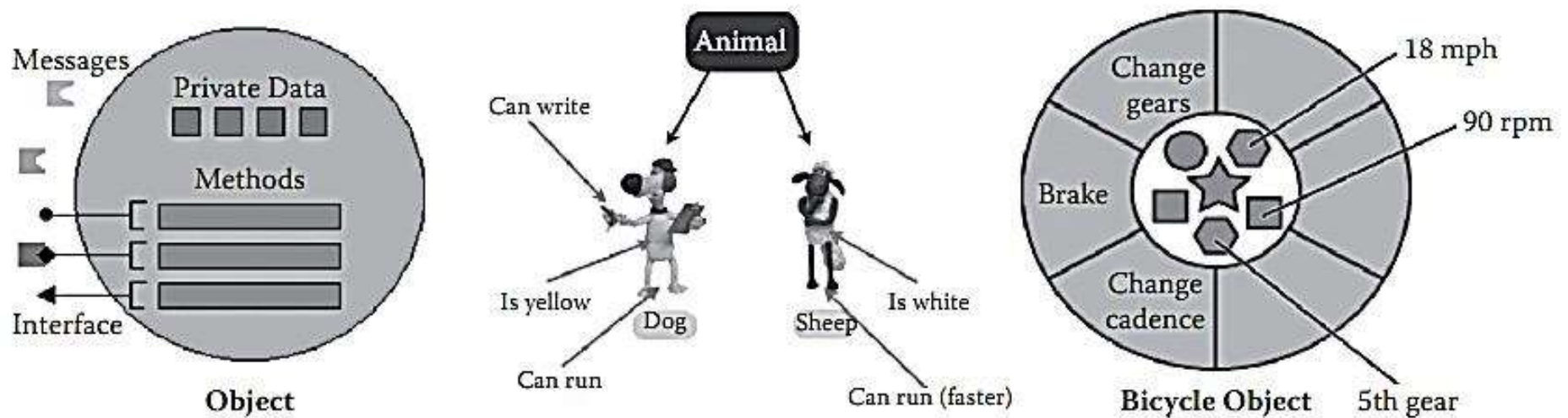# Platform Middleware for WOT

- Communication middleware and platform middleware are closely related with each other

- Platform Middleware or Application Frameworks or Three- Tiered Application Server

- Goal is to bring the IOT applications to the World Wide Web

- According to WOT/ IOT vision, everyday objects will be connected with each other and with Internet

- These will form a distributed network with sensing capabilities

Platform Middleware for WOT

- Observation is that many software architectures & technologies are already using term *object* such as,
  - Object- Oriented Design
  - Object- Oriented Software Engineering And Programming
  - CORBA (Common Object Request Broker Architecture)
  - DOM (Document Object Model)
  - POJO (Plain Old Java Object)
  - COM (Component Object Model) & DCOM (Distributed COM)
  - OPC (Object Linking and Embedding for Process Control)
  - OID (Object Identification)
  - SOAP (Simple Object Access Protocol)
  - JSON (JavaScript Object Notation) and so on

Platform Middleware for WOT

Object

Animal
- Can write
- Is yellow
- Can run
→ Dog

- Is white
- Can run (faster)
→ Sheep

Bicycle Object
- Change gears
- Brake
- Change cadence
- 18 mph
- 90 rpm
- 5th gear

Unified Multitier WOT Architecture

- SOA/EAI versus SODA/MAI
  - WOT/ IOT applications should inherit and enhance the existing data formats and protocols
  - SOAP (simple object access protocol) is a protocol framework specification for exchanging structured information in the implementation of web services
  - It relies on XML for its message format
  - Usually hypertext transfer protocol (HTTP), simple mail transfer protocol (SMTP), Java messaging services (JMS)
  - SOA is a set of principles and methodologies for designing and developing software in the form of interoperable services, usually over the Internet
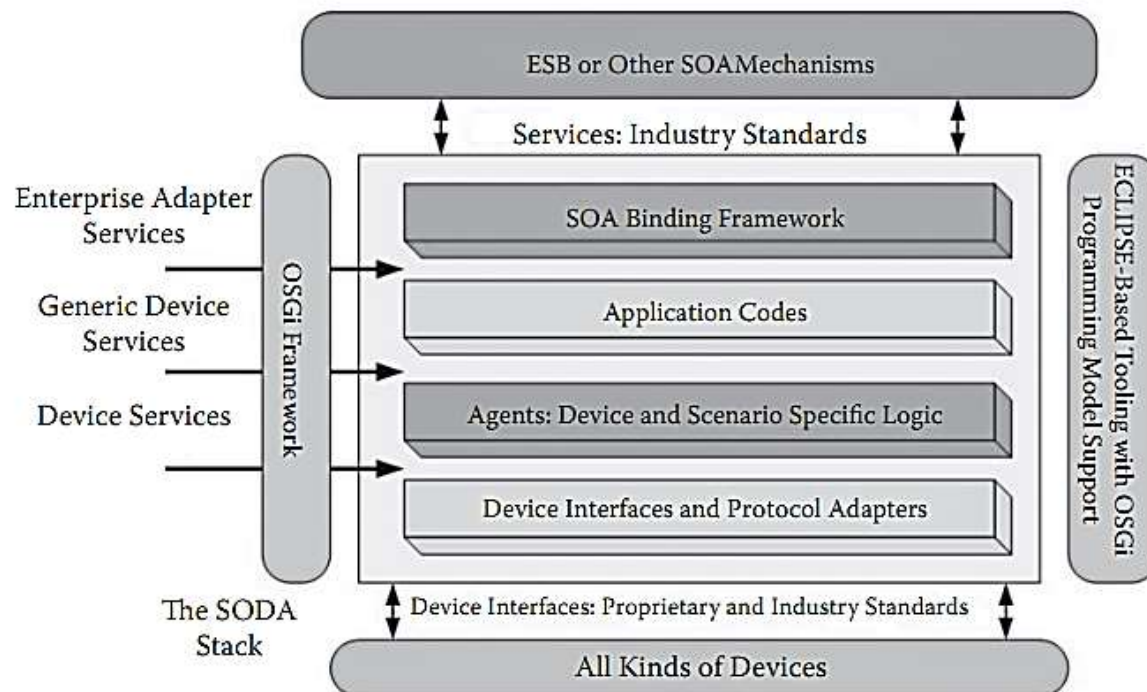
Unified Multitier WOT Architecture

