

# From Pages on the Fly to Workflows in the Cloud

EVOLUTION OF THE WEB ARCHITECTURES

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# 1 World Wide Web in perspective

- ◆ **First Generation Web** – Tim Berners-Lee (CERN, 1993-1995)

*Easy representation of information stored in various files in different formats on a local net*

- ◆ **Second Generation Web** – W3C (MIT, 1995-2001)

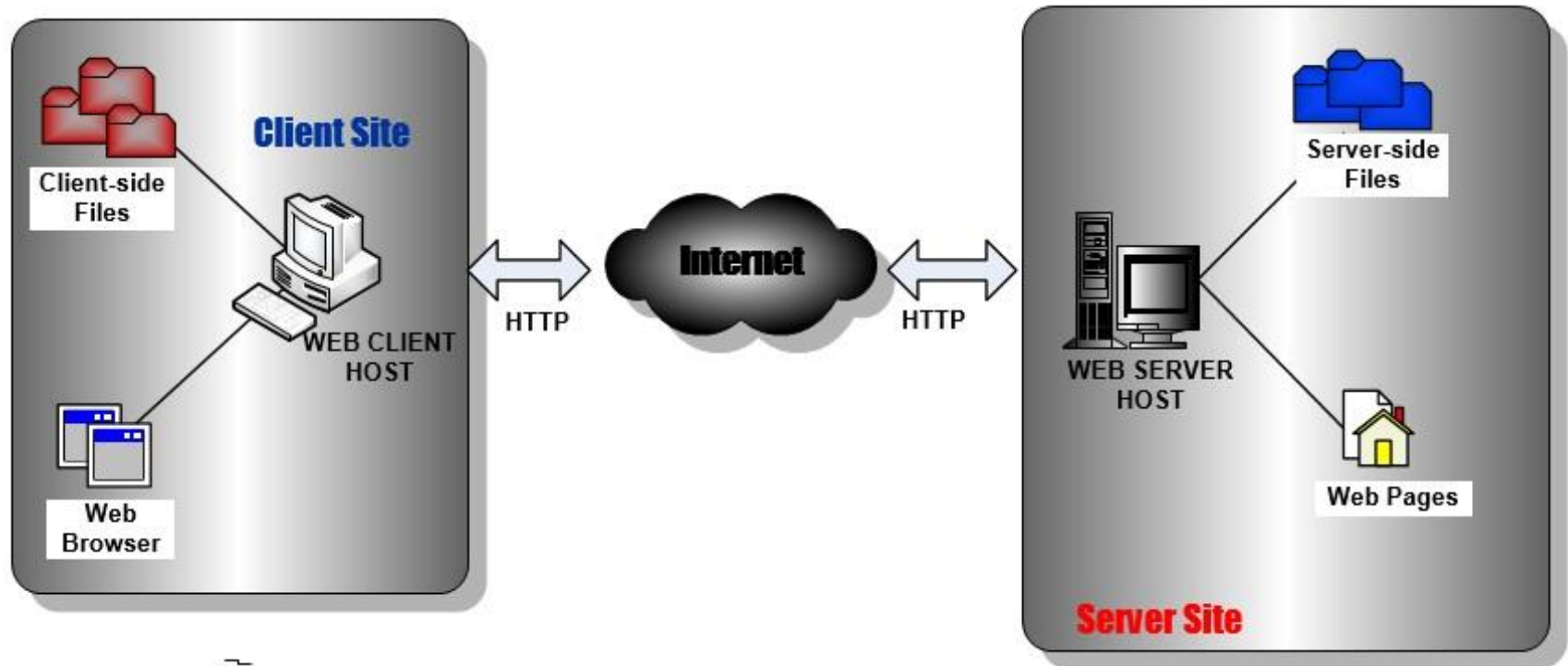
*A giant collection of static and dynamically generated data, preconfigured and dynamically discovered services*

- ◆ **Today's Web – Academia** (Scientific American 2001) vs Industry (Amazon AWS 2003, Google Cloud 2008) *Microservices, process workflows, semantic representations, user profiles, behavior evolutions ...*

