Tutorial 1: using Bottles

How do we exchange data over YARP easily?

A Bottle is a **Portable** object on which a set of operations are defined: add/retrieve data types (string, int, double, vocab, list)

```
Bottle b1;
b1.addString("color");
b1.addString("red");
printf("Bottle b1 is: %s\n", b1.toString().c_str());
// should give: color red

Bottle b2;
b2.addString("height");
b2.addInt(15);
printf("Bottle b2 is: %s\n", b2.toString().c_str());
// should give: height 15

Bottle b3;
b3.addList() = b1;
b3.addList() = b2;
printf("Bottle b3 is: %s\n", b3.toString().c_str());
// should give: (color red) (height 15)
```

```
// alternative way to create a Bottle from textual representation
Bottle b5("(pos left top) (size 10)");
printf("Bottle b5 is: %s\n", b5.toString().c_str());
// should give: (pos left top) (size 10)

Bottle b6;
b6 = b5;
b6.addList() = b4;
printf("Bottle b6 is: %s\n", b6.toString().c_str());
// should give: (pos left top) (size 10) (nested ((color red) (height 5))

printf("size check: %d\n", b6.find("size").asInt());
printf("pos check: %s\n", b6.find("pos").asString().c_str());
// find assumes key->value pairs; for lists, use findGroup
printf("pos group check: %s\n", b6.findGroup("pos").toString().c_str());
// see documentation for Bottle::findGroup
printf("nested check: %s\n", b6.find("nested").toString().c_str());
printf("nested height check: %d\n", b6.find("nested").find("height").asInt());

 printf("b2 elements %s %d\n",b2.get(0).asString(),b2.get(1).asInt());
 // should give: height 15

 b6.clear();
 b6.addVocab(Vocab::encode("req"));
 // convert a string into a vocabulary identifier and add it to the bottle
```

Tutorial 2: using ports

A (very) simple example: read data to/from a port

[on terminal 1] yarp server
[on terminal 2] yarp read /read
[on terminal 3] yarp write /write /read


```
$ yarp write /write /read
Port /write listening at tcp://127.0.0.1:10012
yarp: Sending output from /write to /read using tcp
Added output connection from "/write" to "/read"
hello yarp
1 2 3
```

```
$ yarp read /read
Port /read listening at tcp://127.0.0.1:10002
yarp: Receiving input from /write to /read using
tcp
hello yarp
1 2 3
```

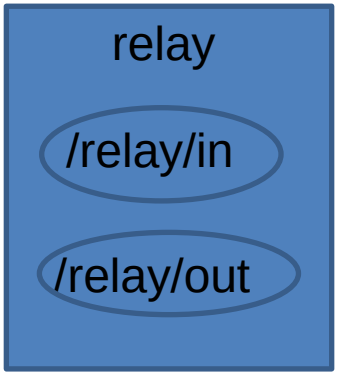
How do we get this?

Let’s now to write a simple “relay” executable which takes whatever comes from a port and forwards it to another one.

