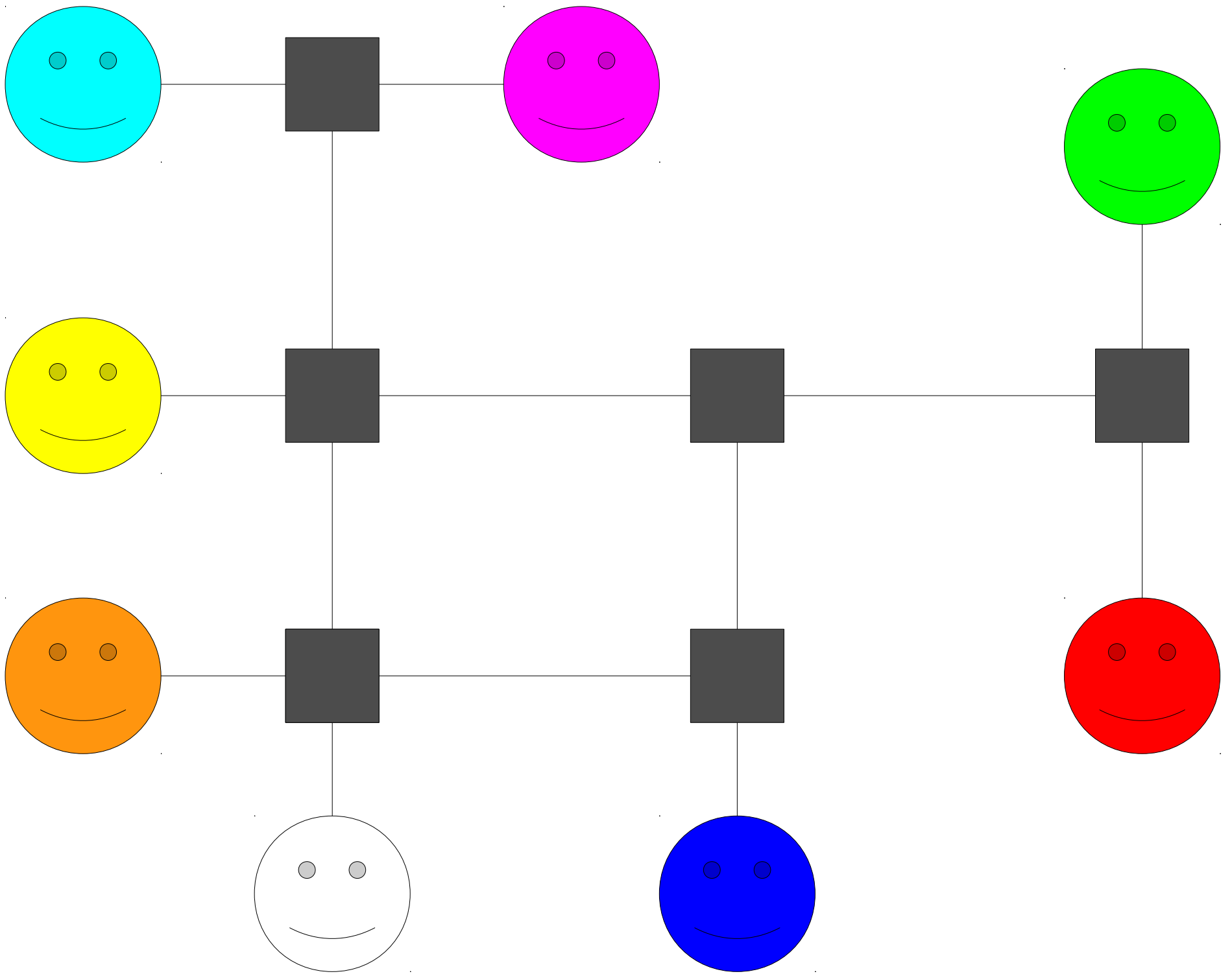


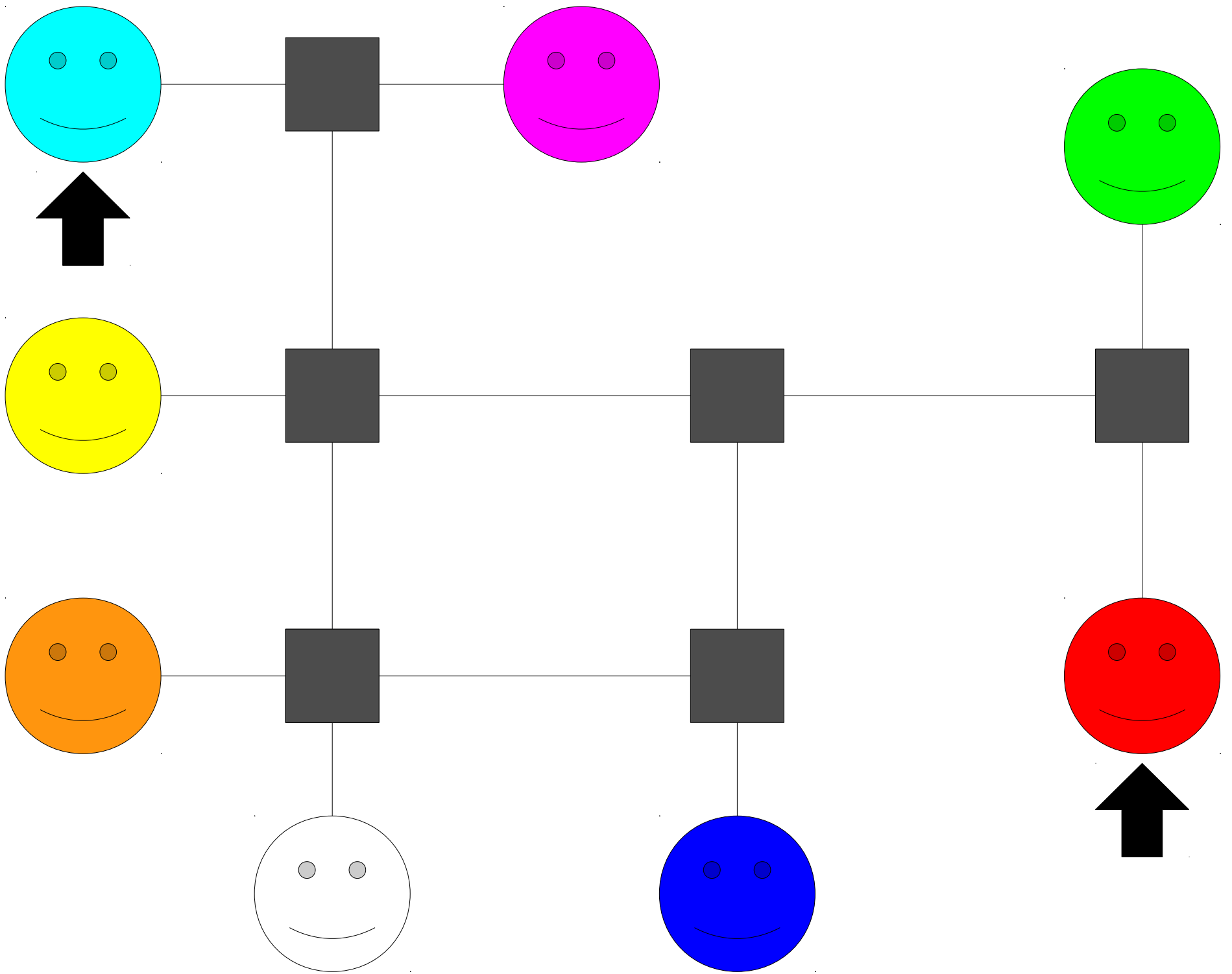
Networking

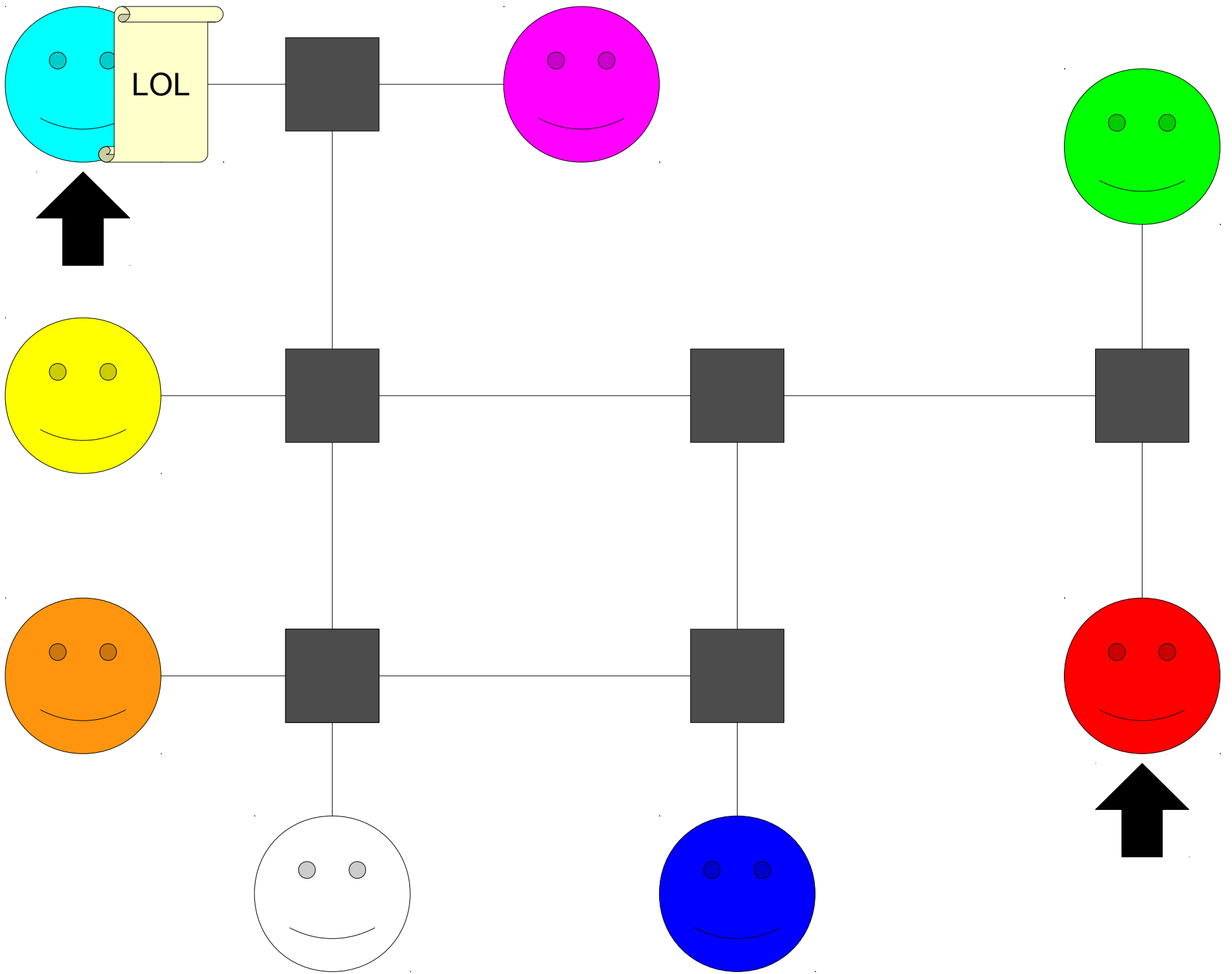
Computer Networks

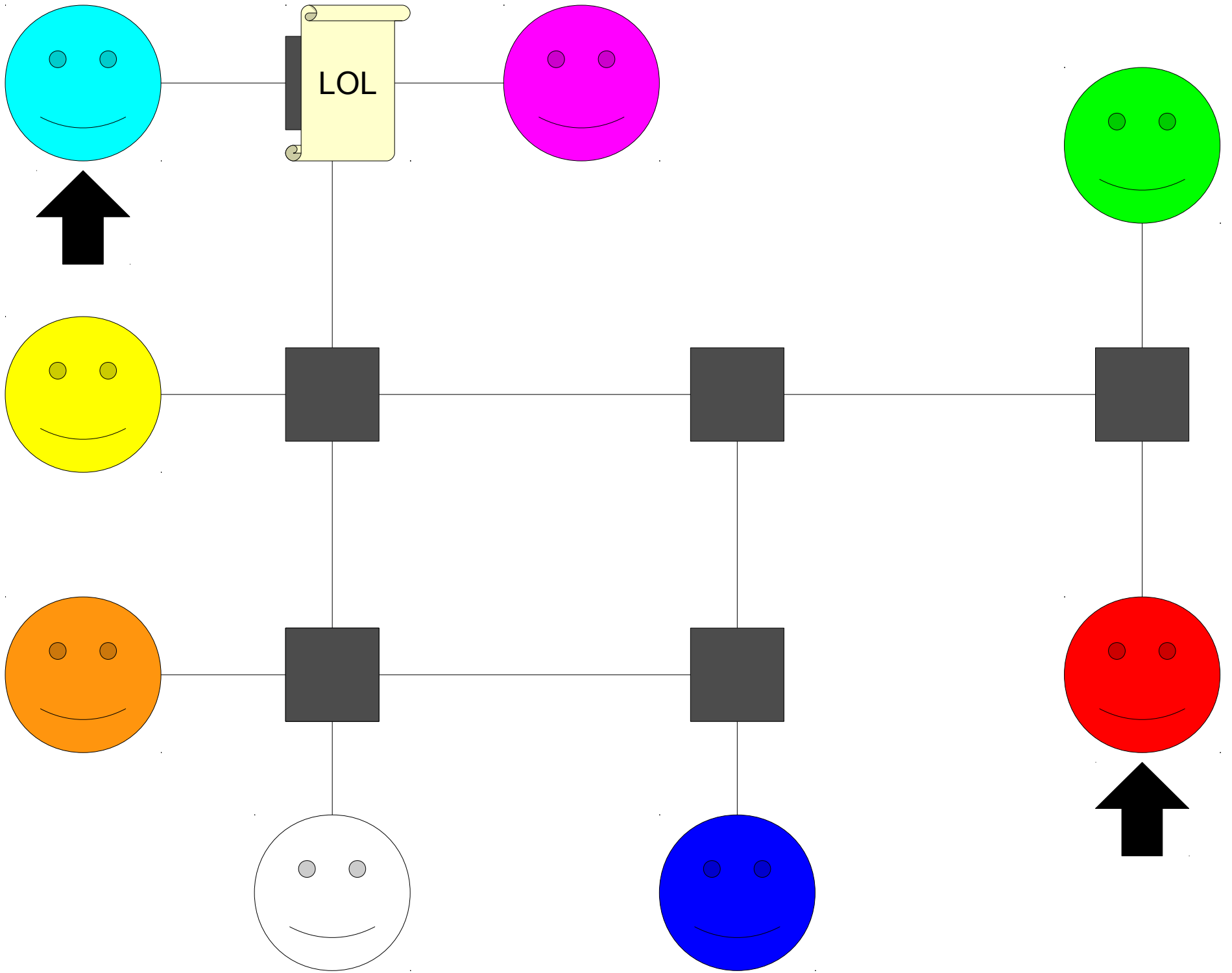
- Computer networks allow us to get amazing things done.
 - Sharing knowledge (Wikipedia, Khan Academy, Coursera, Udacity, etc.)
