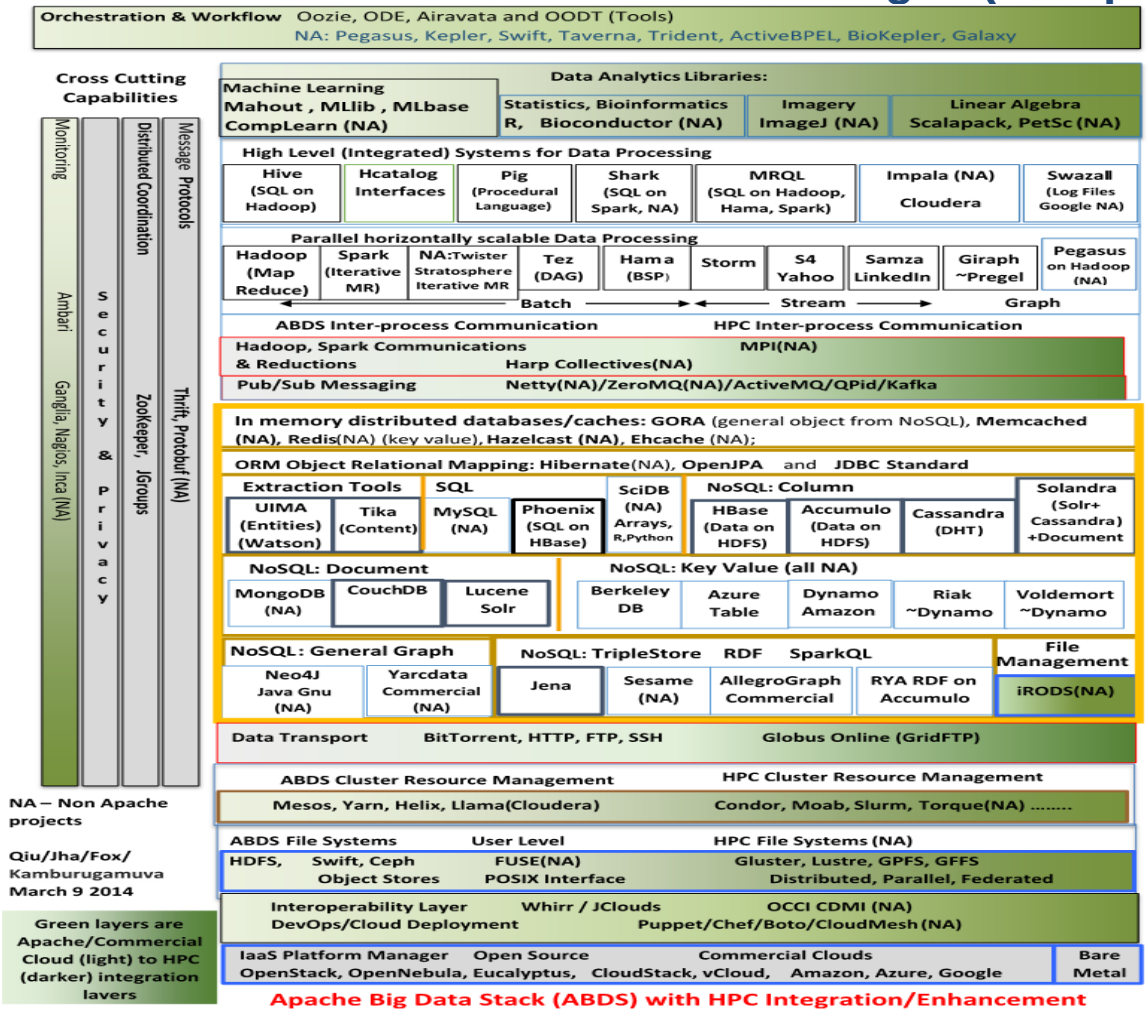
- **NIST Ubiquitous Data Interoperability, Lead Architect**

  Develop an interoperable data infrastructure that is scalable to enable automatic data mashups between heterogeneous datasets from various domains without worrying about the data source and structure.