- ◆ **Tomorrow's Web (2020-)**

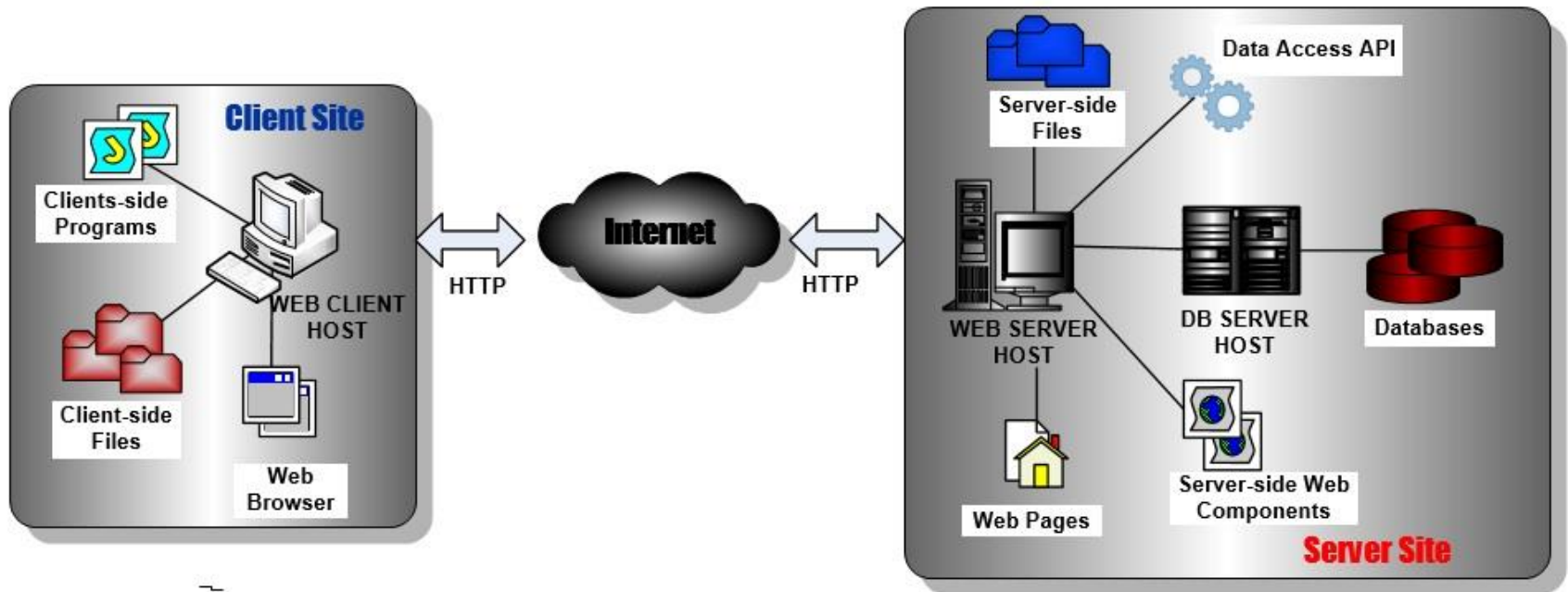
*AI on the Cloud?*

# From the initial Web 0.99...



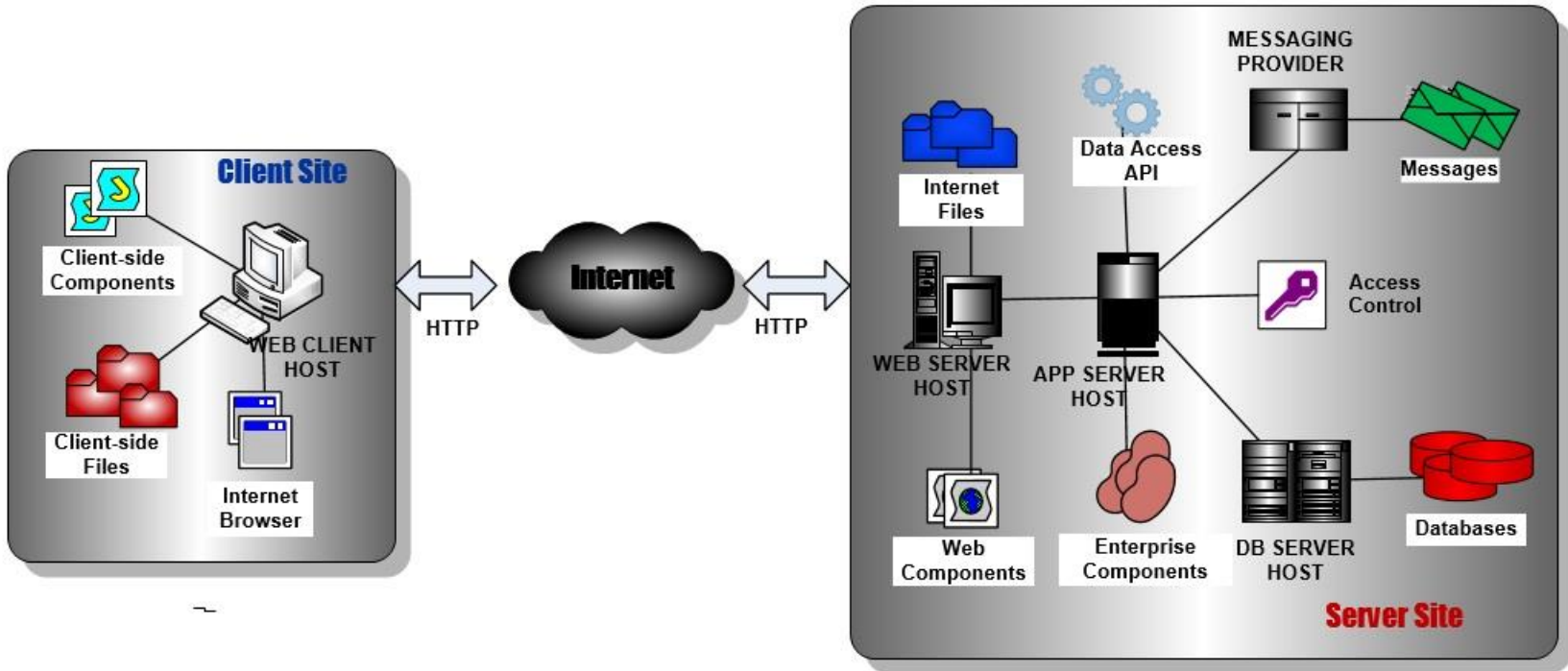
... with the simple set of Web pages

# ... through Web 1.0 ...



... with full-blown Web Applications

# ... and Web 2.0 ...



... with integration of components, services and live feeds

# ... towards Web 3.0, but which way?

1. **Technological route:** Micro Services, Container Orchestration and Workflow Management
2. **Conceptual route:** Ontologies, Knowledge Graphs and Logical Inference
3. **Combined:** Semantic Web Services, AI on Demand and Knowledge Management

# 2 Data Centres, Cloud Services and Application Containerization



- ◆ IaaS, PaaS, SaaS, FaaS: **AWS, Google Cloud, MS Azure** clouds
- ◆ Container Management tools: **Oracle VM, VMWare, Docker** containers
- ◆ DevOps Repositories for agile development: **Slak, Jira, GitHub, GitLab**

# What is the most recent in the cloud age?



- ◆ Private and Hybrid clouds: **Kubernetes** infrastructure – cloud computing behind firewalls
- ◆ FaaS: **Lambdas, Functions** – serverless computing with session maintenance
- ◆ Workflow Management: **AirFlow** – composition, execution and control of containerized services