 - Solving huge problems (folding@home, Mechanical Turk, etc.)
- Computer networks prevent us from getting amazing things done.
 - Social networks (Facebook, Google+, etc.)
 - Streaming video (Netflix, Hulu, etc.)

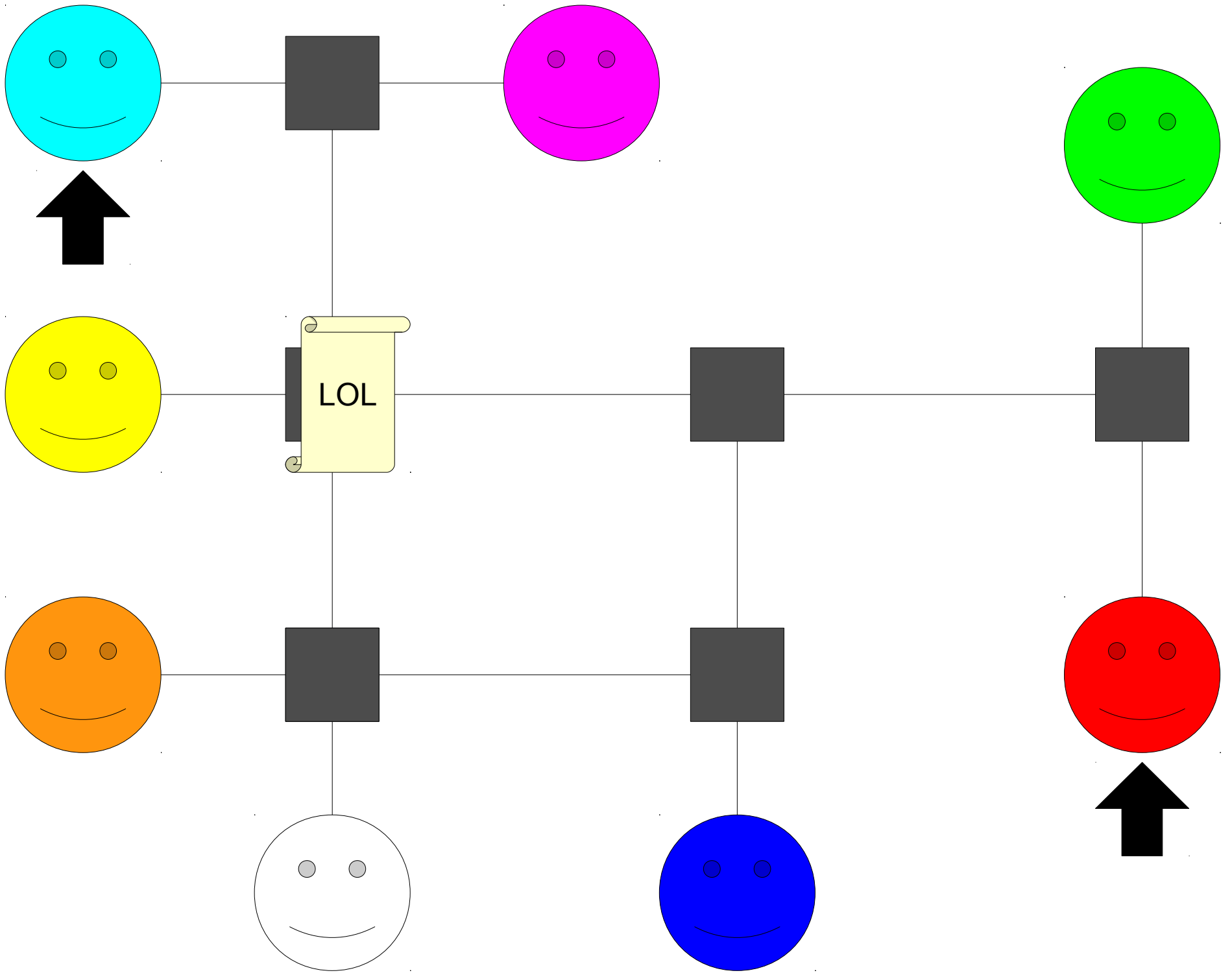
How does it all work?