- **Research Interests**

  Scalable graph mining algorithms and visual analytics for massive audiovisual content, digital data mashup, cloud computing, content metadata description, multimedia synchronization, and Internet protocols.

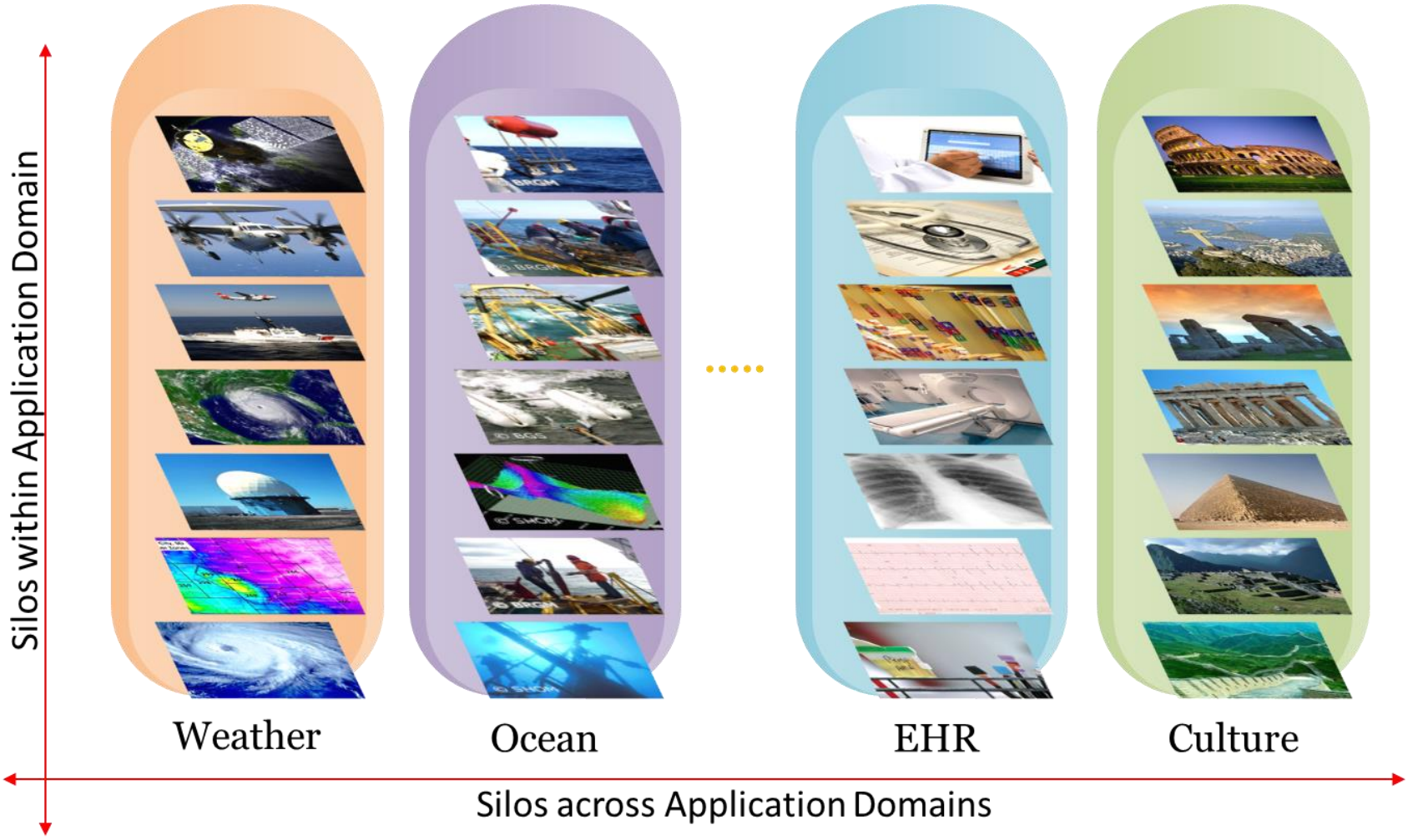
# Big Data Architecture and Infrastructure – Challenges (Computing Stack)



