Internet Protocol (IP)

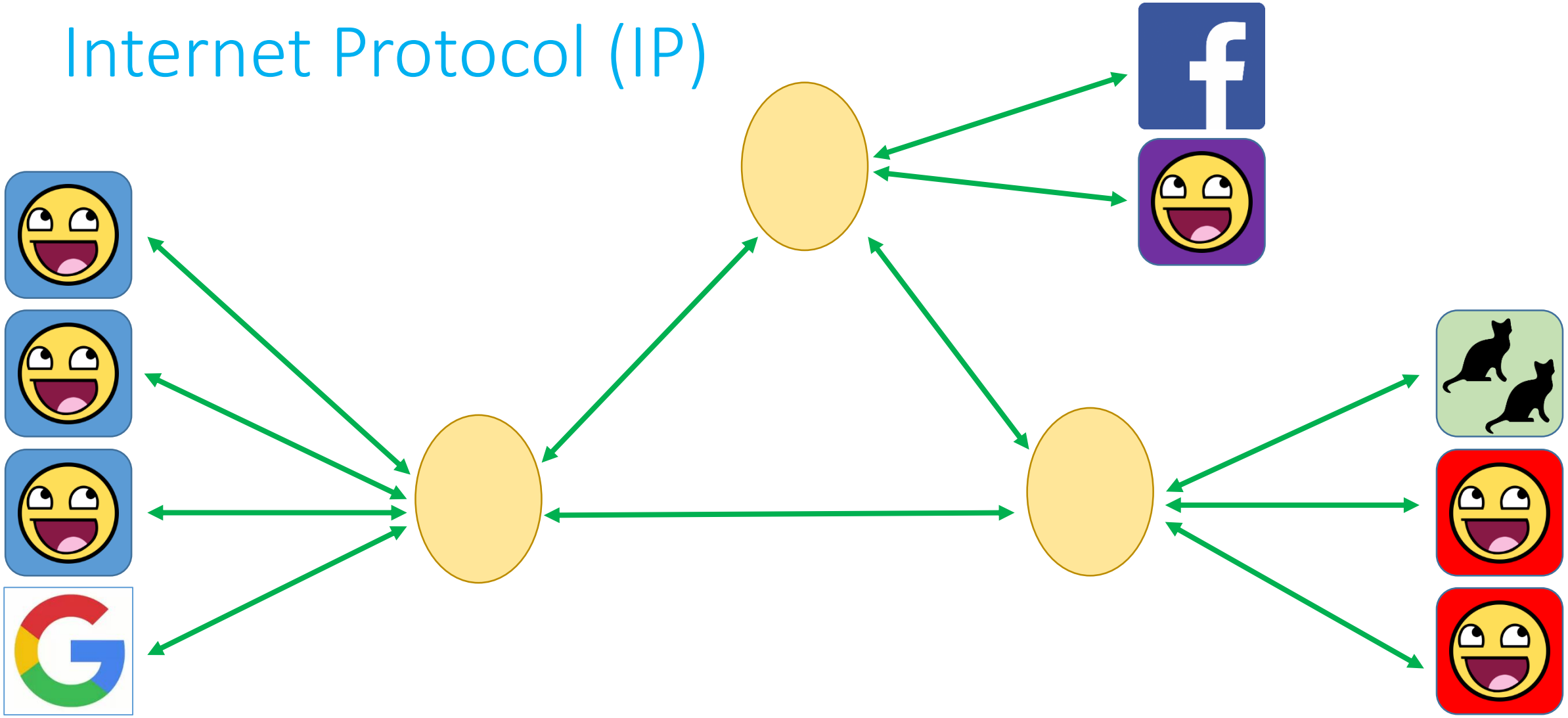
Internet Protocol (IP)

- As discussed previously, “the Internet” is really an *interconnected network* comprised of smaller networks woven together and agreeing to communicate with one another.