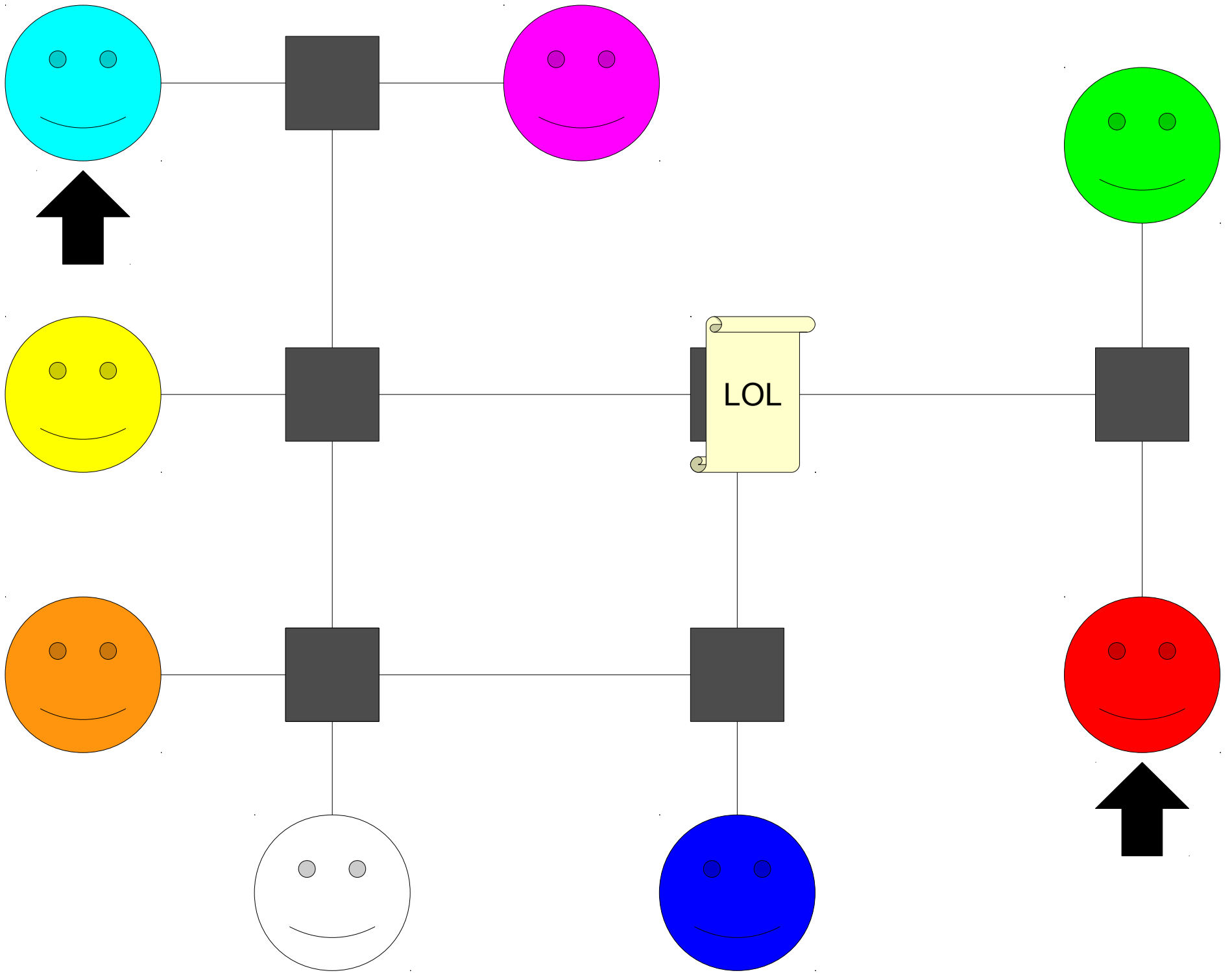


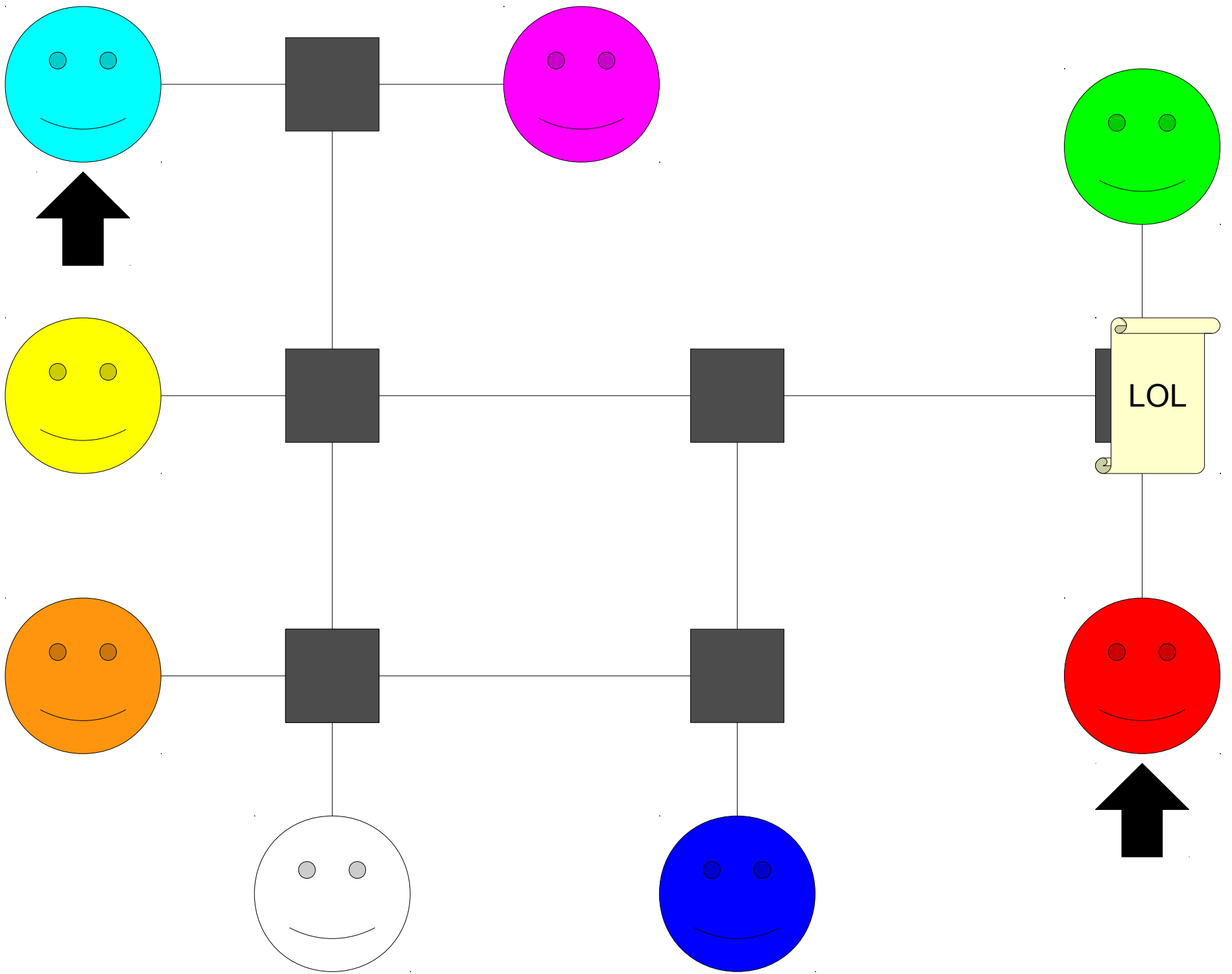


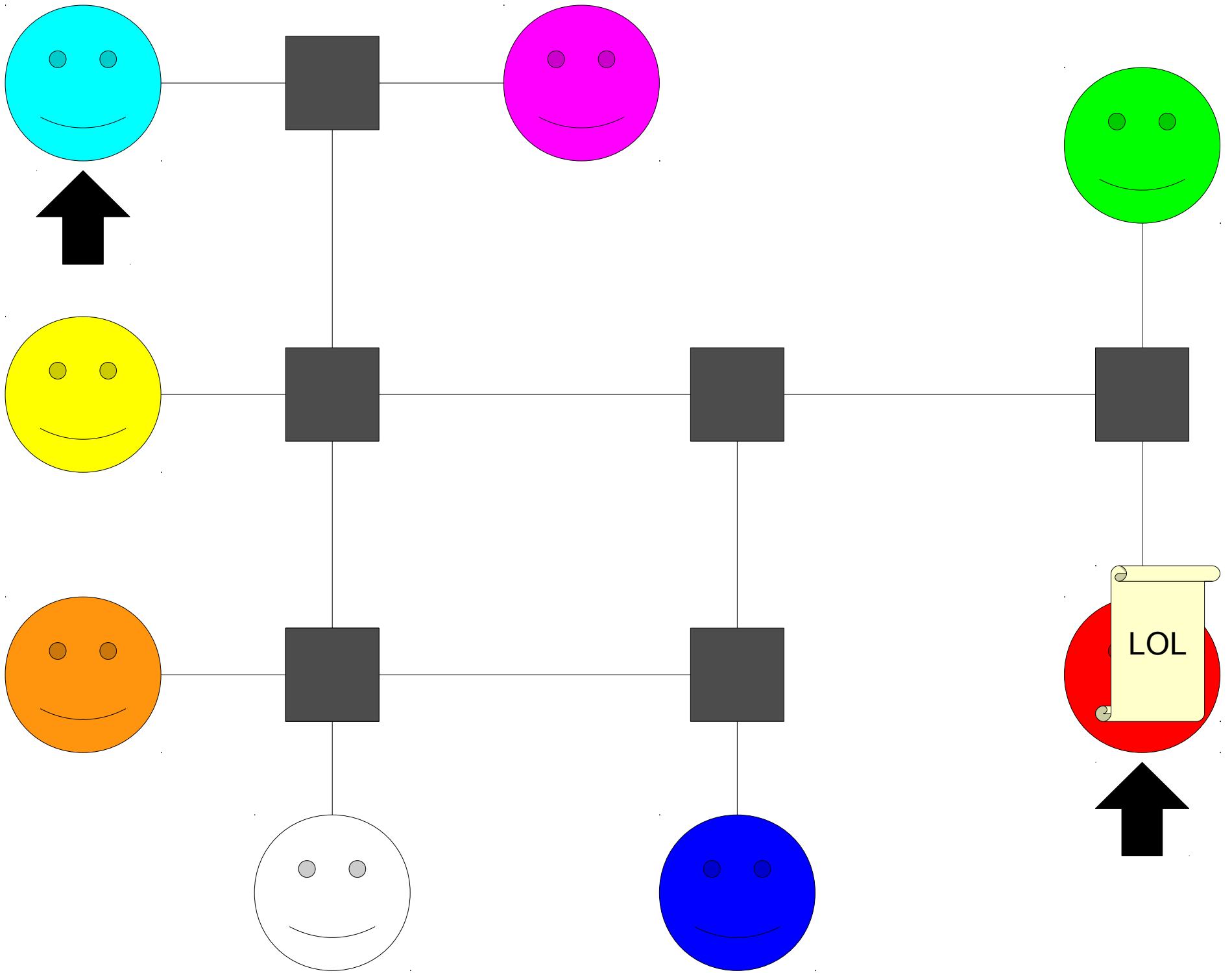


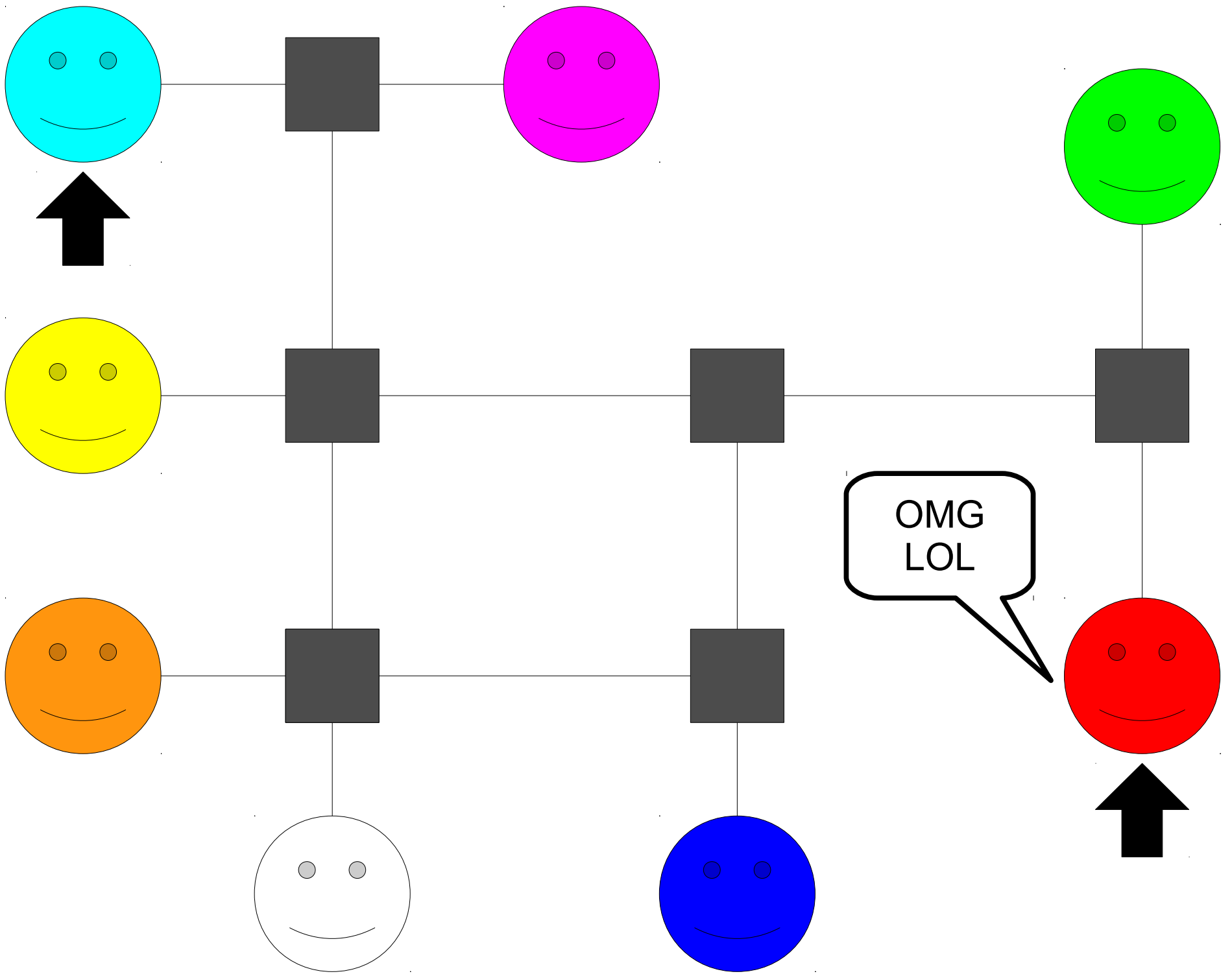