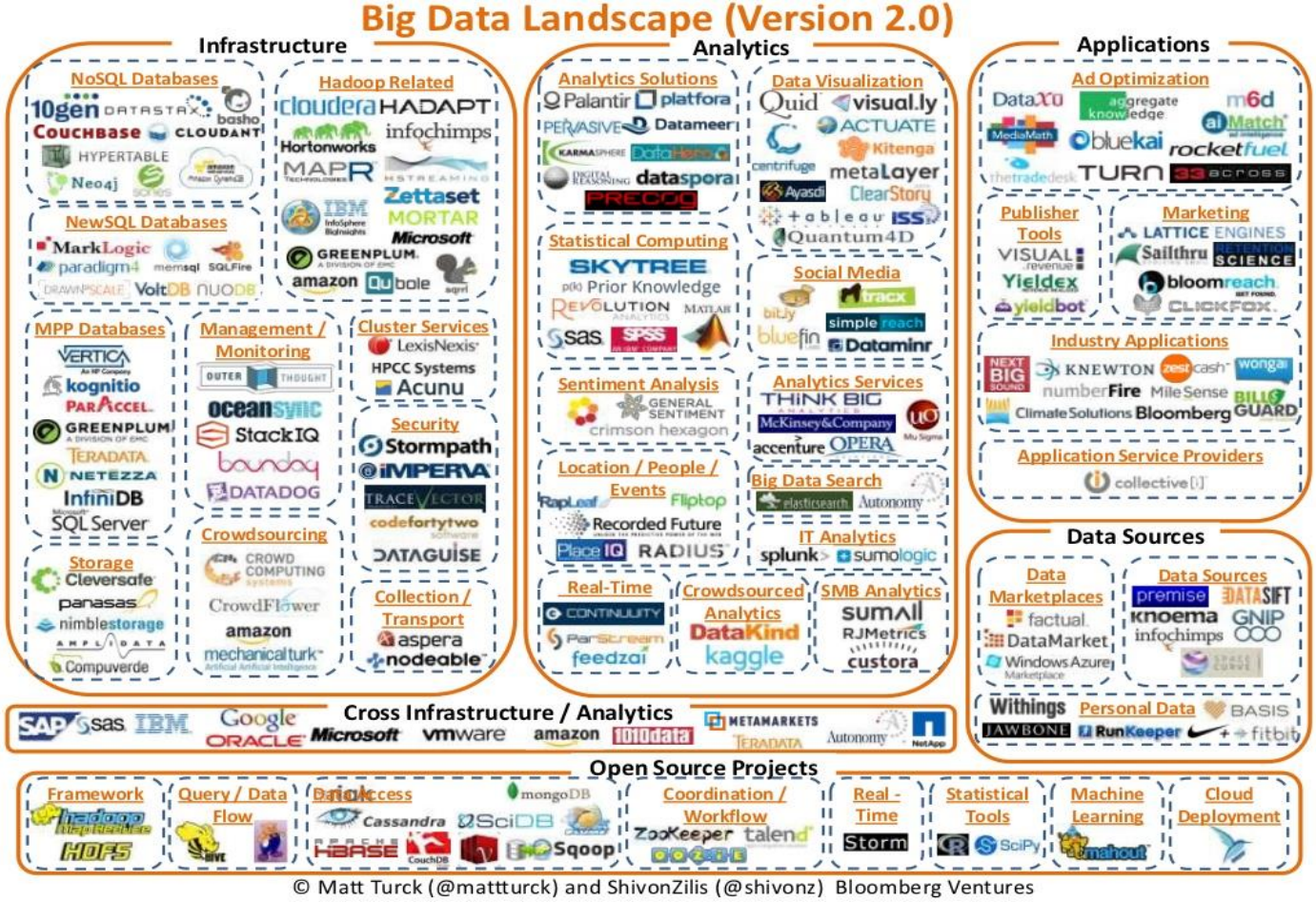
# Big Data Architecture and Infrastructure – Challenges (Analytics Stack)