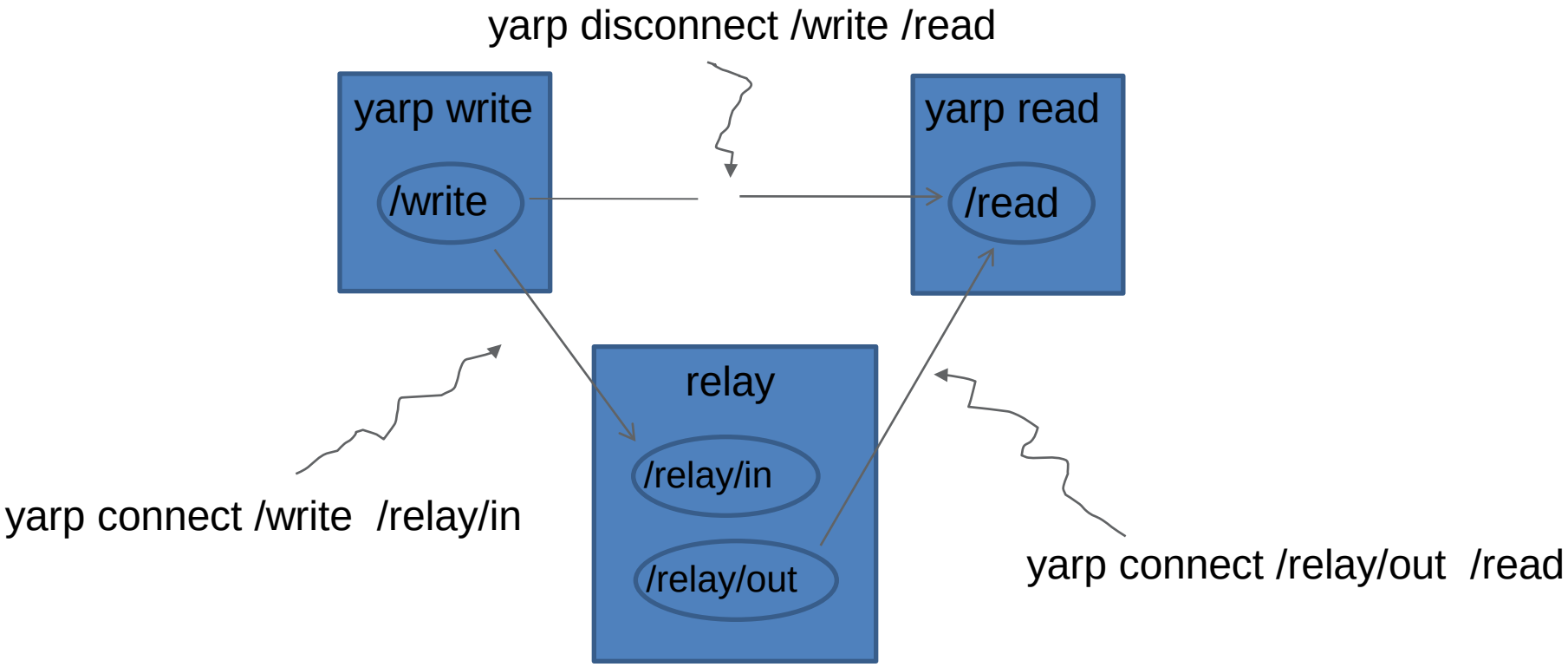
```
int main(int argc, char *argv) {
    Network yarp;
    Port inPort;
    inPort.open("/relay/in");

    Port outPort;
    outPort.open("/relay/out");

    while (true) {
        cout << "waiting for input" << endl;
        Bottle input,output;
        inPort.read(input);
        output=input;
            cout << "writing " << output.toString().c_str() << endl;
        outPort.write(output);
    }
    return 0;
}
```