- SOA requires metadata (unified WoT architecture also needs metadata)

- Web services description language typically describes the services, while the SOAP protocol describes the communication protocols

- Combination of existing SOA and EAI (Enterprise Application Integration) technologies is a good foundation for WOT/ IOT applications

- Service- Oriented Device Architecture (SODA) is proposed to enable device connection to an SOA

Unified Multitier WOT Architecture

- Core of SODA standard is DDL (device description language) based on XML encodings

- DDL classifies devices into three categories: sensors, actuators, and complex devices
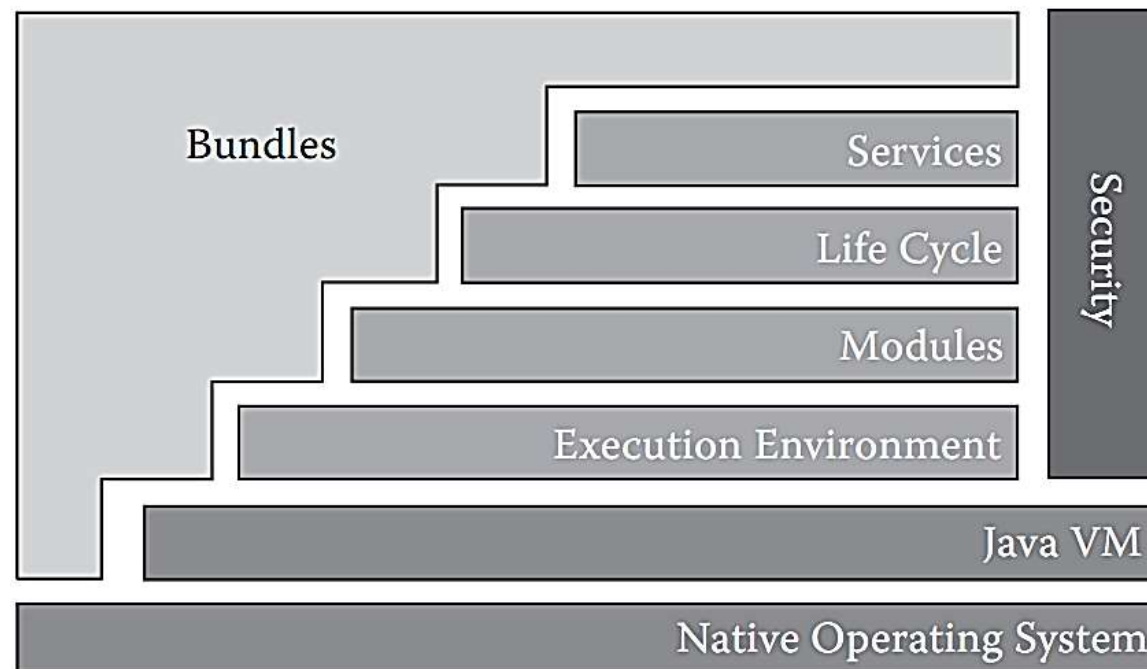
SODA

Architecture

Unified Multitier WOT Architecture

- Example of Device Description Language of SODA

```
<Sensor>
<Description>…</Description>
<Interface>
<Signal id = "ADC1">…</Signal>
<Reading id = "Temp 1">
<Type>Physical</Type>
<Measurement>Temperature</Measurement>
<Unit>Centigrade</Unit>
<Computation>
<Type>Formula</Type>
<Expression> Temp 1 = (((ADC1/1023 * 3.3)-0.5)*
(1000/10)</Expression>
</Computation>
</Reading>
</Interface>
</Sensor>
```

Unified Multitier WOT Architecture

- OSGi: The Universal Middleware
  - Open Services Gateway initiative
  - Module system and service platform for the Java programming language that implements complete and dynamic component model

Unified Multitier WOT Architecture

Multi-tiered IoT Middleware

	IoT Graphics/HMI RAD Tools, Reporting, Trending, Data Mining, Decision Support, etc.
Service Oriented Middleware Layer	Business Oriented Component (BPM, Workflow/Rule Engine, Content Management, multi-tenancy, SOA/EAI, etc.)
Basic Middleware Component Layer	Application Server (Websphere, WebLogic, Jboss, .NET Framework/IIS, etc.) OSGi Framework, etc.)
IoT Connectivity Middleware Layer	M2M Gateway, JCA/Adaptors (OPC, GPRS, Field-bus, etc.) MQ/ESB/JMS, open API, etc.
DBMS Layer	Database (Oracle, IBM, SQL Server, mySQL, etc.) Real-time Databases, etc.
	Hardware, OS (Linux, Unixes, Windows, etc.) and Networks