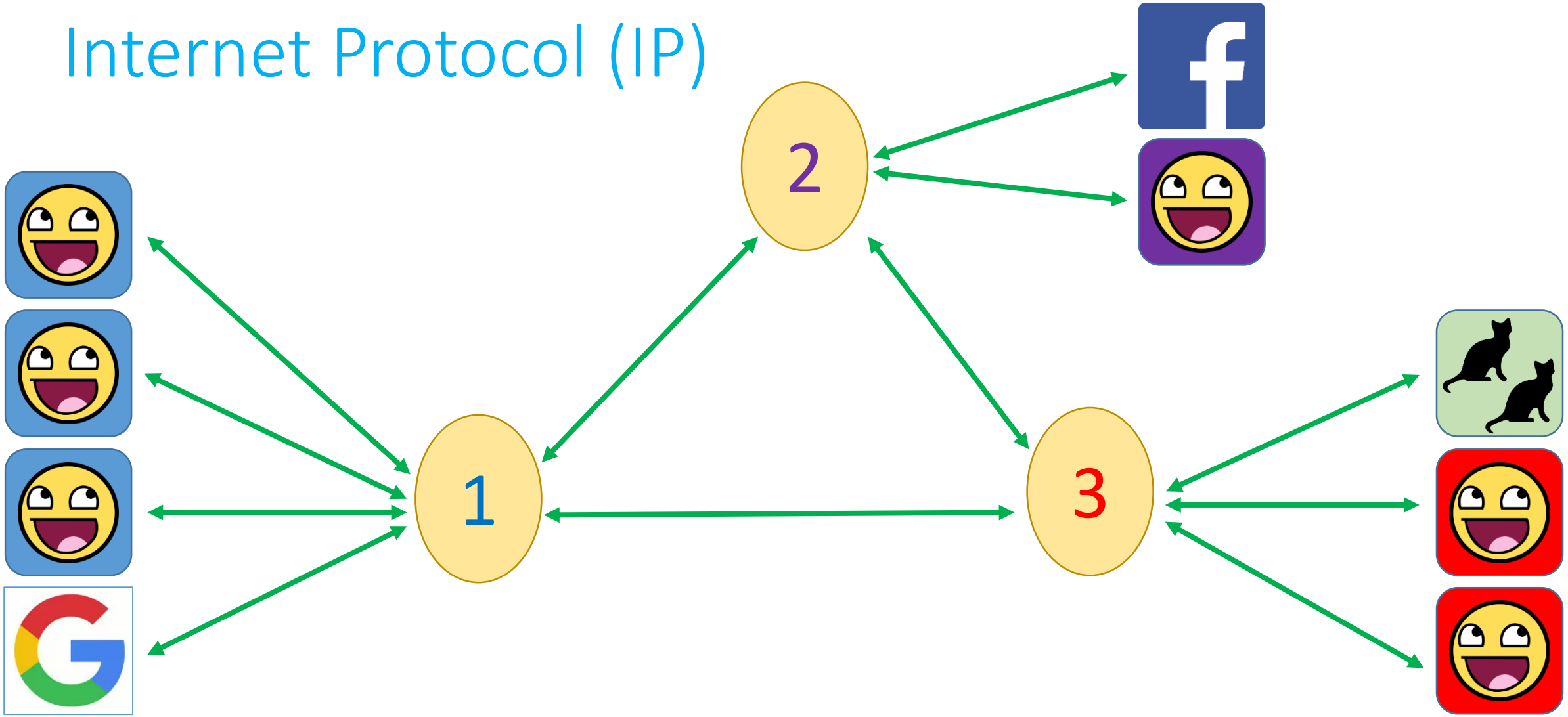
- How do these networks know how to communicate with one another? This is the responsibility of the Internet Protocol (IP).

- Though it’s admittedly on an extremely small scale, this picture is misleading as it pertains to network communication.

Internet Protocol (IP)



Internet Protocol (IP)