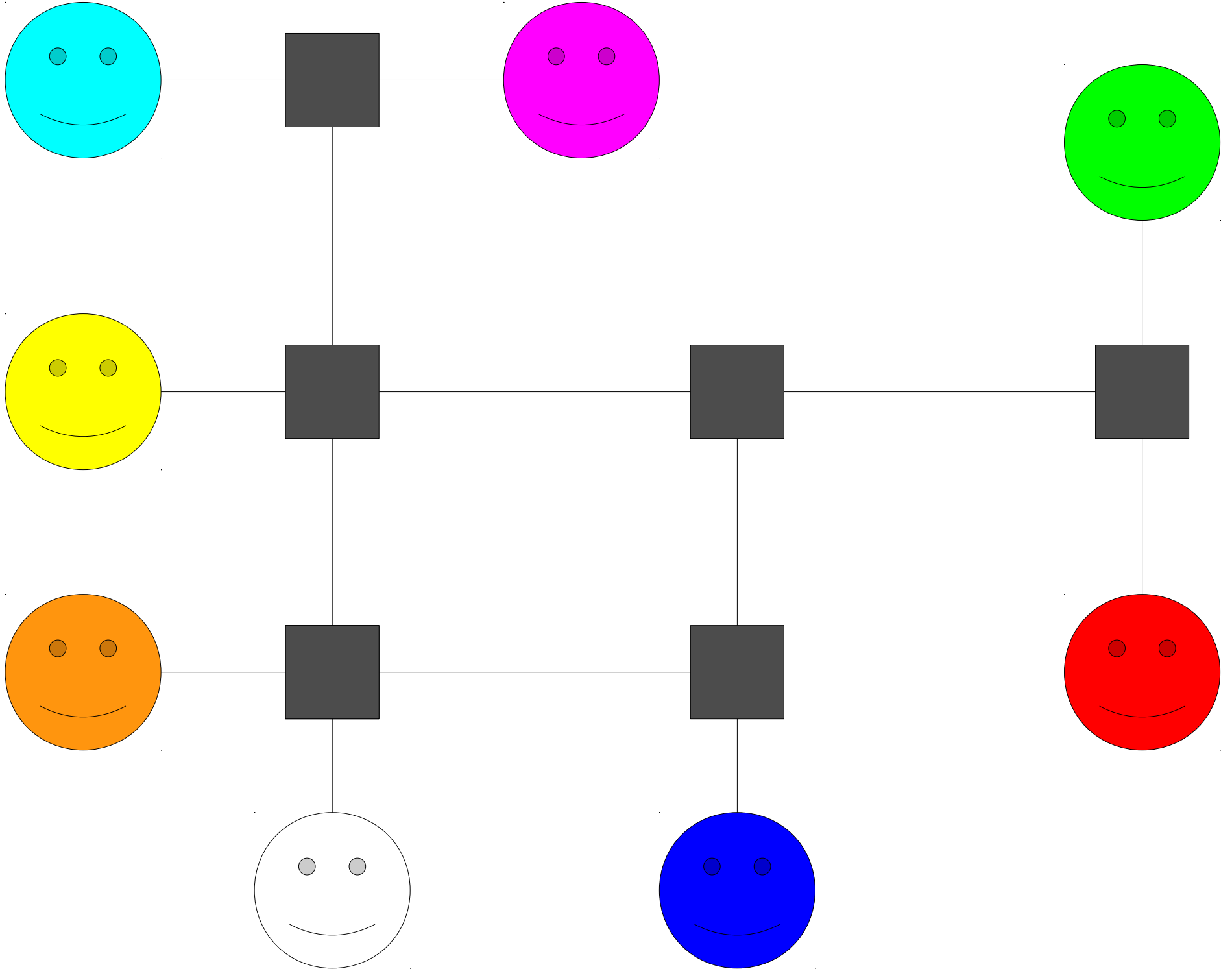


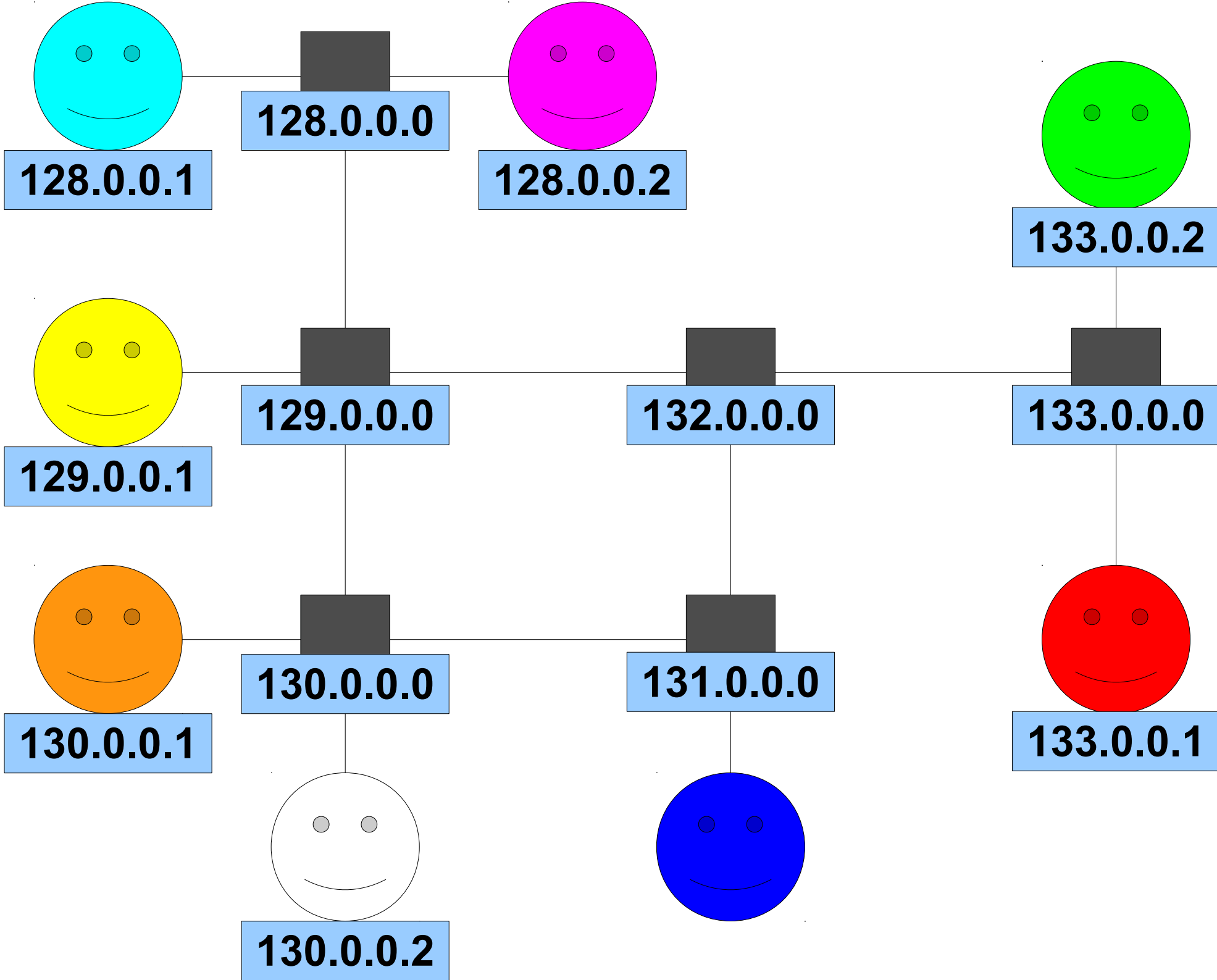


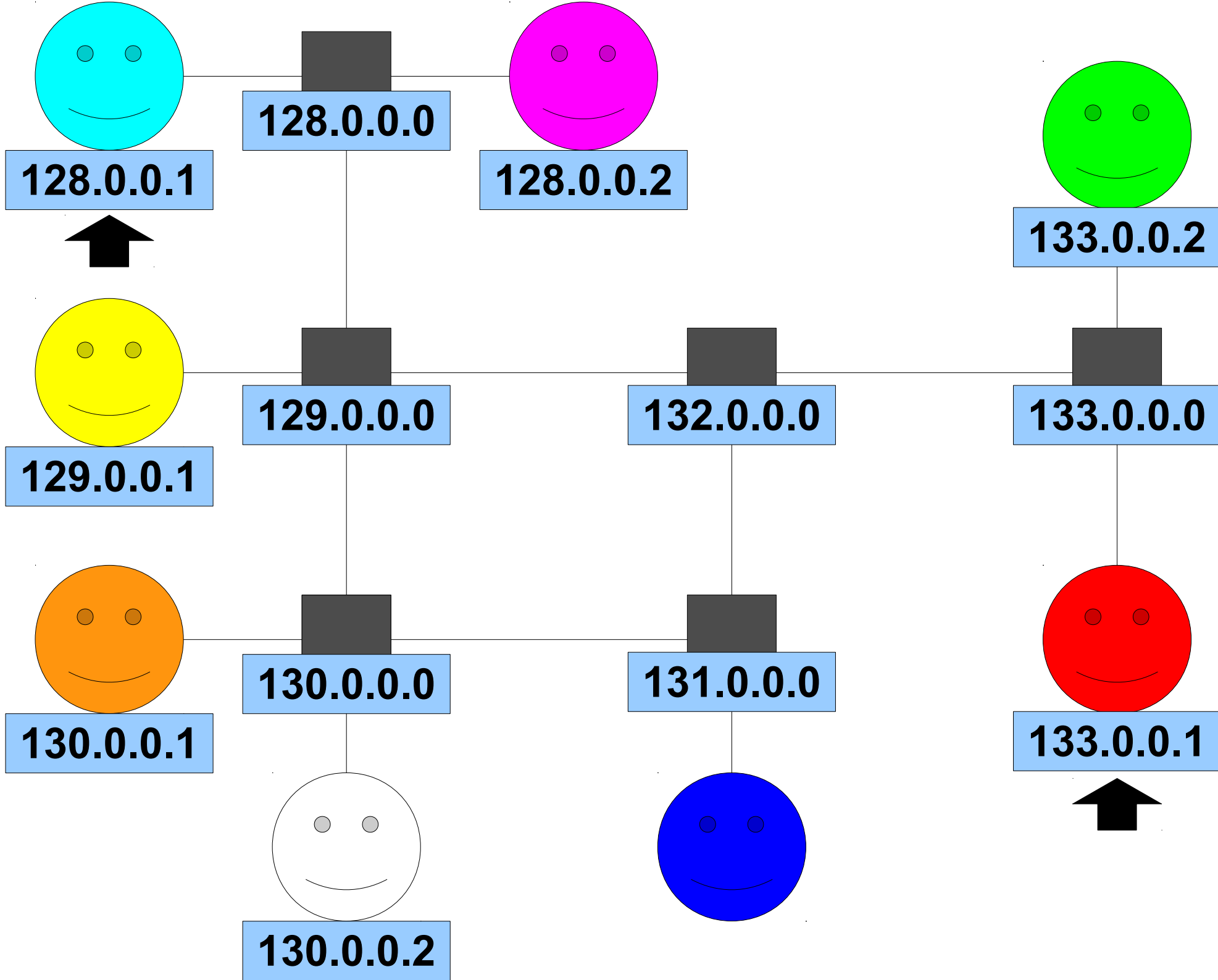


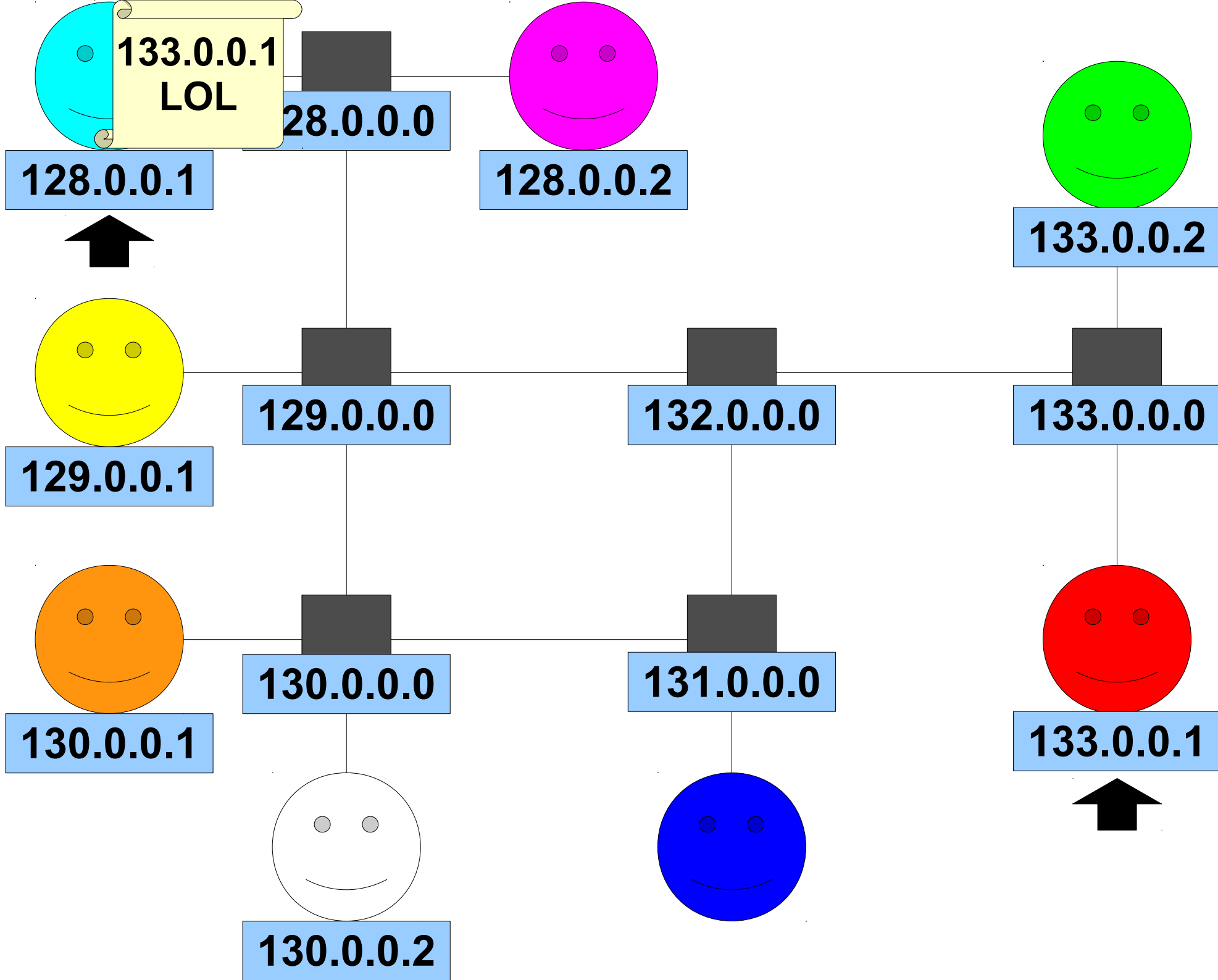
Sending Data

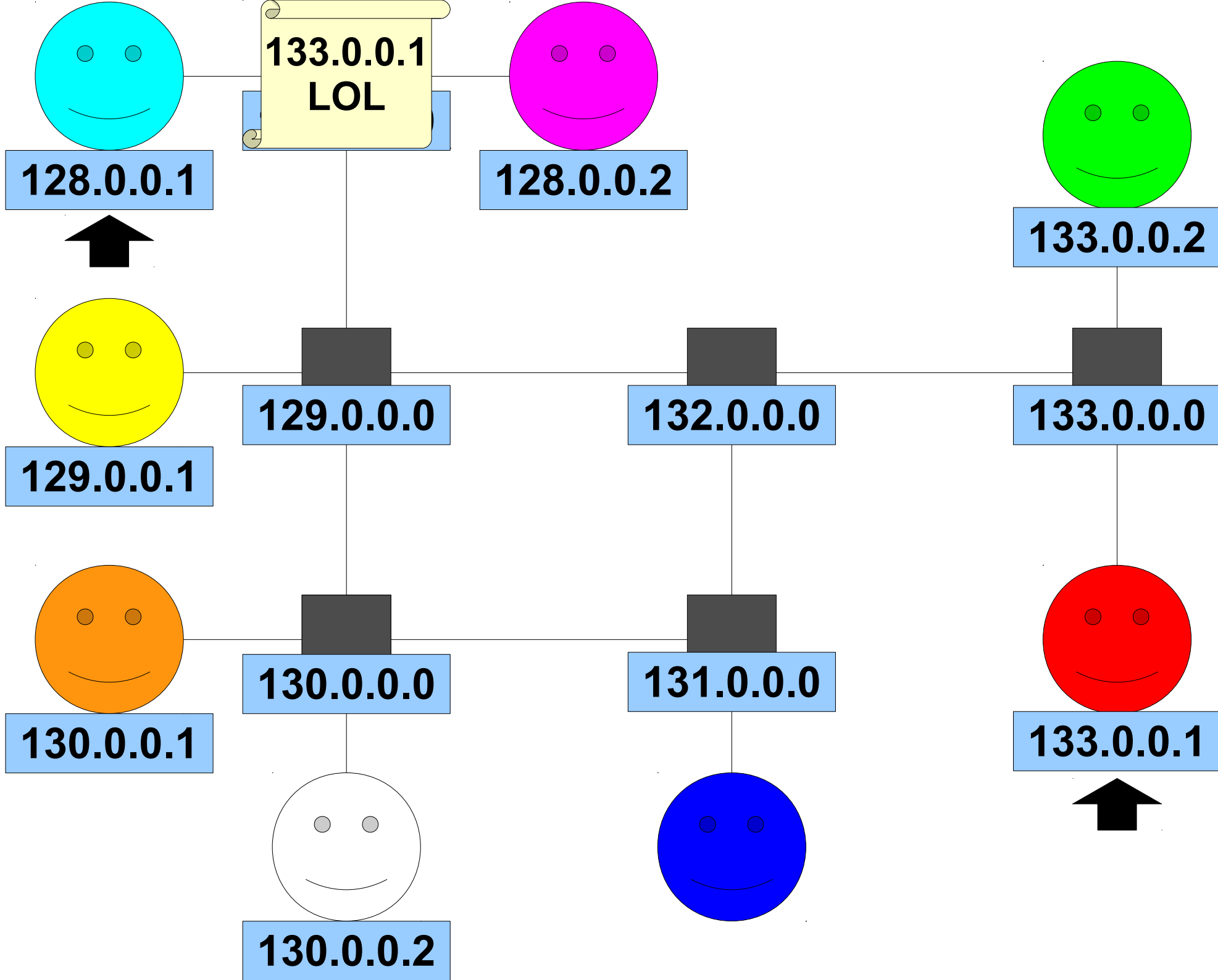
- Data is sent across the Internet in ***packets***.
- Each packet contains a message (called the ***payload***), along with extra information to help it get to its destination correctly.

