JEREMY'S IT LAB

# CCNA Day 60

## JSON, XML, & YAML

6.0 Automation and Programmability 10%

6.1 Explain how automation impacts network management
6.2 Compare traditional networks with controller-based networking
6.3 Describe controller-based and software defined architectures (overlay, underlay, and fabric)
- 6.3.a Separation of control plane and data plane
- 6.3.b North-bound and south-bound APIs

6.4 Compare traditional campus device management with Cisco DNA Center enabled device management
6.5 Describe characteristics of REST-based APIs (CRUD, HTTP verbs, and data encoding)
6.6 Recognize the capabilities of configuration management mechanisms Puppet, Chef, and Ansible
6.7 Interpret JSON encoded data

# Things we'll cover

- Data Serialization
- JSON (JavaScript Object Notation)
- XML (Extensible Markup Language)
- YAML (YAML Ain't Markup Language)

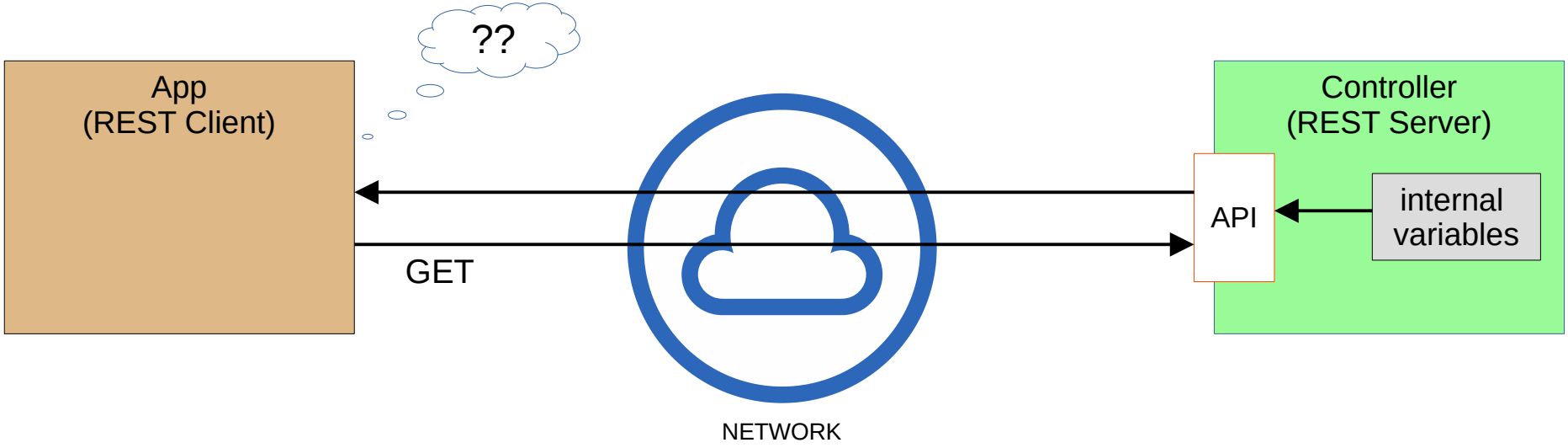
# Data Serialization

- Data serialization is the process of converting data into a standardized format/structure that can be stored (in a file) or transmitted (over a network) and reconstructed later (ie. by a different application).
  → This allows the data to be communicated between applications in a way both applications understand.

- Data serialization languages allow us to represent *variables* with text.

```
{"interface_name": "GigabitEthernet1/1",
 "status": "up",
 "ip_address": "192.168.1.1",
 "netmask": "255.255.255.0"}
```

*Variables* are containers that store values.
"interface_name" = container
"GigabitEthernet1/1" = value