# Orchestration Languages in DevOps

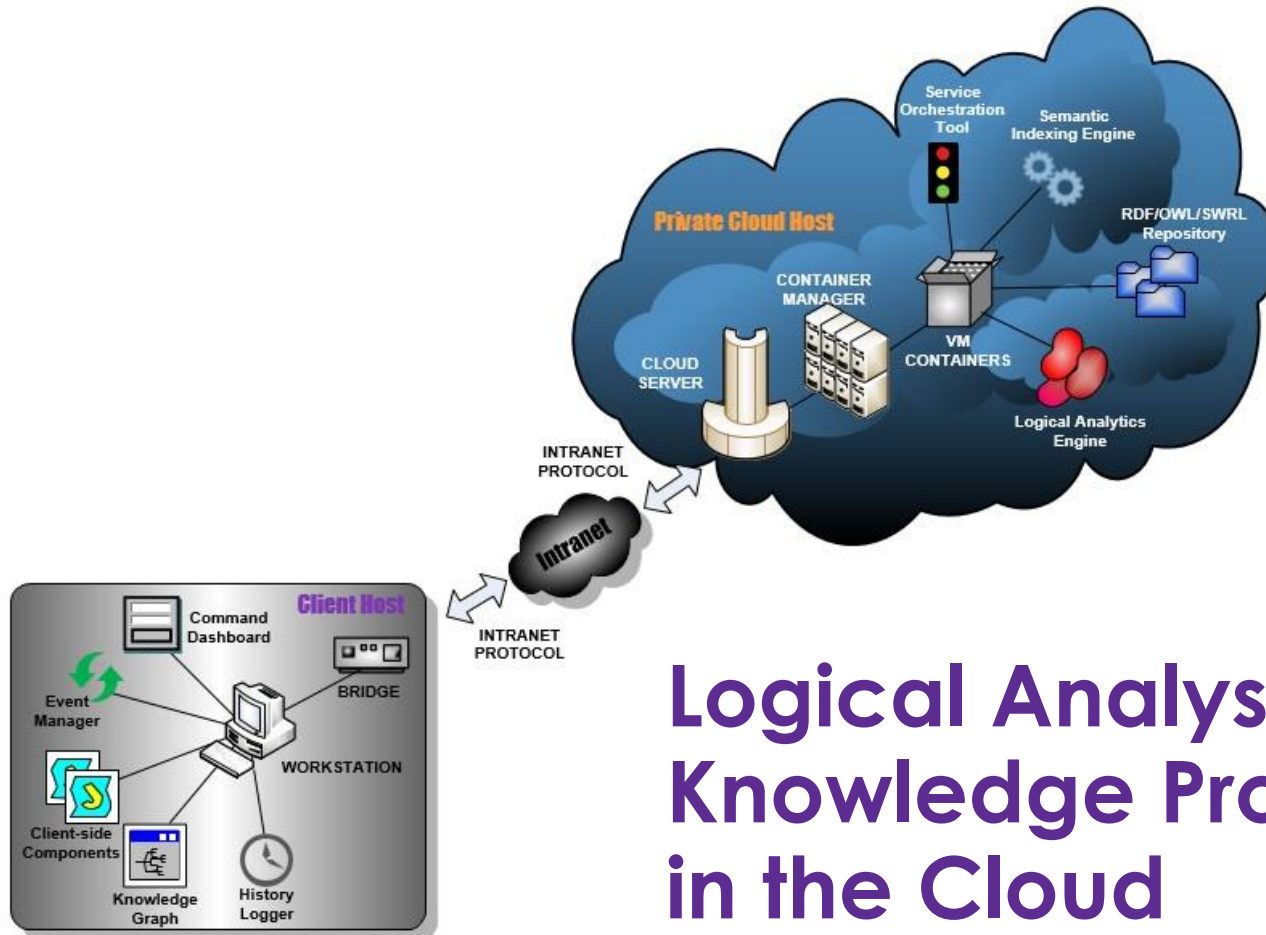


**JSON** for data specification – data formats, programming