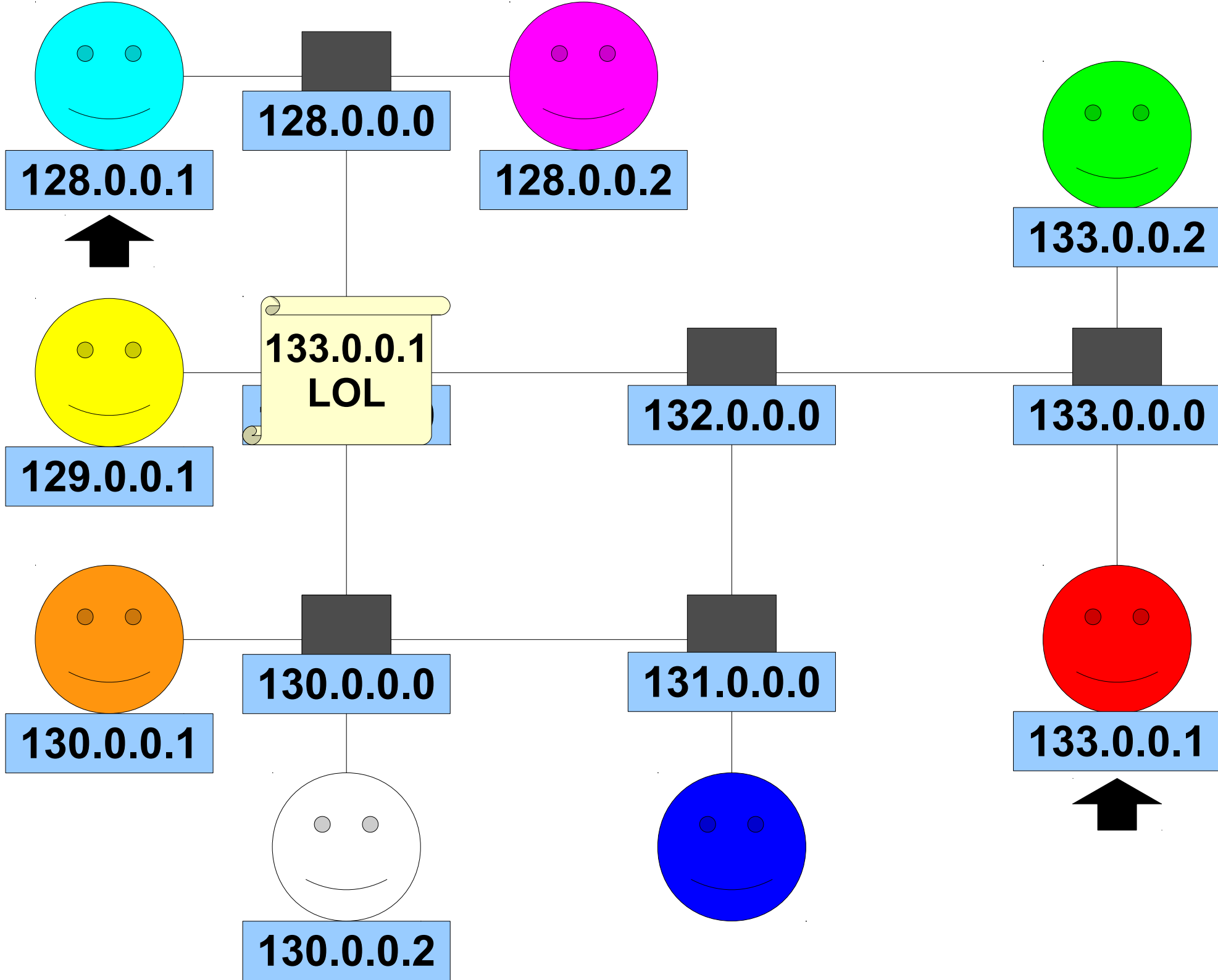


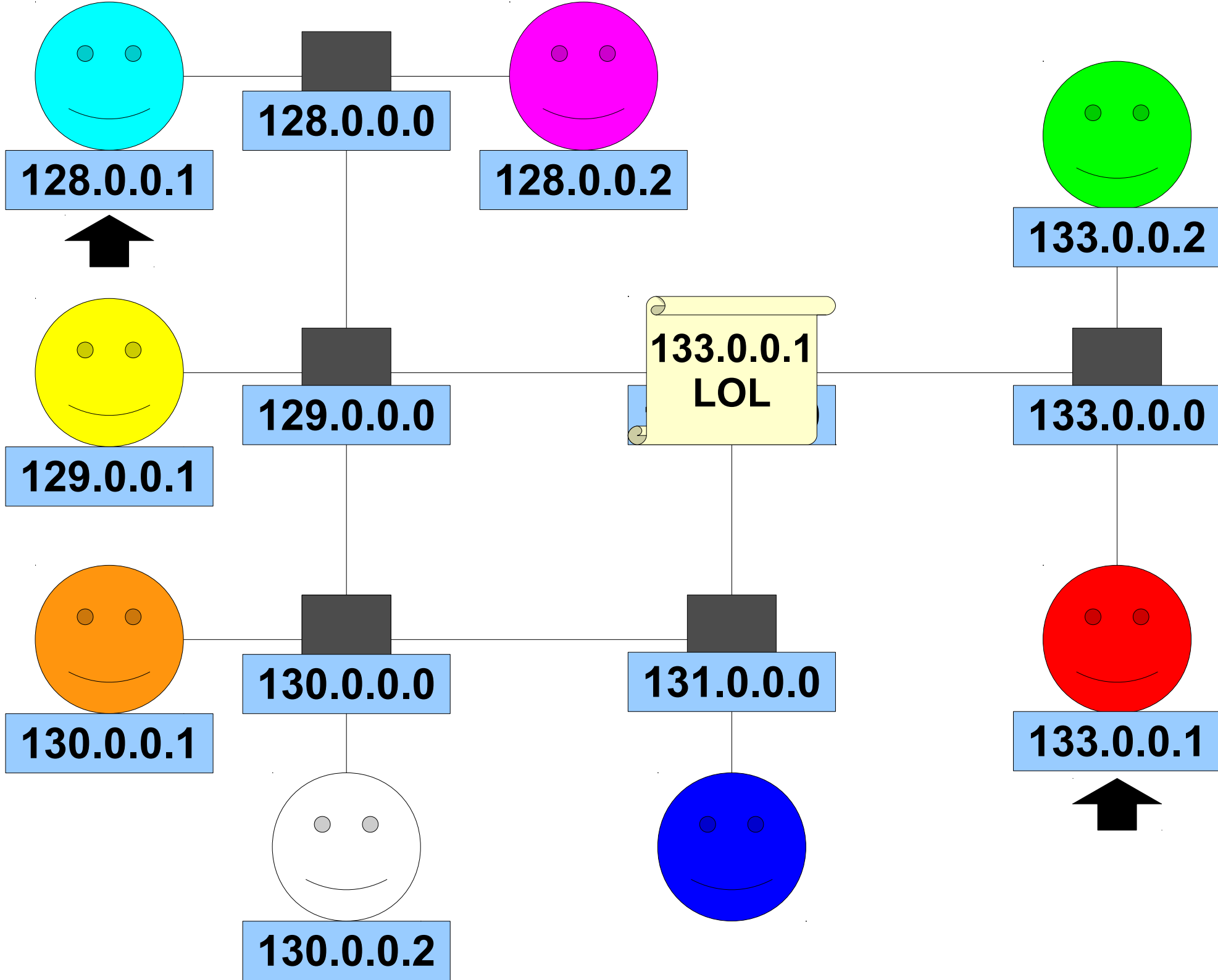


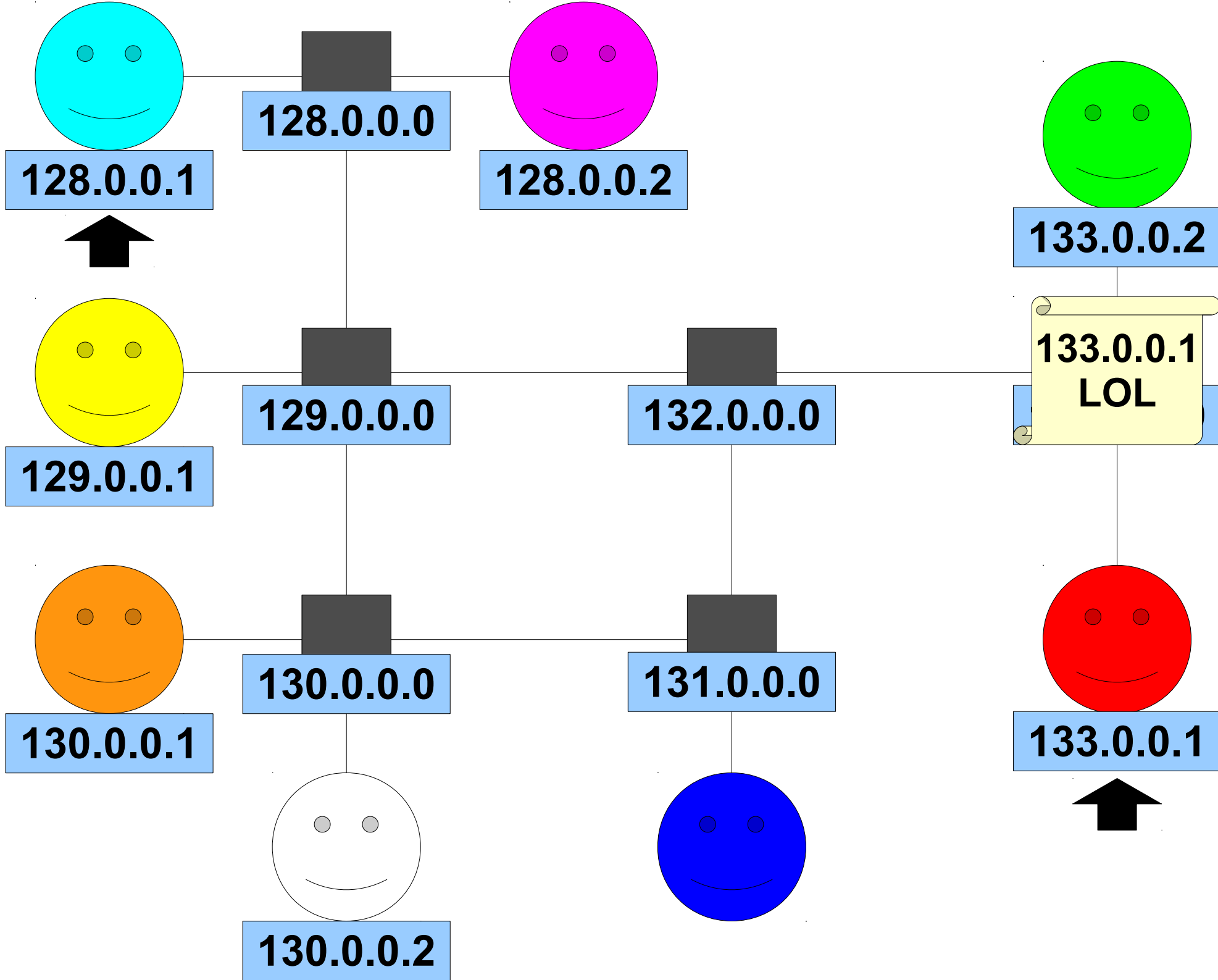


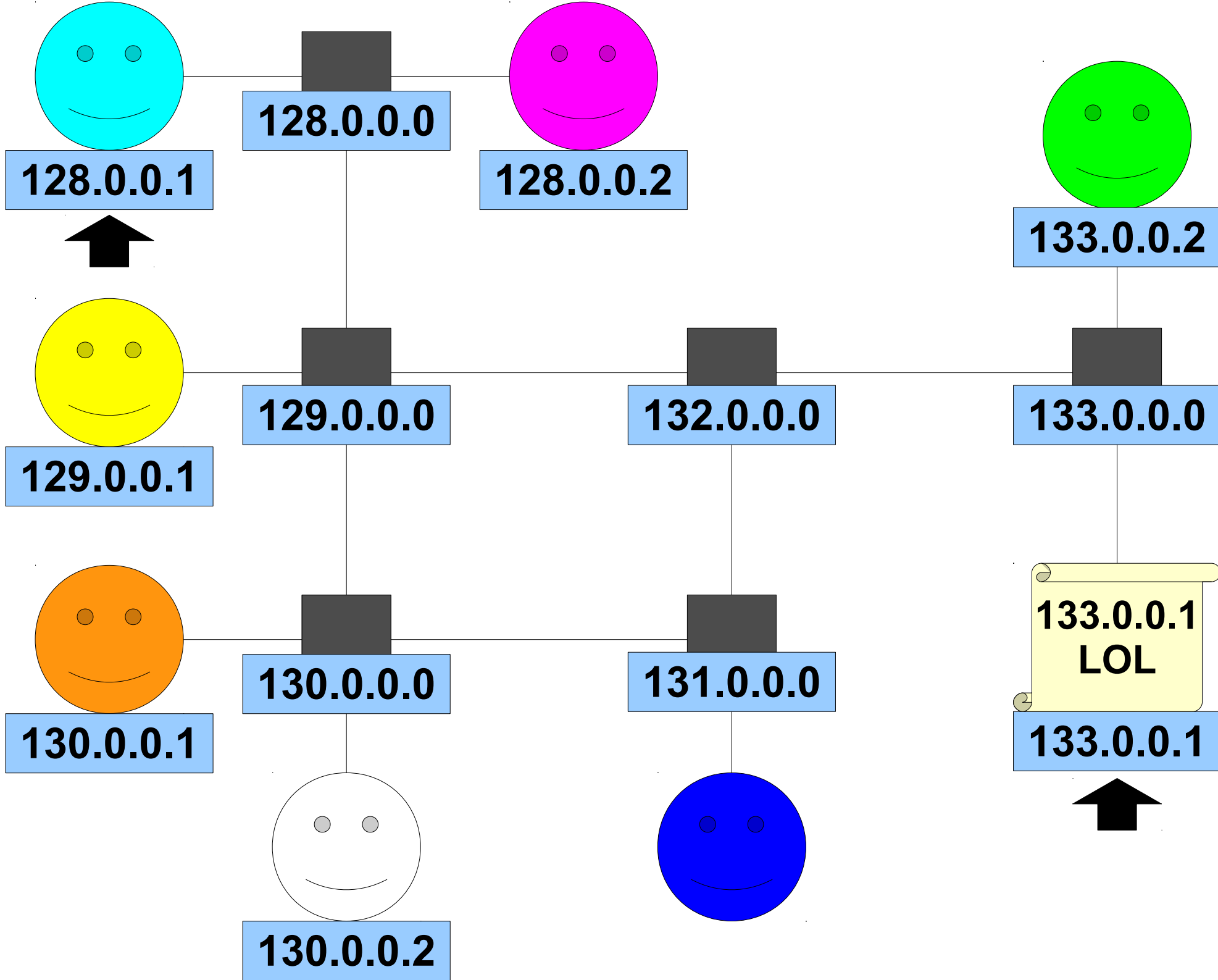


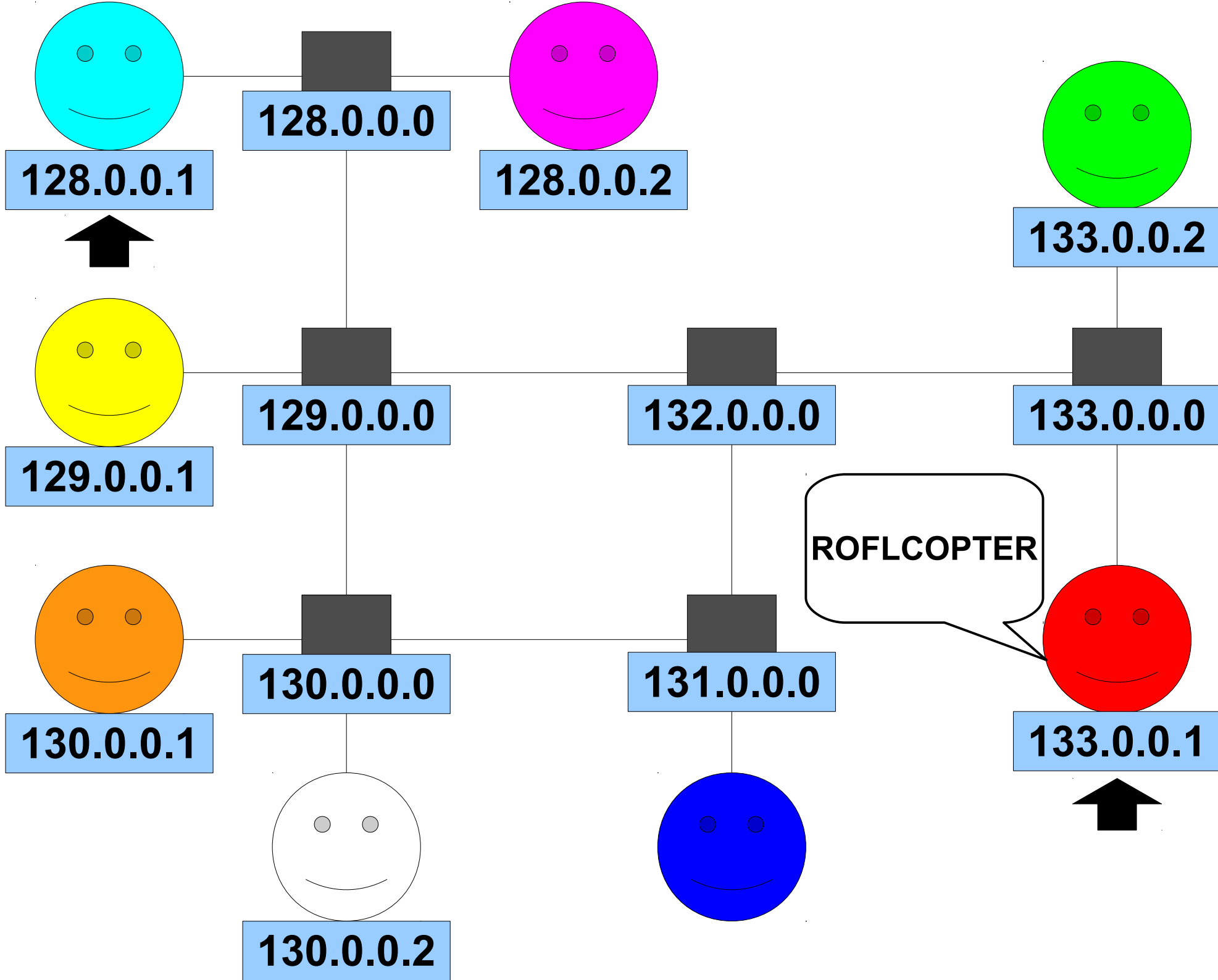












IP Addresses

- Each computer may have one or more ***IP addresses*** so that it can receive messages over the Internet.
 - Similar to a phone number.
- There are two types of IP addresses:
 - IPv4: 2^{32} possible addresses (about four billion), and we've just about run out!
 - IPv6: 2^{128} possible addresses (about 4×10^{34}), and we're very unlikely to run out in the future.

Hostnames

- In order to make it easier to find remote computers, computers can have names associated with them.
 - www.google.com
 - www.stanford.edu
- These names are called **hostnames**.
- A system called the **domain name system** (or **DNS**) is responsible for converting domain names into IP addresses.
 - Like a huge `HashMap<String, IP Address>`

A Small Problem

- At any one time, you could be
 - Surfing the web,
 - Downloading music from iTunes,
 - Checking your email,
 - etc.
- You might have packets from many different machines all arriving at once.
- How does the computer know how to send each message to the right program?

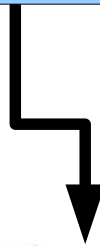
Ports

- Every packet is labeled with a ***port number*** that lets the destination computer know how to process the message.
 - Has nothing to do with physical ports on the computer; it's just a way of differentiating traffic.
- Different applications listen in on different ports:
 - Sending mail (SMTP): Port 25
 - Browsing the web (HTTP): Port 80
 - Checking email (IMAP): Port 143