# Data Serialization

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 "status": "up",
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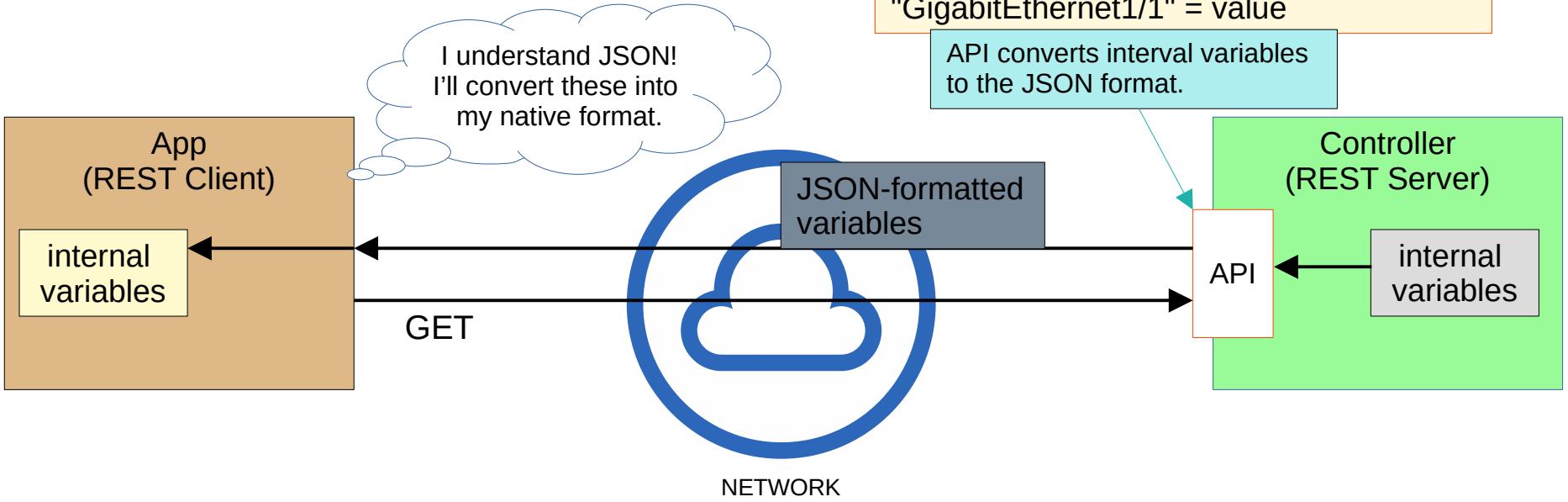
```

*Variables* are containers that store values.
"interface_name" = container
"GigabitEthernet1/1" = value

API converts interval variables to the JSON format.



# JSON

- **JSON** (JavaScript Object Notation) is an open standard **file format** and **data interchange format** that uses human-readable text to store and transmit data objects.

Take the time to read it!

- It is standardized in RFC 8259 (https://datatracker.ietf.org/doc/html/rfc8259).

- It was derived from JavaScript, but it is language-independent and many modern programming languages are able to generate and read JSON data.
  → REST APIs often use JSON.

- *Whitespace* is insignificant.

- JSON can represent four ‘primitive’ data types:
  → string
  → number
  → boolean
  → null

- JSON also has two ‘structured’ data types:
  → object
  → array

# JSON

JSON primitive data types:

- A **string** is a text value.  It is surrounded by double quotes " " .
  → "Hello."
  → "five"
  → "5"
  → "true"
  → "null"

- A **number** is a numeric value.  It is not surrounded by quotes.
  → 5
  → 100

- A **boolean** is a data type that has only two possible values, not surrounded by quotes:
  → true
  → false

- A **null** value represents the intentional absence of any object value.  It is not surrounded by quotes.
  → null

# JSON

JSON structured data types:

- An **object** is an unordered list of *key-value pairs* (variables).
  - → Objects are surrounded by curly brackets {} .
  - → The *key* is a string.
  - → The *value* is any valid JSON data type (string, number, boolean, null, object, array).
  - → The *key* and *value* are separated by a colon : .
  - → If there are multiple key-value pairs, each pair is separated by a comma.

```
{
 "interface": "GigabitEthernet1/1",
 "is_up": true,
 "ipaddress": "192.168.1.1",
 "netmask": "255.255.255.0",
 "speed": 1000
}
```

```
{"interface":"GigabitEthernet1/1","is_
up":true,"ipaddress":"192.168.1.1","ne
tmask":"255.255.255.0","speed":1000}
```

These two are the same!  In JSON, whitespace (spaces etc.) is insignificant.

# JSON

JSON structured data types:

- An **object** is an unordered list of *key-value pairs* (variables).
  → Objects are surrounded by curly brackets {} .
  → The *key* is a string.
  → The *value* is any valid JSON data type (string, number, boolean, null, object, array).
  → The *key* and *value* are separated by a colon : .
  → If there are multiple key-value pairs, each pair is separated by a comma.

