CS120: Computer Networks

Lecture 22. Data Presentation

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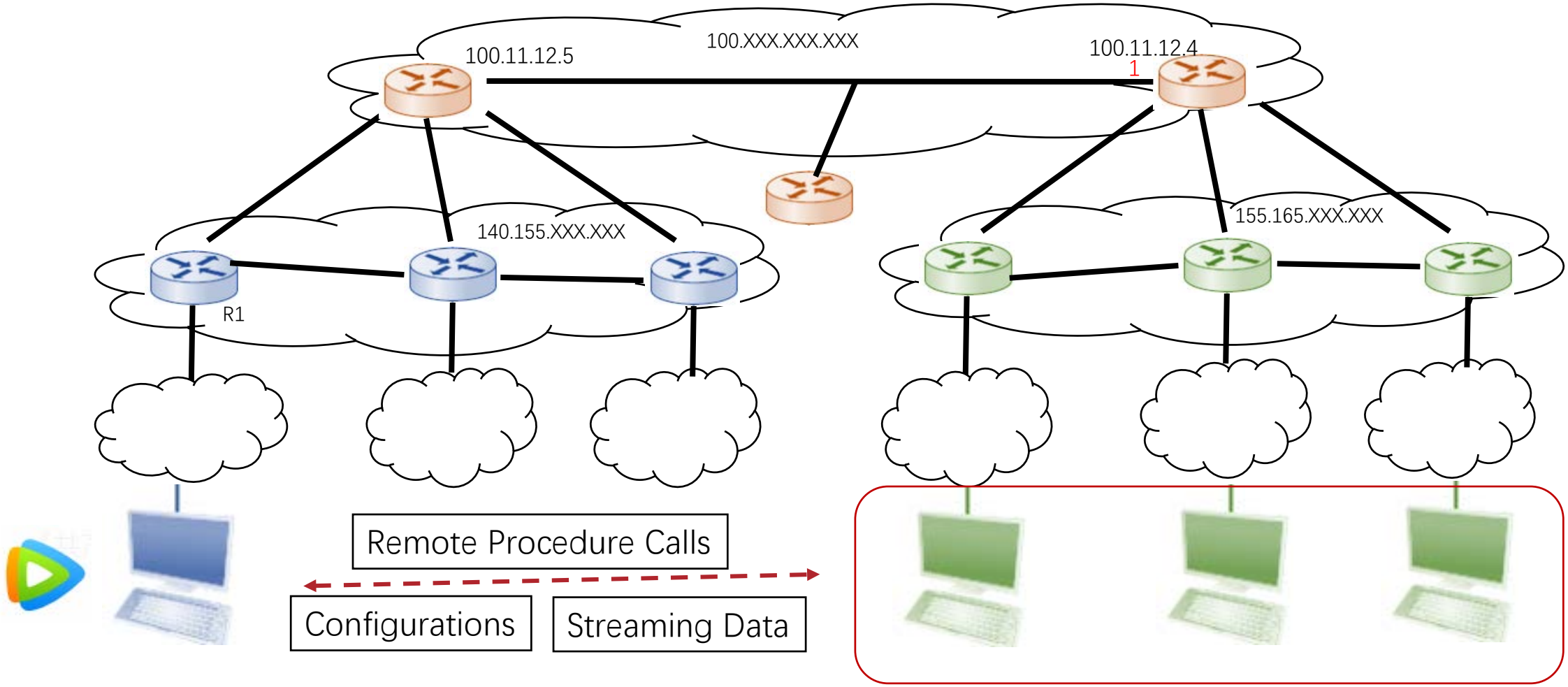
Data in End-to-End Connections