binding, persistent storage

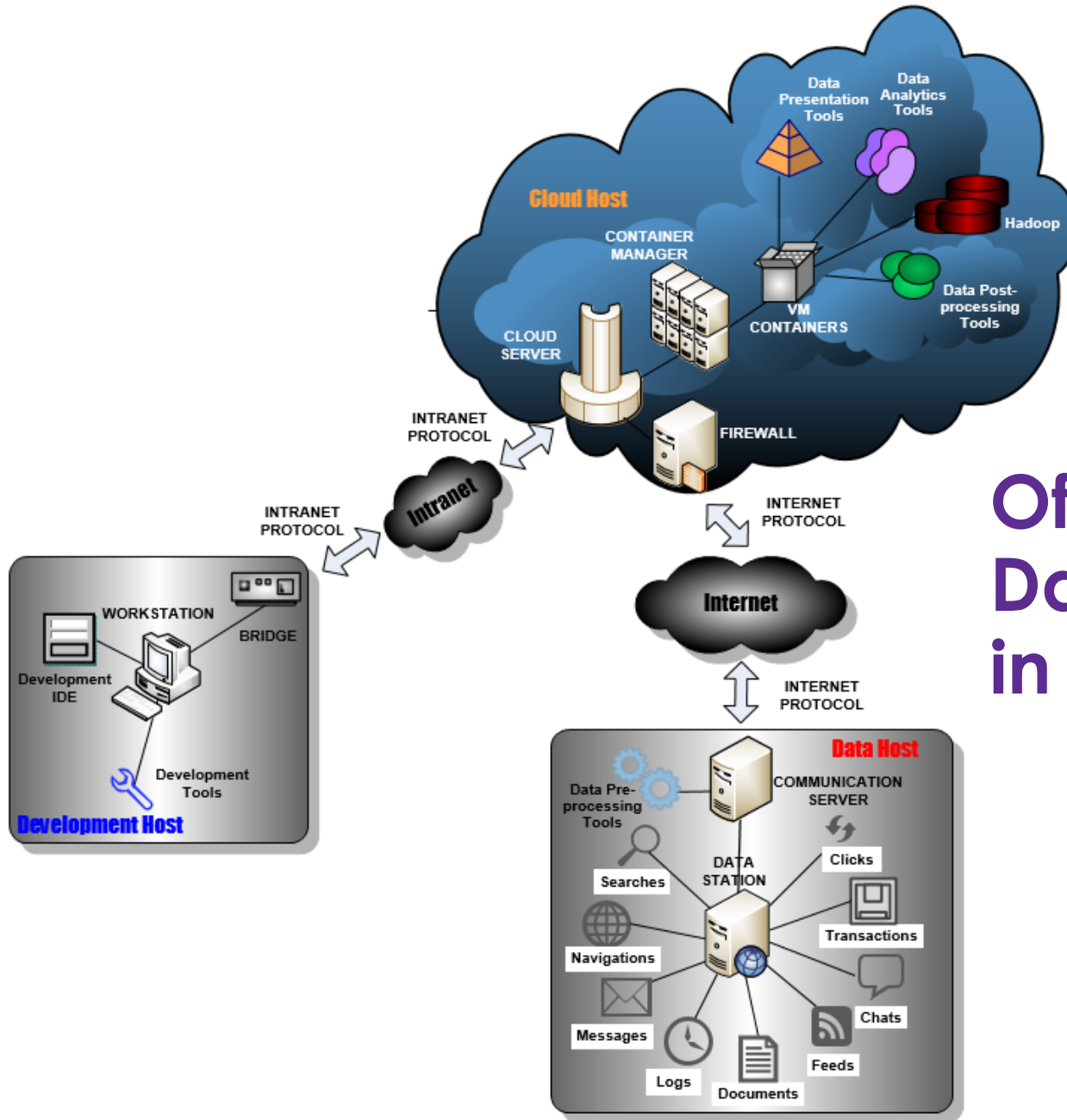
**YAML** for serialization – resources, communication protocols, type mapping