```
{
  ↓string          ↓string
 "interface": "GigabitEthernet1/1",
  ↓string     ↓boolean
 "is_up": true,
  ↓string          ↓string
 "ipaddress": "192.168.1.1",
  ↓string        ↓string
 "netmask": "255.255.255.0",
  ↓string     ↓number
 "speed": 1000
}
```

# JSON

As shown in the following example, objects are a valid data type for the value of a key-value pair:

key value (object)

```
{
    "device": {
        "name": "R1",
        "vendor": "Cisco",
        "model": "1101"
    },
```

key value (object)

```
    "interface_config": {
        "interface_name": "GigabitEthernet1/1",
        "is_up": true,
        "ipaddress": "192.168.1.1",
        "netmask": "255.255.255.0",
        "speed": 1000
    }

}
```

Objects within objects are called ‘nested objects’.

# JSON

JSON structured data types:

- An **object** is an unordered list of *key-value pairs* (variables).

- An **array** is a series of *values* separated by commas.
  → not *key-value pairs*.
  → the values don't have to be the same data type.

```
{
    "interfaces": [
        "GigabitEthernet1/1",
        "GigabitEthernet1/2",
        "GigabitEthernet1/3"
    ],

    "random_values": [
        "Hi",
        5
    ]
}
```

# JSON

```
R1#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         192.168.1.1     YES manual up                    up
GigabitEthernet0/1         unassigned      YES unset  administratively down down
```


```
{
    "ip_interfaces": [
            {
            "Interface":"GigabitEthernet0/0",
            "IP-Address": "192.168.1.1",
            "OK?": "YES",
            "Method": "manual",
            "Status": "up",
            "Protocol": "up"
            },
            {
            "Interface":"GigabitEthernet0/1",
            "IP-Address": "unassigned",
            "OK?": "YES",
            "Method": "unset",
            "Status": "administratively down",
            "Protocol": "down"
            }
    ]
}
```

# JSON

JSON primitive data types:

- A **string** is a text value.  It is surrounded by double quotes " " .
- A **number** is a numeric value.  It is not surrounded by quotes.
- A **boolean** is a data type that has only two possible values, not surrounded by quotes.
- A **null** value represents the intentional absence of any object value.  It is not surrounded by quotes.

JSON structured data types:

- An **object** is an unordered list of *key-value pairs* (variables).
  → Sometimes called a **dictionary**.
- An **array** is a series of *values* separated by commas.

# XML

- **XML** (Extensible Markup Language) was developed as a markup language, but is now used as a general data serialization language.
  →markup languages (ie. HTML) are used to format text (font, size, color, headings, etc.)

- XML is generally less human-readable than JSON.

- Whitespace is insignificant.

- Often used by REST APIs.

- <key>value</key>

```
R1#show ip interface brief | format
<?xml version="1.0" encoding="UTF-8"?>
  <ShowIpInterfaceBrief xmlns="ODM://built-in//show_ip_interface_brief">
    <SpecVersion>built-in</SpecVersion>
    <IPInterfaces>
      <entry>
        <Interface>GigabitEthernet0/0</Interface>
        <IP-Address>192.168.1.1</IP-Address>
        <OK>YES</OK>
        <Method>manual</Method>
        <Status>up</Status>
        <Protocol>up</Protocol>
      </entry>
      <entry>
        <Interface>GigabitEthernet0/1</Interface>
        <OK>YES</OK>
        <Method>unset</Method>
        <Status>administratively down</Status>
        <Protocol>down</Protocol>
      </entry>
    </IPInterfaces>
  </ShowIpInterfaceBrief>
```

# XML

```
R1#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0         192.168.1.1     YES manual up                    up
GigabitEthernet0/1         unassigned      YES unset  administratively down down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    <SpecVersion>built-in</SpecVersion>
    <IPInterfaces>
      <entry>
        <Interface>GigabitEthernet0/0</Interface>
        <IP-Address>192.168.1.1</IP-Address>
        <OK>YES</OK>
        <Method>manual</Method>
        <Status>up</Status>
        <Protocol>up</Protocol>
      </entry>
      <entry>
        <Interface>GigabitEthernet0/1</Interface>
        <OK>YES</OK>
        <Method>unset</Method>
        <Status>administratively down</Status>
        <Protocol>down</Protocol>
      </entry>
    </IPInterfaces>
  </ShowIpInterfaceBrief>
```

# YAML

- **YAML** originally meant *Yet Another Markup Language*, but to distinguish its purpose as a data-serialization language rather than a markup language, it was repurposed to *YAML Aint Markup Language.*
- YAML is used by the network automation tool Ansible (we'll cover that later!).
- YAML is very human-readable.
- Whitespace **is significant** (unlike JSON and XML).
  → Indentation is very important.
- YAML files start with --- .
- - is used to indicate a list.
- Keys and values are represented as key:value.