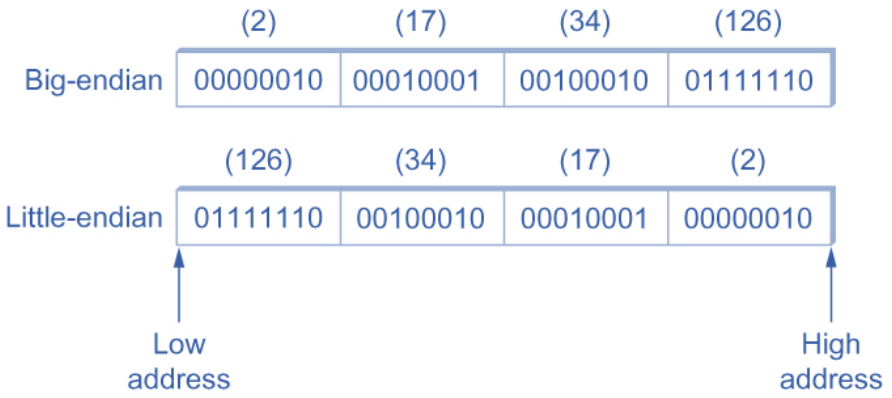


Data in End-to-End Connections

- Presentation Formatting
- Data Compression
  - Lossless Compression
  - Multimedia Compression

Presentation Formatting

- Challenges
  - Different Host Architecture: 16bit, 32bit, 64bit
    - eg. long
  - Different Compilers
    - Different layout/padding of structures
    - eg. struct BitField { unsigned char : 2; unsigned int : 2; }
  - Different base type representation
    - eg. X-endian for 34,677,374



Presentation Formatting

- Solution
  - Marshalling (encoding) application data into messages
  - Unmarshalling (decoding) messages into application data

Presentation Formatting

- Solution
  - Conversion Strategy
    - Canonical intermediate form
    - Receiver-makes-right
  - Base types (e.g., ints, floats) => Convert
  - Flat types (e.g., structures, arrays) => Pack to base types
  - Complex types (e.g., pointers) => Serialization

Presentation Formatting: Examples

- eXternal Data Representation (XDR)
  - Used in SunRPC
  - Canonical intermediate form
  - Defined in RFC1014
    - C-type
    - big-endian
    - Step in 4-bytes
    - etc.

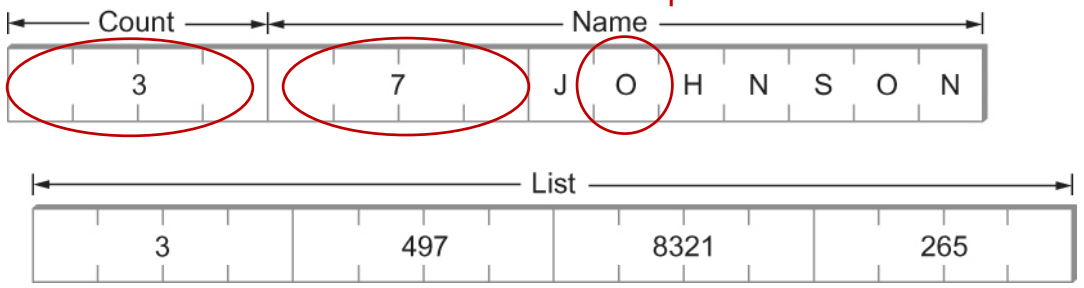
Presentation Formatting: Examples

- eXternal Data Representation (XDR) Steps:
  - Define bytes to be serialized in struct
  - Compile in client and server
  - Stub helps to encode and decode

```
#define MAXNAME 256;
#define MAXLIST 100;
struct item {
 int count;
 char name[MAXNAME];
 int list[MAXLIST];
};
```