**Source: http://1.bp.blogspot.com/-PKiTQa0mrn4/T_mGb6AI3yI/AAAAAAAAA8Q/TtH7xyjQ3FA/s640/analytics+tools+landscape.bmp**

# Big Data Architecture and Infrastructure – Challenges (Data Stack)



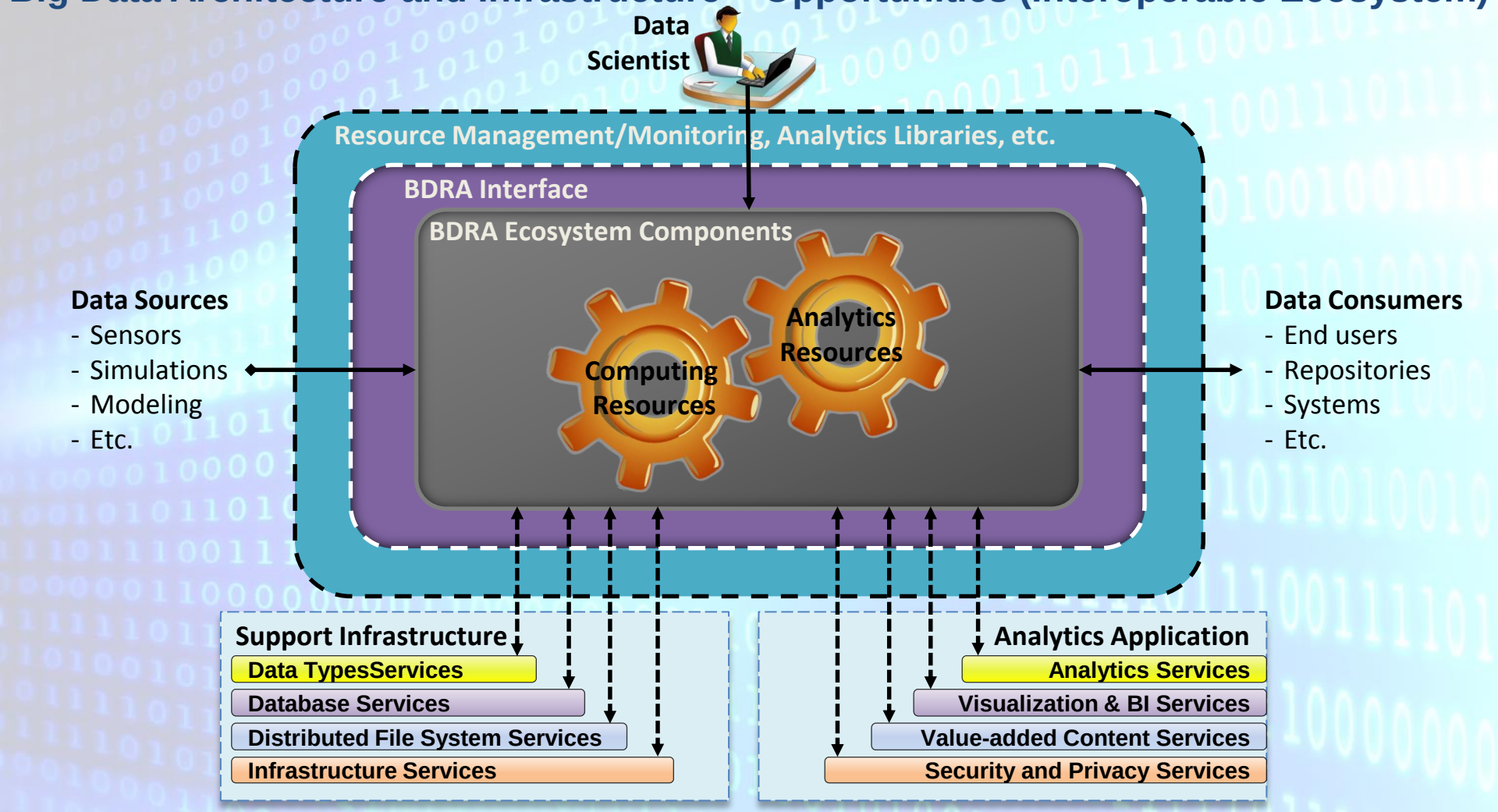
# Big Data Architecture and Infrastructure – Challenges (Integration)