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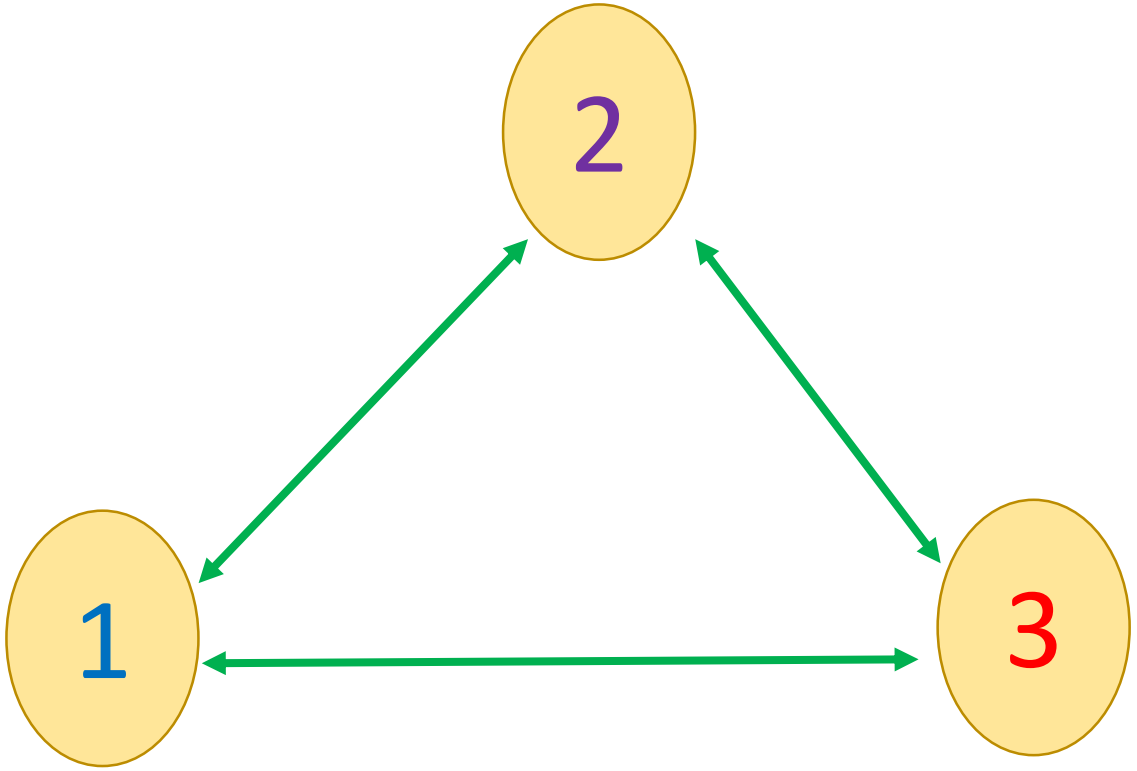

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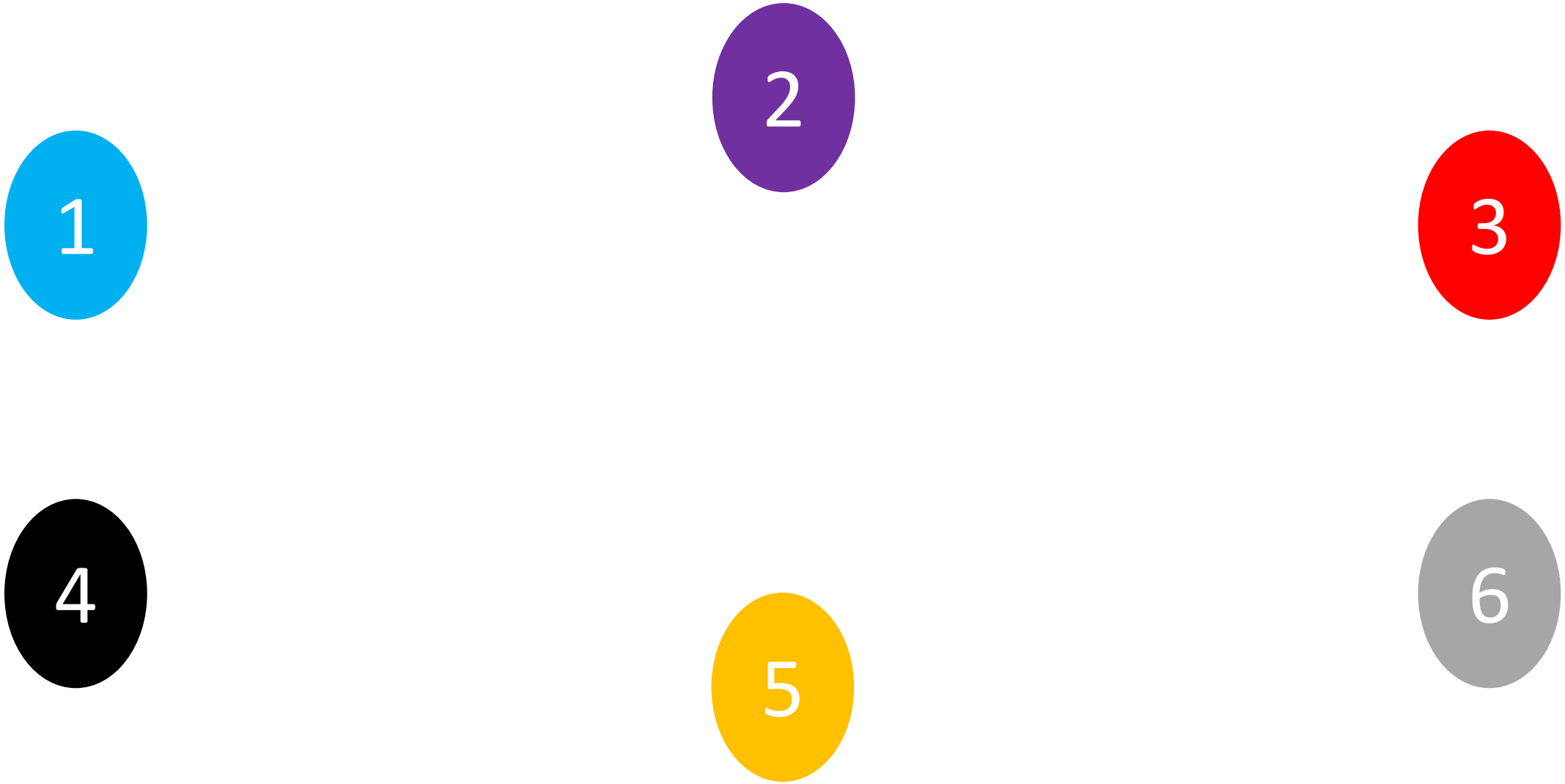