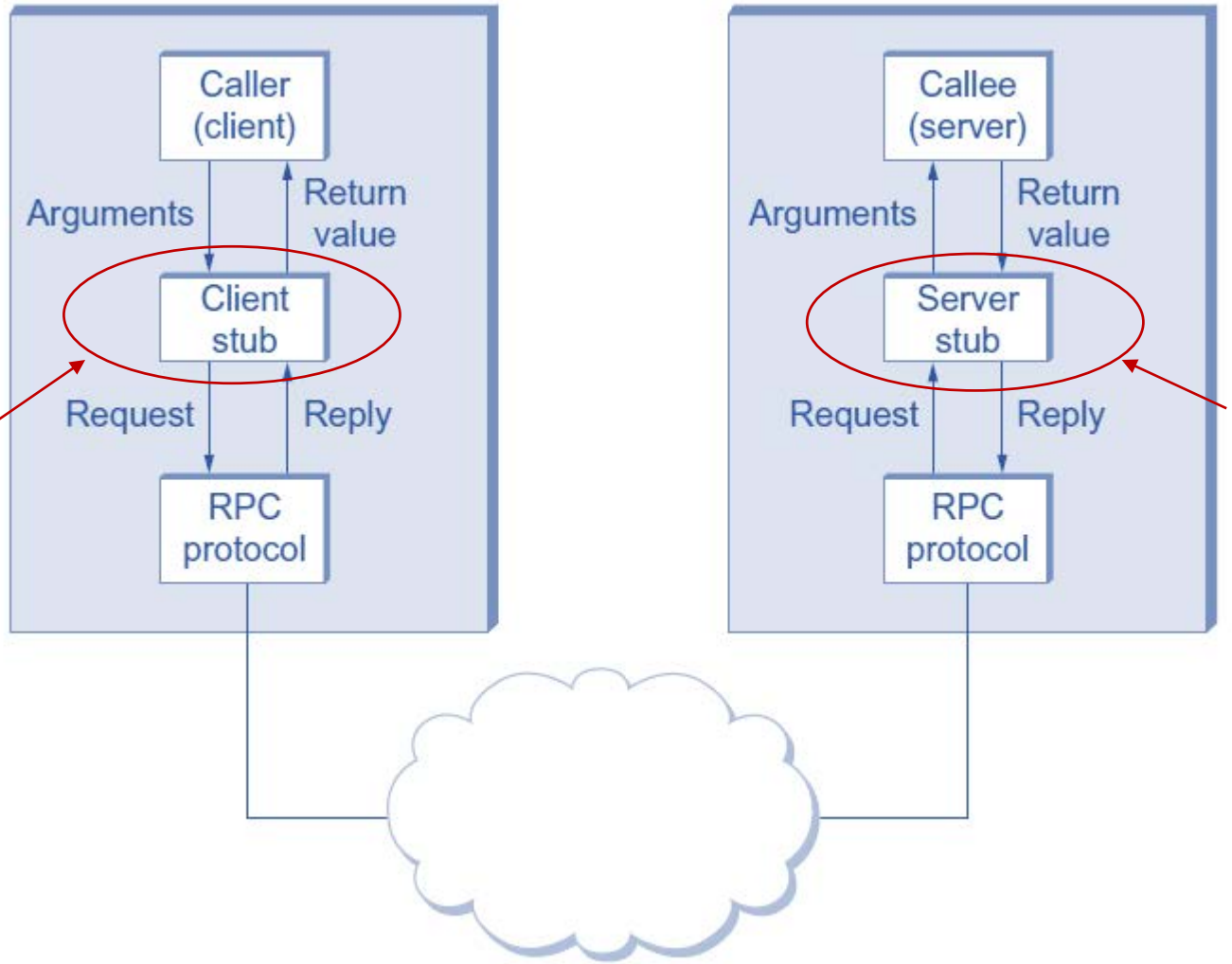
Size of each element is a multiple of 4 bytes

Except chars



RPC Mechanism

Stub is like a proxy to translates procedure calls between network transmissions



Marshals parameters and calls the server

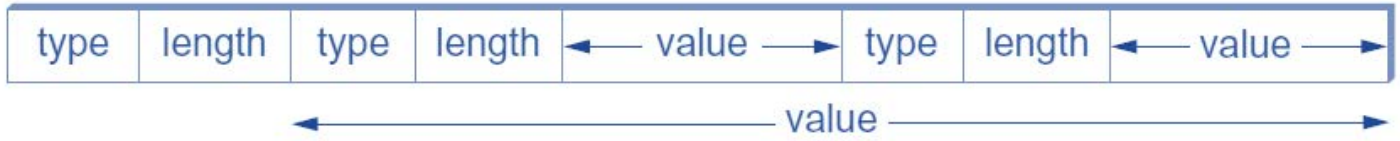
Unmarshals parameters and calls the local function

Presentation Formatting: Examples

- Abstract Syntax Notation One (ASN.1)
  - ISO Standard, used in SNMP
  - Canonical intermediate form
  - Based on tag: <tag, length, value>
  - Format can be interpreted, but of low efficiency
    - Overhead: marshaling processing, byte boundary, additional space for length, etc.