© Matt Turck (@mattturck) and ShivonZilis (@shivonz) Bloomberg Ventures

**Source: http://www.ongridventures.com/wp-content/uploads/2012/10/Big-Data-Landscape.jpg**

# Big Data Architecture and Infrastructure – Opportunities (Interoperable Ecosystem)



# Samples of Independent Big Data Activities

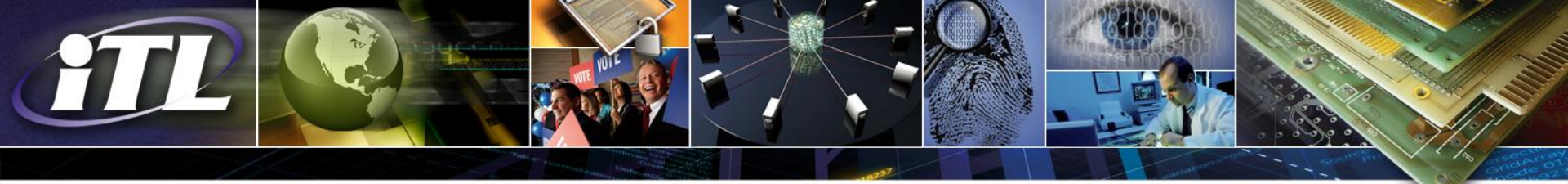
## EU Big Data Value Association (BDVA)

TF0: GA and BOD
TF1: Programme
TF2: Impact
TF3: Community
TF4: Communication

TF5: Legal &Policy
TF6: Technical*
TF7: Application*
TF8: Business*
TF9: Social (Societal)*
TF10: Skills and Education*

* Pending Formalisation

TF6: Technical: Identifying and refining the technical challenges of the programme – eg Data Management
(Created Sub-Group 6 to deal with Big Data standardization)




# Samples of Independent Big Data Activities

## US National Science Foundation (NSF) Big Data Hubs

| Northeast | South | Midwest | West |
|---|---|---|---|
| • Education | • Health Disparities | • Food-Water-Energy | • Big Data technology |
| • Cities / Regions | • Coastal Hazards | • Health Sciences, Life Sciences, Bioinformatics, Genomics | • Managing natural resources and hazards |
| • Discovery Science | • Industrial | • Smart Cities and Communities | • Precision medicine |
| • Energy | • Materials and Manufacturing | • Digital Agriculture (precision farming, sustainability, …) | • Metro data science |
| • Finance | • Habitat Planning | • Advanced Manufacturing | • Data-enabled scientific discovery and learning |
| • Health | | • Network Science | |
| | | • Transportation | |
| | | • Business Analytics | |
| | | • Ring 1: Tools and Services | |
| | | • Ring 2: Data Science | |

## Samples of Independent Big Data Activities

### NIST Big Data Public Working Group (June 2013 – now)

**Goal:** *Develop a consensus-based reference architecture that is vendor-neutral, technology and infrastructure agnostic to enable any stakeholders to perform analytics processing for their given data sources without worrying about the underlying computing environment.*