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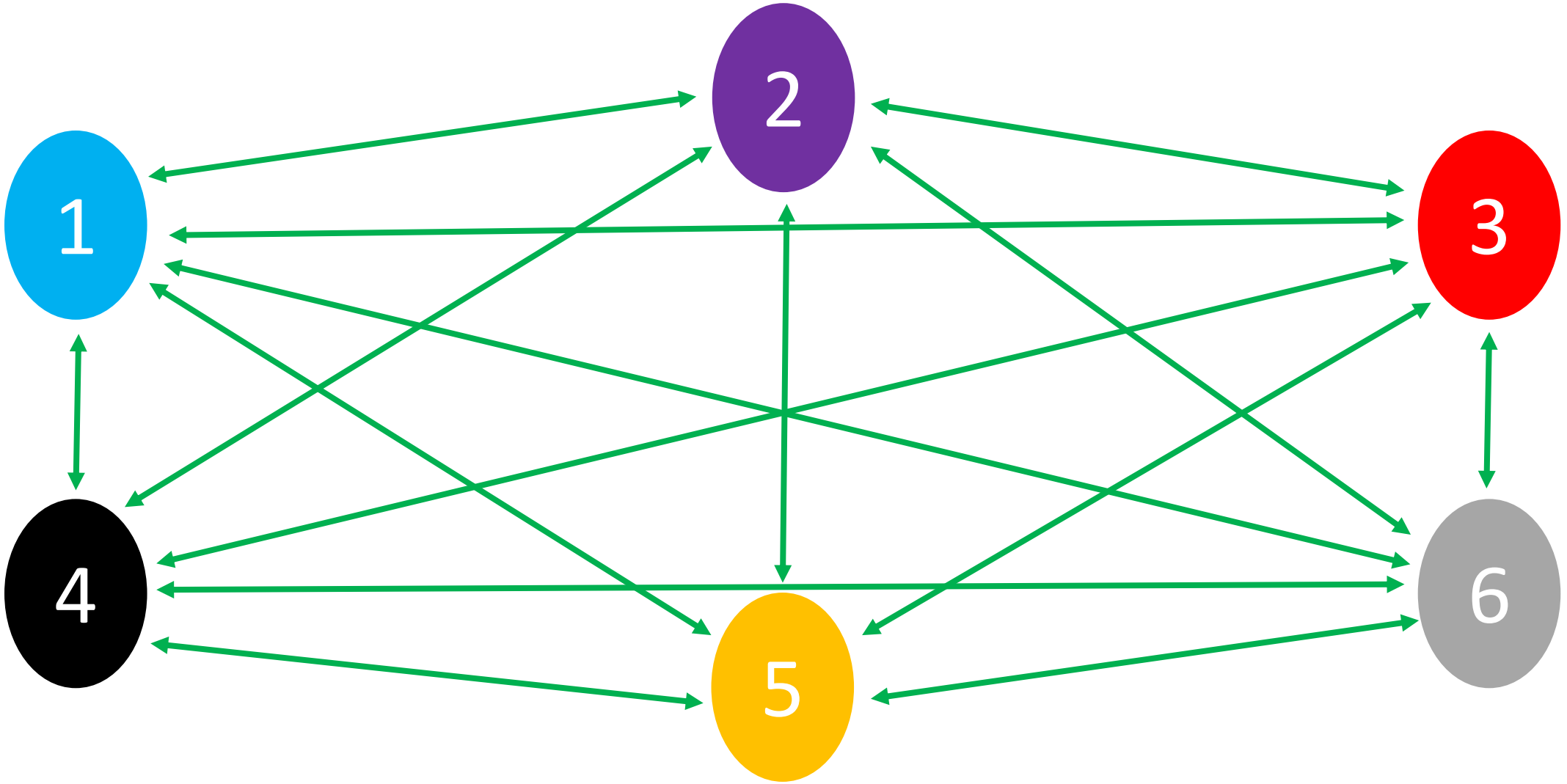