Integer:

Compound types:

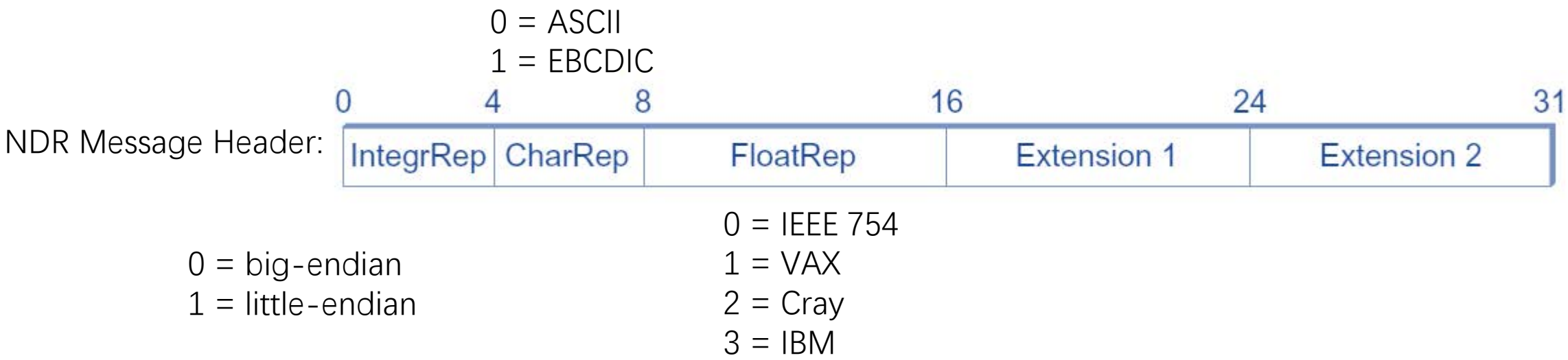


Length Field for >127:

Length Field for <= 127:

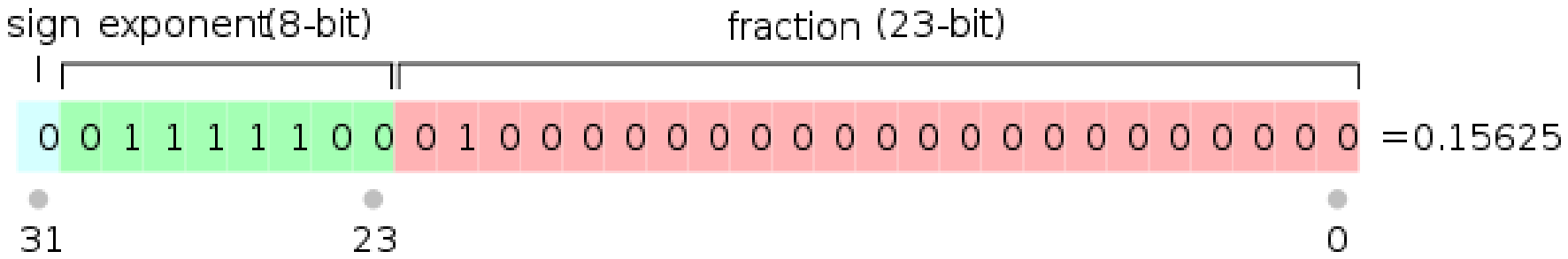
Presentation Formatting: Examples

- Network Data Representation (NDR)
  - Used in DCE
  - Receiver-makes-right
  - Architecture tag at the front of each message