***V1 (high-level NBD-RA components and descriptions) Big Data Interoperability Framework,*** Released September 16, 2015

http://bigdatawg.nist.gov

**Activities – 5 Subgroups**

1. Definitions & Taxonomies
2. Use Cases & Requirements
3. Security & Privacy
4. Reference Architecture
5. Standards Roadmap

- **NIST SP1500-1: Definitions**
- **NIST SP1500-2: Taxonomies**
- **NIST SP1500-3: Use Cases & Requirements**
- **NIST SP1500-4: Security & Privacy**
- **NIST SP1500-5: Architecture Survey – White Paper**
- **NIST SP1500-6: Reference Architecture**
- **NIST SP1500-7: Standards Roadmap**

# Samples of Independent Big Data Activities

## ISO/IEC JTC 1/WG 9 Working Group on Big Data

**Summary Key Findings:**

- Big Data systems are difficult to construct tools and applications that integrate data from multiple Big Data sources. The systems should be designed with security in mind from the ground up rather than have it emerge as an afterthought.
- Identified 16 potential standardization gaps to enable Big Data Systems interoperability.

**Organizational Drivers to Provide:**

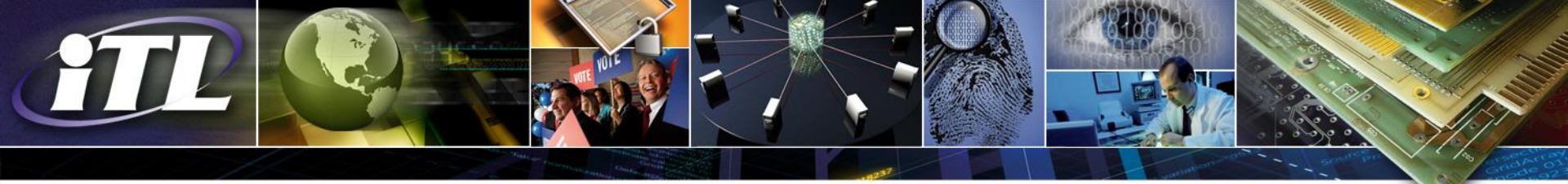
1. Insight: enable discovery of deeper, fresher insights from all enterprise data resources
2. Productivity: improve efficiency, effectiveness, and decision-making
3. Speed: facilitate more timely, agile response to business opportunities, threats, and challenges
4. Breadth: provide a single view of diverse data resources throughout the business chain
5. Control: support tighter security, protection, and governance of data throughout its lifecycle
6. Scalability: improve the scale, efficiency, performance, and cost-effectiveness of data/analytics platforms

* JTC 1 Big Data Report: http://www.iso.org/iso/big_data_report-jtc1.pdf

## Collaboration Focus Areas

### Join Big Data international standards development

- 140+ from 22 NBs: Australia, Austria, Brazil, Canada, China, Finland, France, Germany, India, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, Russian Federation, Spain, Singapore, Sweden, UK, US
- Current Projects
  - **ISO/IEC 20546 Information technology – Big data – Overview and vocabulary**
  - **ISO/IEC 20547 Information Technology – Big data Reference architecture (5 Parts)**
    - Part 1: (TR) Framework and Application Process
    - Part 2: (TR) Use Cases and Derived Requirements
    - Part 3: (IS) Reference Architecture
    - Part 4: (IS) Security and Privacy Fabric (under SC 27/WG 4)
    - Part 5: (TR) Standards Roadmap
- ISO/IEC Liaisons: SC 6/WG 7, SC 27, SC 29, SC 32, SC 36, SC 38, SC 39, ISO/TC 69, ISO/TC 204, ITU-T SG13




## Other Topics

**Make application domains (Big Data, IoT, CPS, Smart Cities, etc.) available**

- Share public accessible ***use cases***
- Share public accessible ***non-PII datasets***
- Share public accessible ***analytics tools***