Internet Protocol (IP)

- With only six networks, things are rapidly getting out of hand. And the modern Internet consists of a lot more than six networks. We simply can’t afford to wire them together such that each directly connects with every other.

- But still, we need each network to be able to talk to each other network, or we end up with pieces of the network that are unable to speak to other parts of the network.

Internet Protocol (IP)

- This is where **routers** come back into play.

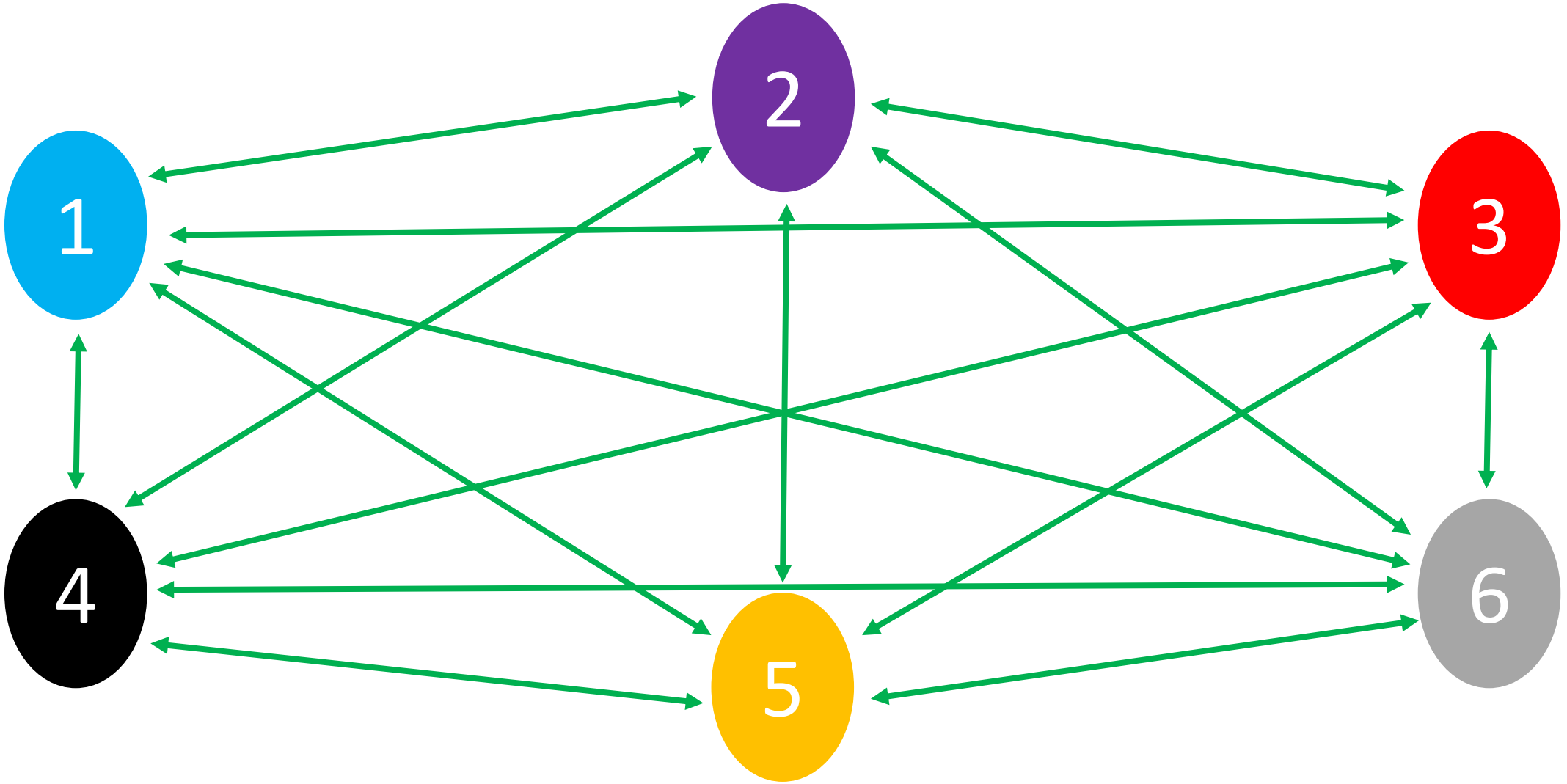
- What if, instead of being connected to every other network, each network was connected to a limited number of routers (each of which was connected to other nearby routers), and each router had instructions built into it on how to move information toward its destination?