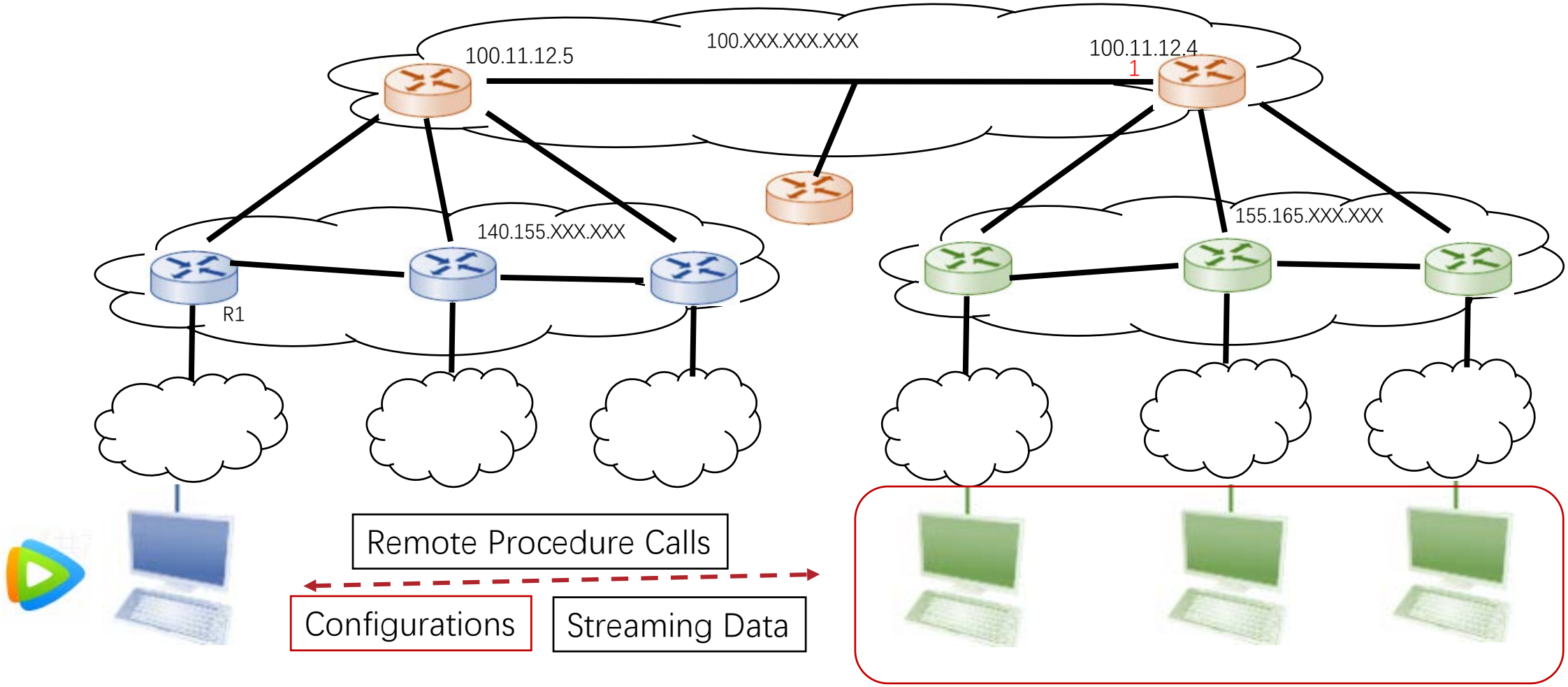


IEEE 754

- https://www.h-schmidt.net/FloatConverter/IEEE754.html



Data in End-to-End Connections



Markup Languages

- Examples: XML and HTML
- Approach
  - Data is represented as text
    - Readable for human
    - Can reuse XML parsers
  - Text tags (markup) are used to express information about the data.

```
<?xml version="1.0"?>
<employee>
        <name>John Doe</name>
        <title>Head Bottle Washer</title>
        <id>123456789</id>
        <hiredate>
                <day>5</day>
                <month>June</month>
                <year>1986</year>
        </hiredate>
</employee>
```

Markup

Nested structure

Extensible Markup Language (XML)