**TerraForm** for Infrastructure as a code

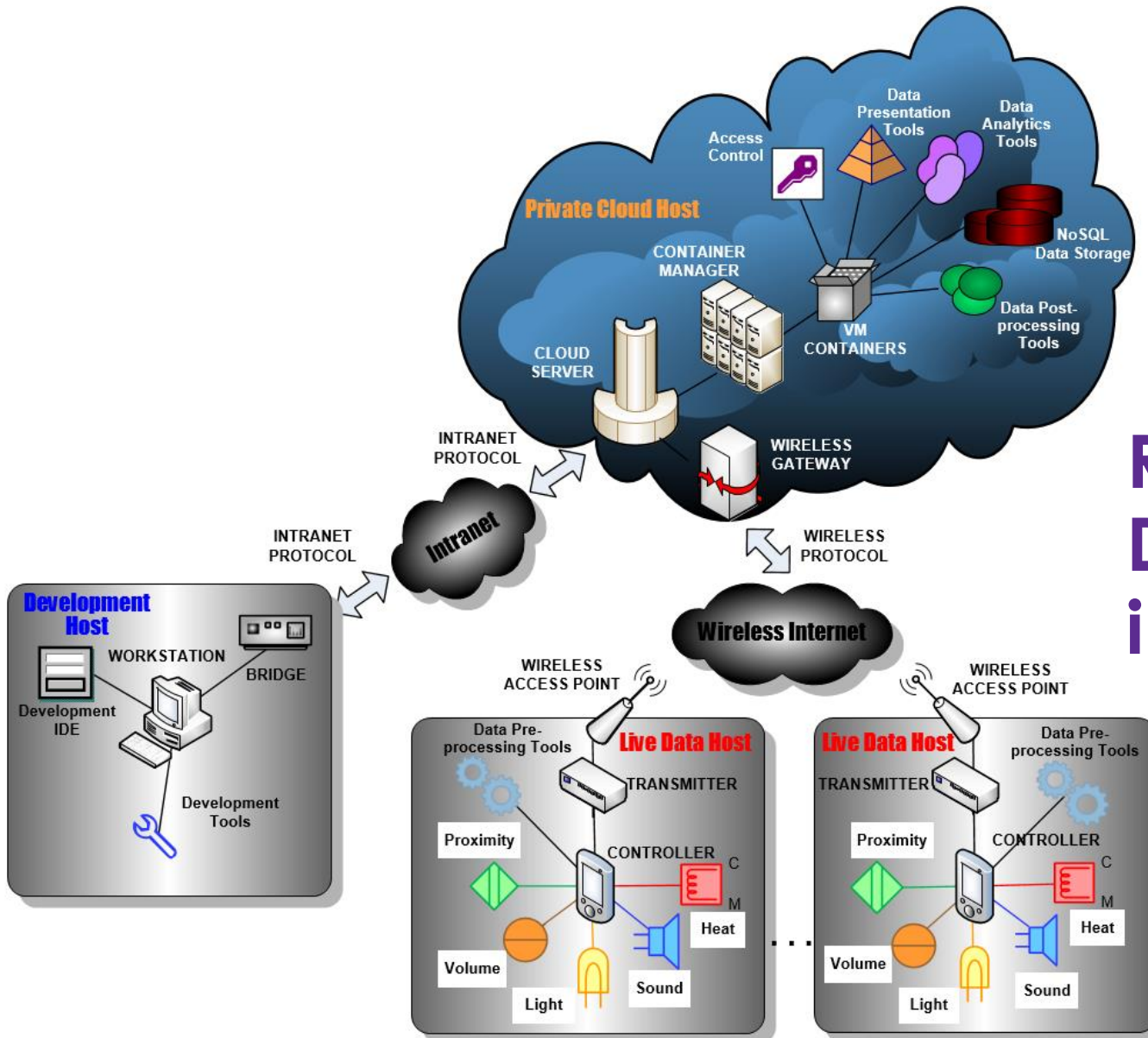
**CWL** for workflow description – process steps, parameters binding, infrastructure configuration, process execution, concurrency control