- This information might be stored in a routing table, inside of the router.

Internet Protocol (IP)

- For this illustration, let's assume each network has IP addresses in the range of *n.x.x.x*, where *n* is its network number, and each x is in the range [0, 255].
  - A generalization of the way things actually work!

Internet Protocol (IP)



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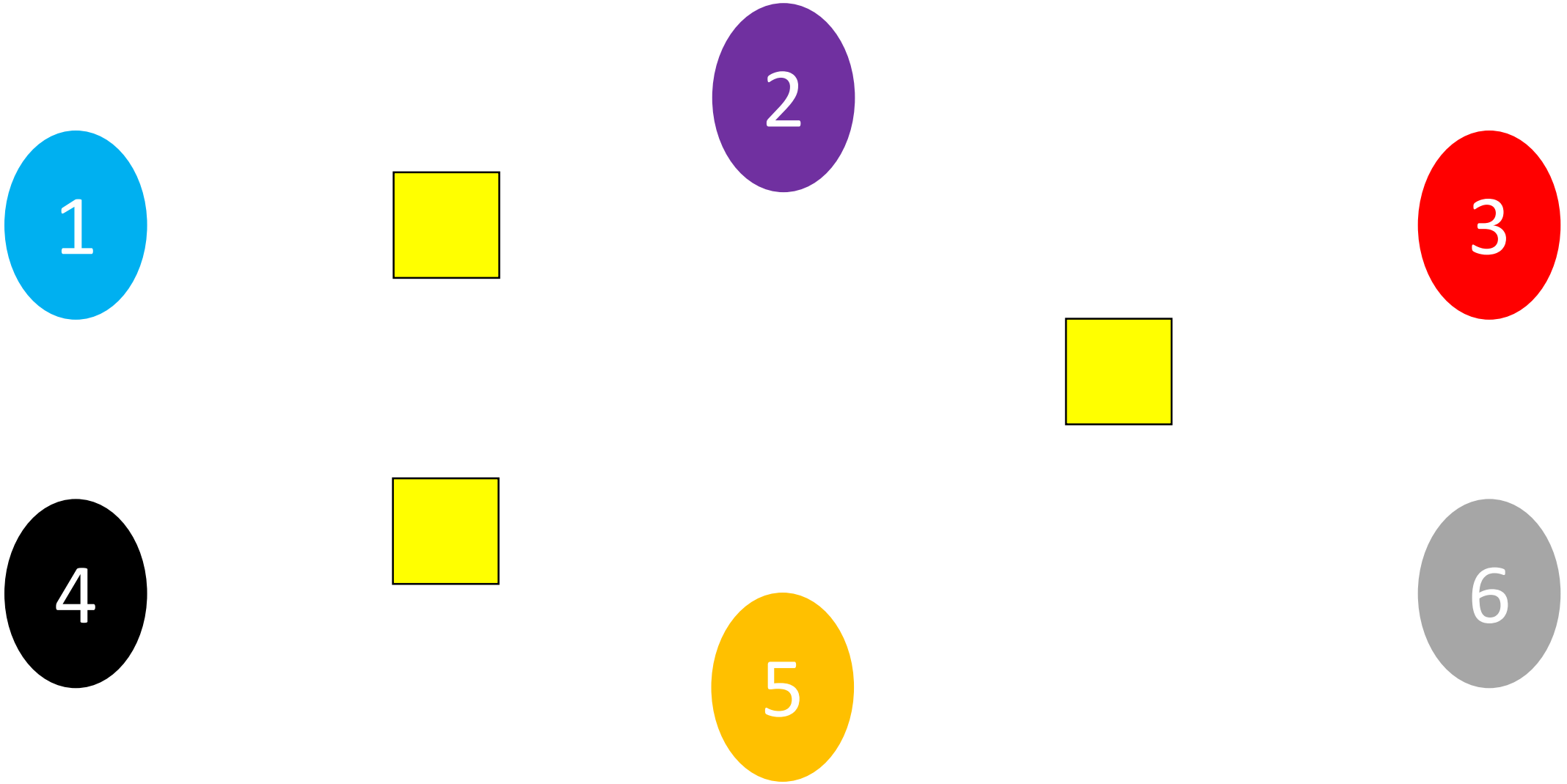