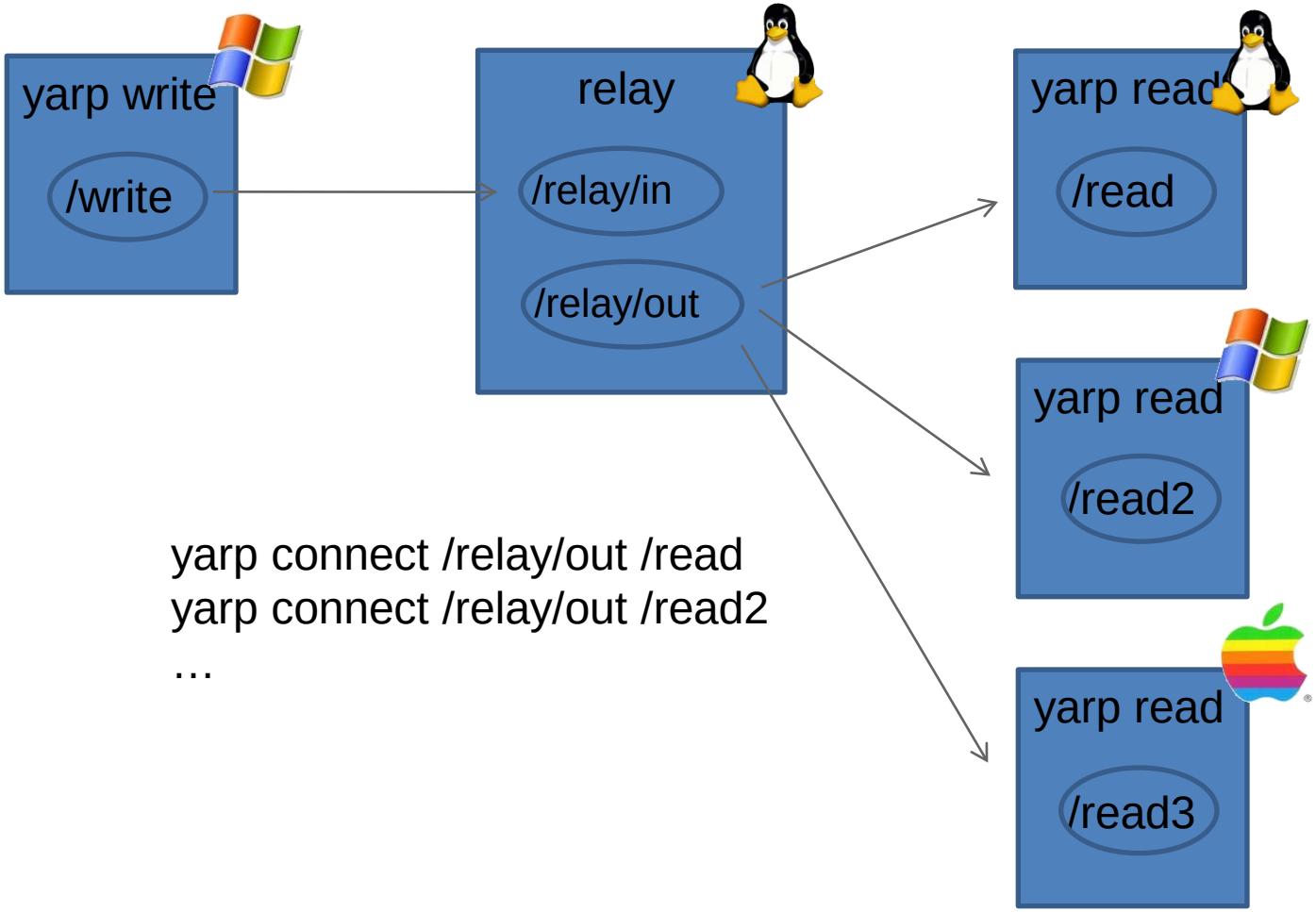


Connect the new module to our network



how the network grows

It is easy to add, for example, another reader…
Processes can run on different machines, with different OS



yarp connect /relay/out /read
yarp connect /relay/out /read2
…

Tutorial 3: decoupling timing

BufferedPort

- In the previous example timing between ports is coupled:
  - The reader waits until data arrives to the port
  - The writer waits until data is transmitted
- Buffered ports allow decoupling time:
  - non blocking read
  - non blocking write
- May loose messages

- Read:

```
BufferedPort<Bottle> p;        // Create a port.
p.open("/in");                 // Give it a name on the network.
while (true) {
      Bottle *b = p.read();    // Read/wait for until data arrives. ...
      // Do something with data in *b
 }
```

- Write:

```
BufferedPort<Bottle> p;        // Create a port.
p.open("/out");                // Give it a name on the network.
while (true) {
      Bottle& b = p.prepare(); // Get a place to store things. ...
      // Generate data.
      p.write();               // Send the data.
}
```

- Polling: when you do not want to wait for input data:

```
BufferedPort<Bottle> p;
...
Bottle *b = p.read(false);
if (b!=NULL) {
  // data received in *b
}
```

Tutorial 3: getting callbacks

- Callbacks: useful if you want to be notified when data arrives
- Easy to do with BufferedPorts

```
class DataPort : public BufferedPort<Bottle> {
    virtual void onRead(Bottle& b) {
        // process data in b
    }
};
...
DataPort p;
p.useCallback();  // input should go to onRead() callback
p.open("/in");
```

Things are a bit more complicated with normal ports

```
class DataProcessor : public PortReader {
    virtual bool read(ConnectionReader& connection) {
        Bottle b;
        bool ok = b.read(connection);
        if (!ok) return false;
        // process data in b
        return true;
    }
};

Port p;
p.open(..)
DataProcessor processor;
...
p.setReader(processor);  // no need to call p.read() on port any more.
```

Tutorial 4: getting replies

Client side

```
Port p;                 // Create a port.
p.open("/out");         // Give it a name on the network.
while (true) {
  Bottle in,out;        // Make places to store things.
  ...                   // prepare command "out".
  p.write(out,in);      // send command, wait for reply.
  ...                   // process response "in".
}
```

Server side

```
Port p;                 // Create a port.
p.open("/in");          // Give it a name on the network.
Bottle in, out;         // Make places to store things.
while (true) {
  p.read(in,true);      // Read and warn that we'll be replying.
  ...                   // Do something with data, prepare reply
  p.reply(out);         // send reply.
}
```

Replies in a callback

```
class DataProcessor : public PortReader {
    virtual bool read(ConnectionReader& connection) {
        Bottle in, out;
        bool ok = in.read(connection);
        if (!ok) return false;
        ...      // process data "in", prepare "out"
        ConnectionWriter *returnToSender = connection.getWriter();
        if (returnToSender!=NULL) {
           out.write(*returnToSender);
        }
        return true;
    }
};
DataProcessor processor;
...
p.setReader(processor);  // no need to call p.read() on port any more.
```