# Logical Analysis and Knowledge Processing in the Cloud



# Offline Data Analysis in the Cloud



# Real-time Data Analysis in the Cloud

# 3 Knowledge Technologies, Machine Learning and Intelligent Systems



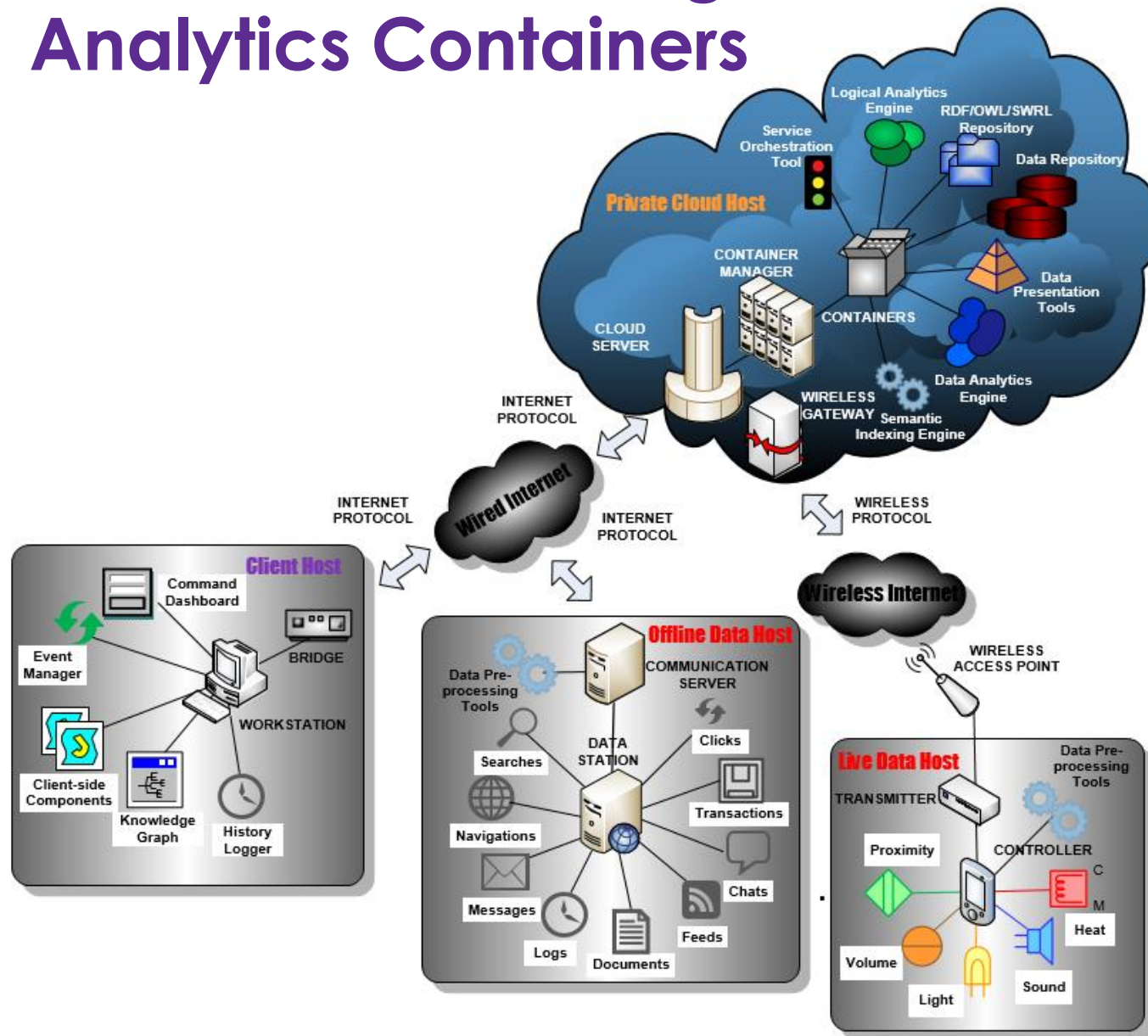
- ◆ Ontologies and Semantic Disambiguation
- ◆ Knowledge Representations and Logical Constraints
- ◆ Commonsense and Expert Rules and Logical Inference