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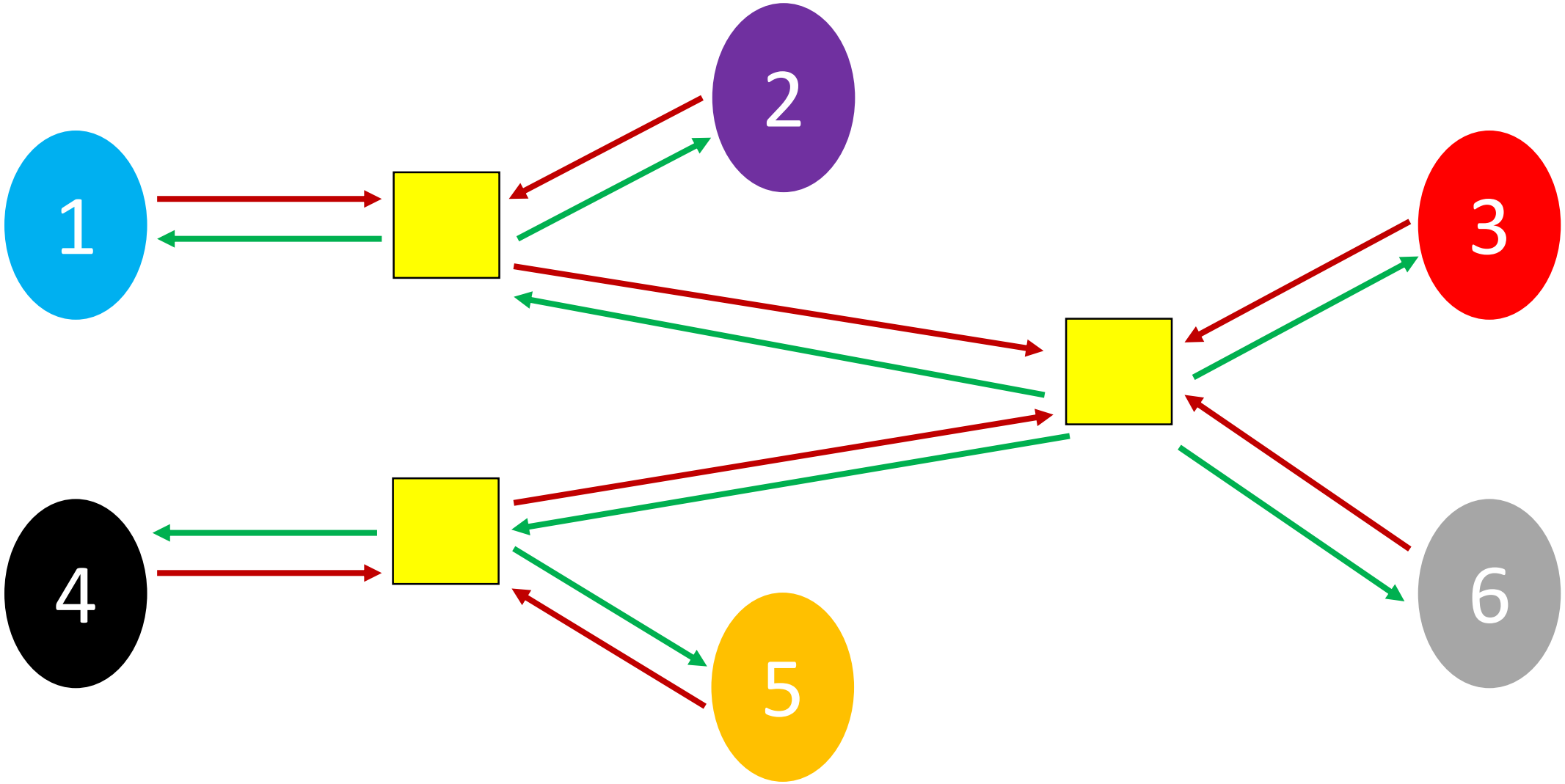