```
---
ip_interfaces:
- Interface: GigabitEthernet0/0
  IP-Address: 192.168.1.1
  OK?: 'YES'
  Method: manual
  Status: up
  Protocol: up
- Interface: GigabitEthernet0/1
  IP-Address: unassigned
  OK?: 'YES'
  Method: unset
  Status: administratively down
  Protocol: down
```

# YAML

## JSON

```
{
    "ip_interfaces": [
            {
            "Interface":"GigabitEthernet0/0",
            "IP-Address": "192.168.1.1",
            "OK?": "YES",
            "Method": "manual",
            "Status": "up",
            "Protocol": "up"
            },
            {
            "Interface":"GigabitEthernet0/1",
            "IP-Address": "unassigned",
            "OK?": "YES",
            "Method": "unset",
            "Status": "administratively down",
            "Protocol": "down"
            }
    ]
}
```

## YAML

```
---
ip_interfaces:
- Interface: GigabitEthernet0/0
  IP-Address: 192.168.1.1
  OK?: 'YES'
  Method: manual
  Status: up
  Protocol: up
- Interface: GigabitEthernet0/1
  IP-Address: unassigned
  OK?: 'YES'
  Method: unset
  Status: administratively down
  Protocol: down
```

# Things we covered

- Data Serialization
- JSON (JavaScript Object Notation)
- XML (Extensible Markup Language)
- YAML (YAML Ain’t Markup Language)

# Quiz 1

In which of the following data serialization languages is whitespace significant?

a) JSON

b) YAML

c) XML

d) All of the above

# Quiz 2

Which of the following data serialization languages formats key-value pairs like this?

```
<key>value</key>
```

a) JSON

b) YAML

c) XML

d) All of the above

# Quiz 3

Which of the following is NOT a valid JSON data type?

a) object

b) string

c) number

d) boolean

e) key

f) array

g) null

# Quiz 4

Examine the JSON-formatted data. Which of the following statements is true?

```
{
 "interface": "GigabitEthernet1/1",
 "is_up": true,
 "ipaddress": "192.168.1.1",
 "netmask": "255.255.255.0",
 "speed": 1000,
}
```

a) It is valid JSON data.

b) A curly bracket is missing.

c) There are too many commas.

d) There are too many colons.

# Quiz 5

Examine the JSON-formatted data. Which of the following statements is true?

a) The value of “ip_interfaces” is an object.

b) The value of “ip_interfaces” is an array.

c) The value of “ip_interfaces” is multiple objects.

d) The value of “ip_interfaces” is a string.


```
{
    "ip_interfaces": [
            {
            "Interface":"GigabitEthernet0/0",
            "IP-Address": "192.168.1.1",
            "OK?": "YES",
            "Method": "manual",
            "Status": "up",
            "Protocol": "up"
            },
            {
            "Interface":"GigabitEthernet0/1",
            "IP-Address": "unassigned",
            "OK?": "YES",
            "Method": "unset",
            "Status": "administratively down",
            "Protocol": "down"
            }
    ]
}
```

# Quiz 6

Which of the following is an example of valid JSON-formatted data?

a)

```
{
    "interfaces", [
        "GigabitEthernet1/1",
        "GigabitEthernet1/2",
        "GigabitEthernet1/3"
    ],

    "random_values": [
        "Hi",
        5
    ]
}
```

b)

```
{
    "interfaces": [
        "GigabitEthernet1/1",
        "GigabitEthernet1/2",
        "GigabitEthernet1/3"
    ],

    "random_values": [
        "Hi",
        5:
    ]
}
```

c)

```
{
    "interfaces": [
        "GigabitEthernet1/1"
        "GigabitEthernet1/2",
        "GigabitEthernet1/3"
    ],

    "random_values": [
        "Hi",
        5
    ]
}
```

d)

```
{
    "interfaces": [
        "GigabitEthernet1/1",
        "GigabitEthernet1/2",
        "GigabitEthernet1/3"
    ],

    "random_values": [
        "Hi",
        5
    ]
}
```

# Quiz 7

Examine the JSON-formatted data. Which of the following statements is true?

a) The value of “is_up” is a boolean.

b) It is not valid JSON data.

c) The value of “ipaddress” is a number.

d) The value of “speed” is a string.