# What is the most recent in the AI age?

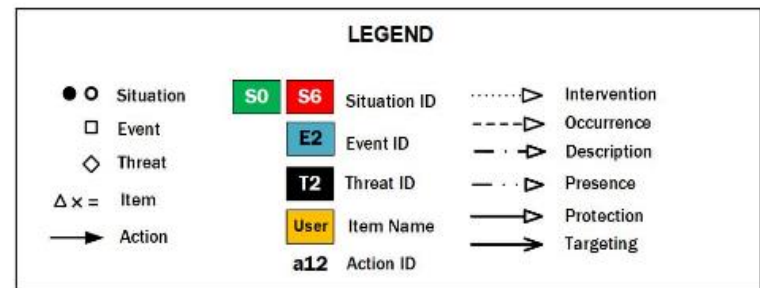
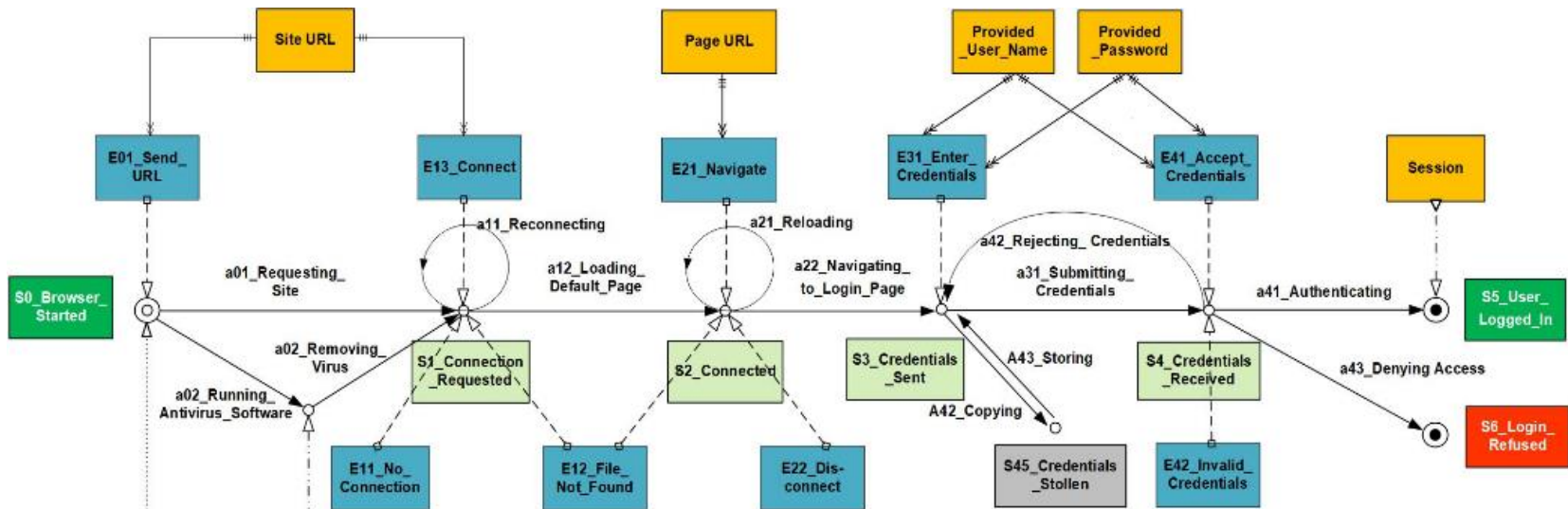


- ◆ **AI on demand:** Containerized services which apply their own algorithms to their own data
- ◆ **Knowledge Graphs:** Merging knowledge representation and logical analytics
- ◆ **Chatbots:** Interaction through speech recognition and natural language generation
- ◆ **Deep Learning:** Incorporating domainspecific knowledge into the data models

# Combine Knowledge and Data Analytics Containers



# Intelligence Graphs for Security Analytics in Dynamic Systems





**Any questions?**