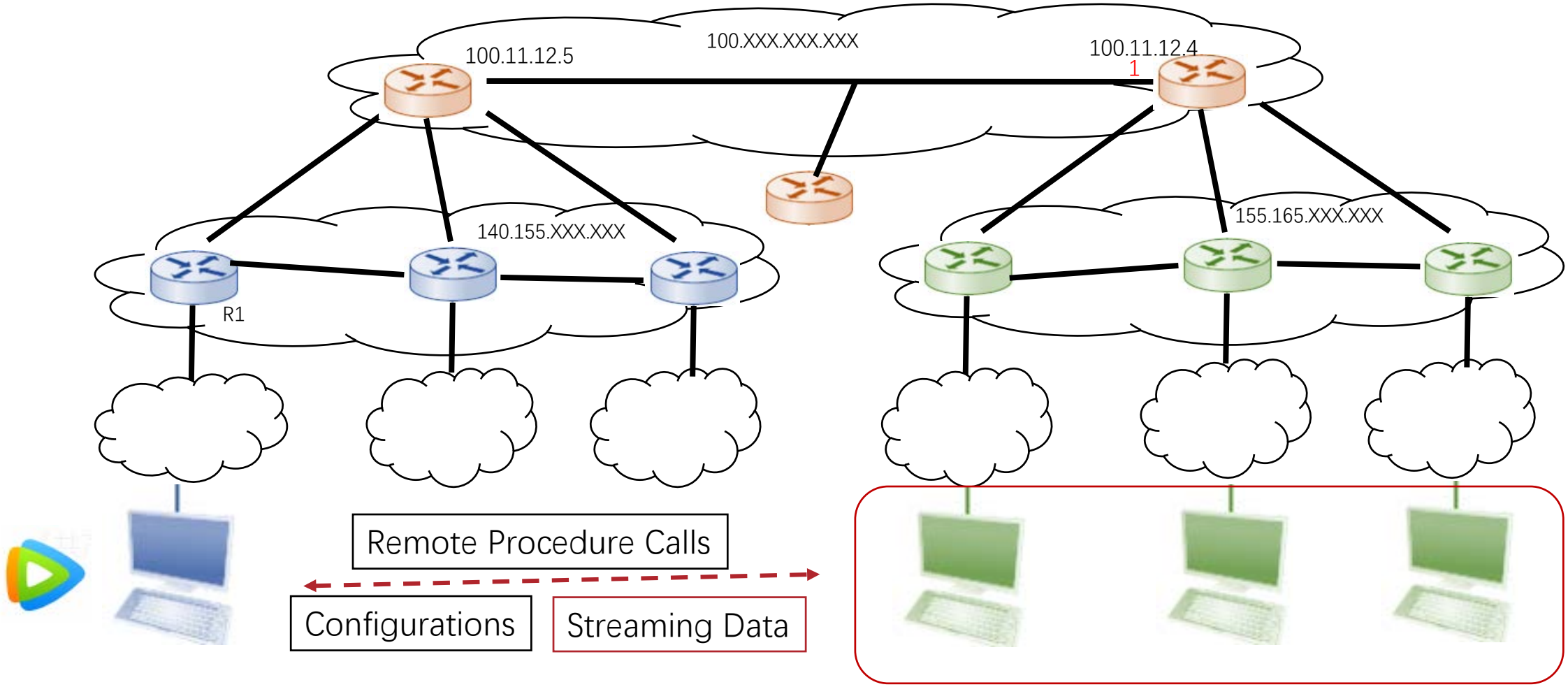
- XML Schema
  - Define XML

```
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema">
   <element name="employee">
       <complexType>
           <sequence>
               <element name="name" type="string"/>
               <element name="title" type="string"/>
               <element name="id" type="string"/>
                  <element name="hiredate">
                     <complexType>
                         <sequence>
                            <element name="day" type="integer"/>
                            <element name="month" type="string"/>
                            <element name="year" type="integer"/>
                         </sequence>
…
```

Extensible Markup Language (XML)

- XML Namespace
  - Use Uniform Resource Identifier (URL) to identify a unique namespace
  - Define an XML namespace
    - `xmlns:emp="http://www.example.com/employee">`
  - Identifier with namespace
    - `<emp:title>Head Bottle Washer</emp:title>`

Data in End-to-End Connections



Traffic of a Full Size Video Stream

- Resolution: 1920*1080
- Framerate: 30fps
- Color per pixel: 3
- Color depth: 8 bits
- Required Throughput: 1920*1080*3*8*30 bps = 1.5Gbps

Reference

- Textbook 7.1 7.2