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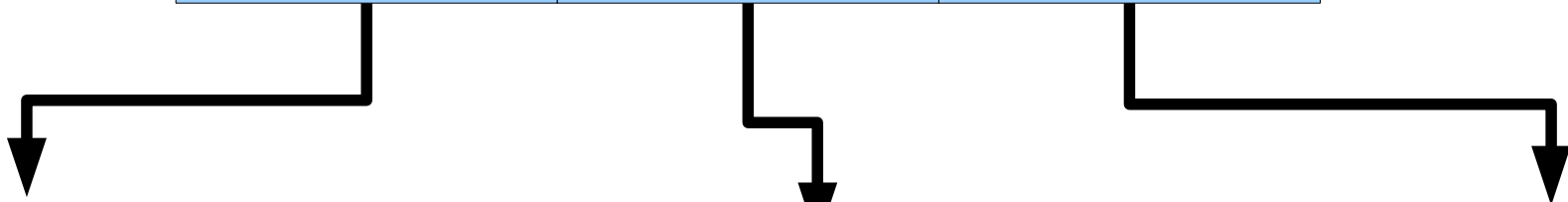
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CutePuppies.html

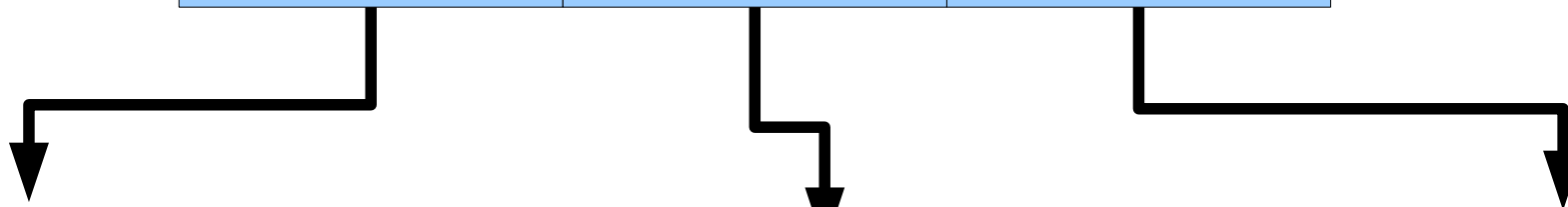
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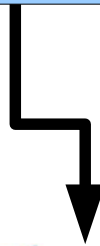
CutePuppies.html



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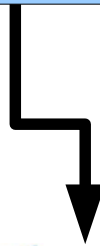


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Let it Go.m4a

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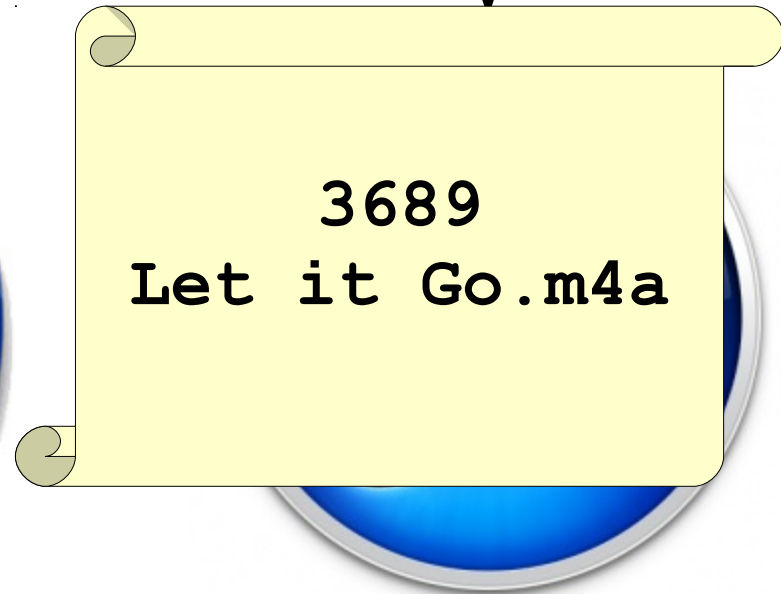
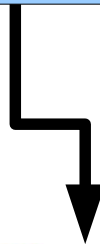
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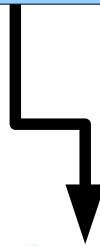


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Let it Go.m4a

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Sockets

- A ***socket*** is a combination of an IP address (destination computer) and port number (what program should read the message).
- Contains all the information necessary to ensure that a message gets to the right program on the right computer.
- To set up a connection to a remote computer, you need to create a socket connection to that computer.

Application Protocols

- Now that we can get computers talking to one another, how do they communicate information in a meaningful way?
- An *application protocol* is a set of rules computers can follow to communicate over a network.
- Each computer follows the rules of the protocol to share information.

An Example: **HTTP**

Networking in Java

- To connect to a remote machine:
 - Create a socket connection to the machine by giving a combination of the host name and the port.