```
{

    "device": {
       "name": "R1",
       "vendor": "Cisco",
       "model": "1101"
    },


    "interface_config": {
       "interface_name": "GigabitEthernet1/1",
       "is_up": true,
       "ipaddress": "192.168.1.1",
       "netmask": "255.255.255.0",
       "speed": 1000
    }

}
```

# Quiz 8

Examine the JSON-formatted data. Which of the following statements is true?

a) The whitespace formatting is invalid.

b) A curly bracket is missing.

c) A comma is missing.

d) It is valid JSON data.

```
{"interface":"GigabitEthernet1/1","is_up"
:true,"ipaddress":"192.168.1.1","netmask"
:"255.255.255.0","speed":1000}
```

# Quiz 9

Examine the JSON-formatted data. Which of the following statements is true?

a) It is valid JSON data.

b) A curly bracket is missing.

c) A square bracket is missing.

d) The value of “version” is a string.

```
{   "network": {
    "version": 2,
    "renderer": "networkd",
    "ethernets": {
      "enp3s0": {
        "addresses": [
          "10.10.10.2/24"
        ],
        "nameservers": {
          "search": [
            "mydomain",
            "otherdomain"
          ],
          "addresses": [
            "10.10.10.1",
            "1.1.1.1"
          ]
        },
        "routes": [
          {
            "to": "default",
            "via": "10.10.10.1"
          }
      }
    }
  }
}
```

```
{   "network": {
    "version": 2,
    "renderer": "networkd",
    "ethernets": {
      "enp3s0": {
        "addresses": [
          "10.10.10.2/24"
        ],
        "nameservers": {
          "search": [
            "mydomain",
            "otherdomain"
          ],
          "addresses": [
            "10.10.10.1",
            "1.1.1.1"
          ]
        },
        "routes": [
          {
            "to": "default",
            "via": "10.10.10.1"
          }
        ]
      }
    }
  }
}
```

# Quiz 10

Examine the JSON-formatted data. Which of the following statements is true?

a) It is valid JSON data.

b) A curly bracket is missing.

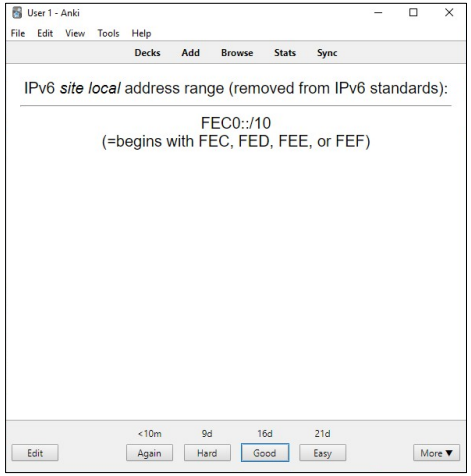
c) A square bracket is missing.

d) The value of “dhcp4” is a boolean.

```
{   "network": {
    "version": 2,
    "renderer": "networkd",
    "wifis": {
      "wlp2s0b1": {
        "dhcp4": "no",
        "dhcp6": "no",
        "addresses": [
          "192.168.0.21/24"
        ],
        "nameservers": {
          "addresses": [
            "192.168.0.1",
            "8.8.8.8"
          ]
        },
        "access-points": {
          "network_ssid_name": {
            "password": "**********"
          }
        },
        "routes": [
          {
            "to": "default",
            "via": "192.168.0.1"
          }
        ]
      } } } }
```

# Supplementary Materials

- Review flash cards (link in the description)



# JCNP-Level Channel Members

| | | | | |
|---|---|---|---|---|
| SilberBell | Vitaos194 | Gerrard Baker | Kenneth Williams | john goff |
| Nemo | Benjie Balolong | Tom Oakes | Seamus Mooney | funnydart |
| Marko Barbaric | SEABAUSS | Tebogo Kgoloane | Marcel Lord | velvijaykum |
| tanvir Khan | Mason Anderson | Павел М | Echo Slam | Boson Software |
| Amiens H | meir salmon | Abraham Yeiah | Gustavo BR | Devin Sukhu |
| Gina M Lindley | pietrocious | Njoku Valentine | Prakaash Rajan | Yonatan Makara |
| Valeri Elenkov | Dragos Hirnea | Suki Ghuman | Nasir Chowdhury | Vance Simmons |

*as of November 14th, 2021