 - Create a `BufferedReader` to read messages coming from the other computer.
 - Create a `PrintWriter` to send messages to the other computer.
 - Send and receive messages as you see fit!

Time-Out for Announcements!

Assignment 7

- Assignment 7 (NameSurfer) is due on Monday at 3:15PM.
 - Stop by the LaIR with questions!
 - Stop by our office hours with questions!
- Midterms will be graded this weekend; should be returned on Monday.

Casual CS Dinner

- Stanford Women in Computer Science (WiCS) is holding their second biquarterly Casual CS Dinner tonight.
- 6PM - 8PM on the fifth floor of Gates.
- Great event - highly recommended!

Hack | Overflow

Hardware Edition



Learn



design



Create

What is HackOverflow?

HackOverflow is a 12-hour hackathon hosted by Stanford Women in Computer Science (WiCS), focused on building with awesome hardware. We'll be providing fun things to hack on, mentors, workshops, swag, and food!

Saturday, April 25, 2015

10 AM – 10 PM

Huang Engineering Center Basement

RSVP: <https://hackoverflow.typeform.com/to/zNSIMK>

Back to CS106A!

Client/Server Architecture

- A ***server*** is a program that waits for incoming connections.
 - Typically, has some data or service that it can provide.
- A ***client*** is a program that initiates a connection to a server.
 - Typically, wants to use that data or service.
 - The program we just wrote was a client that connected to a remote web server.

Acting as a Server

- A program can act as a server as follows:
 - Create a `ServerSocket` on a given port and wait for an incoming connection.
 - Obtain a `Socket` that lets you communicate with the machine that has connected.
 - Proceed as before.

A Simple Chat Program