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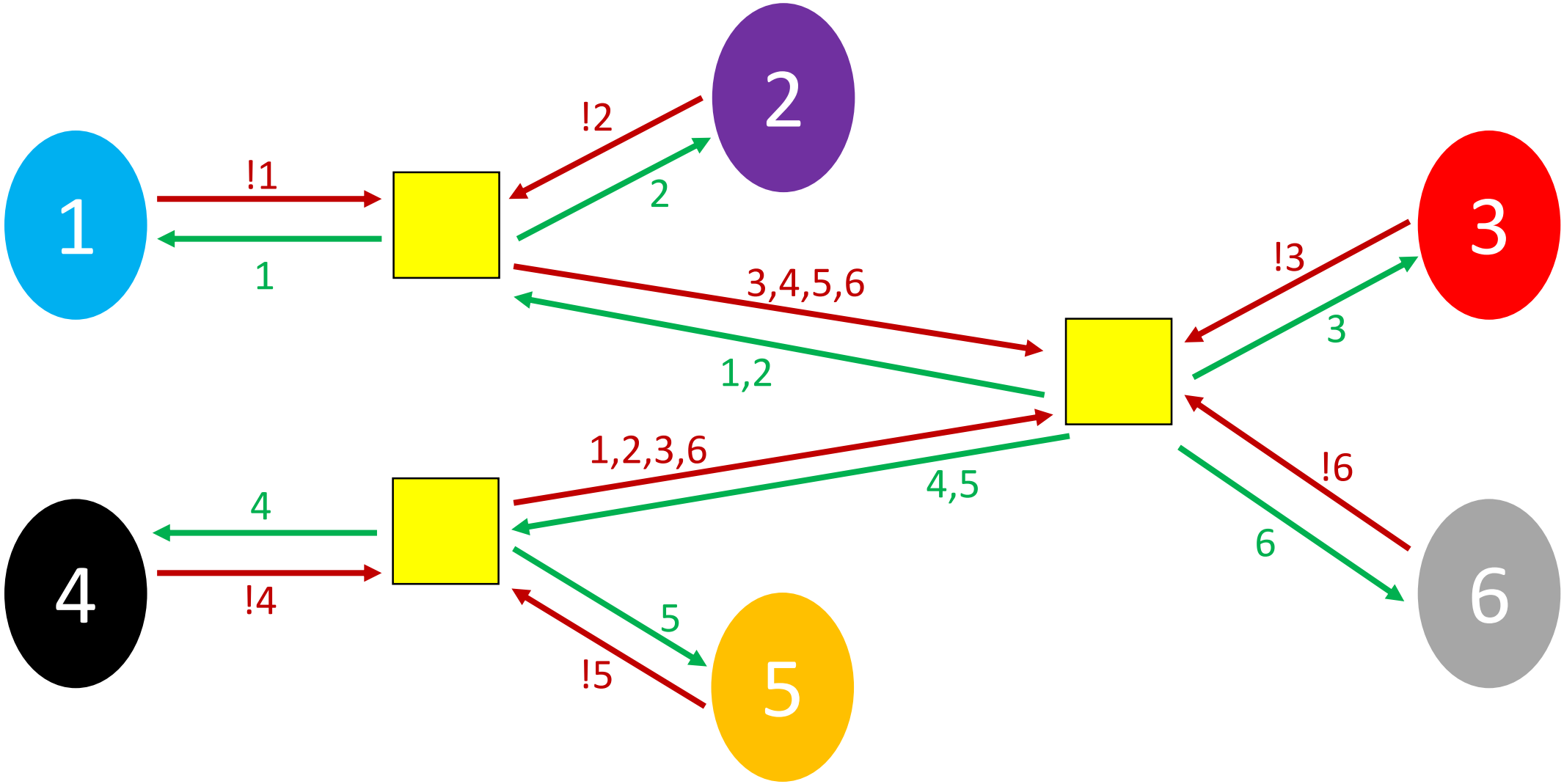
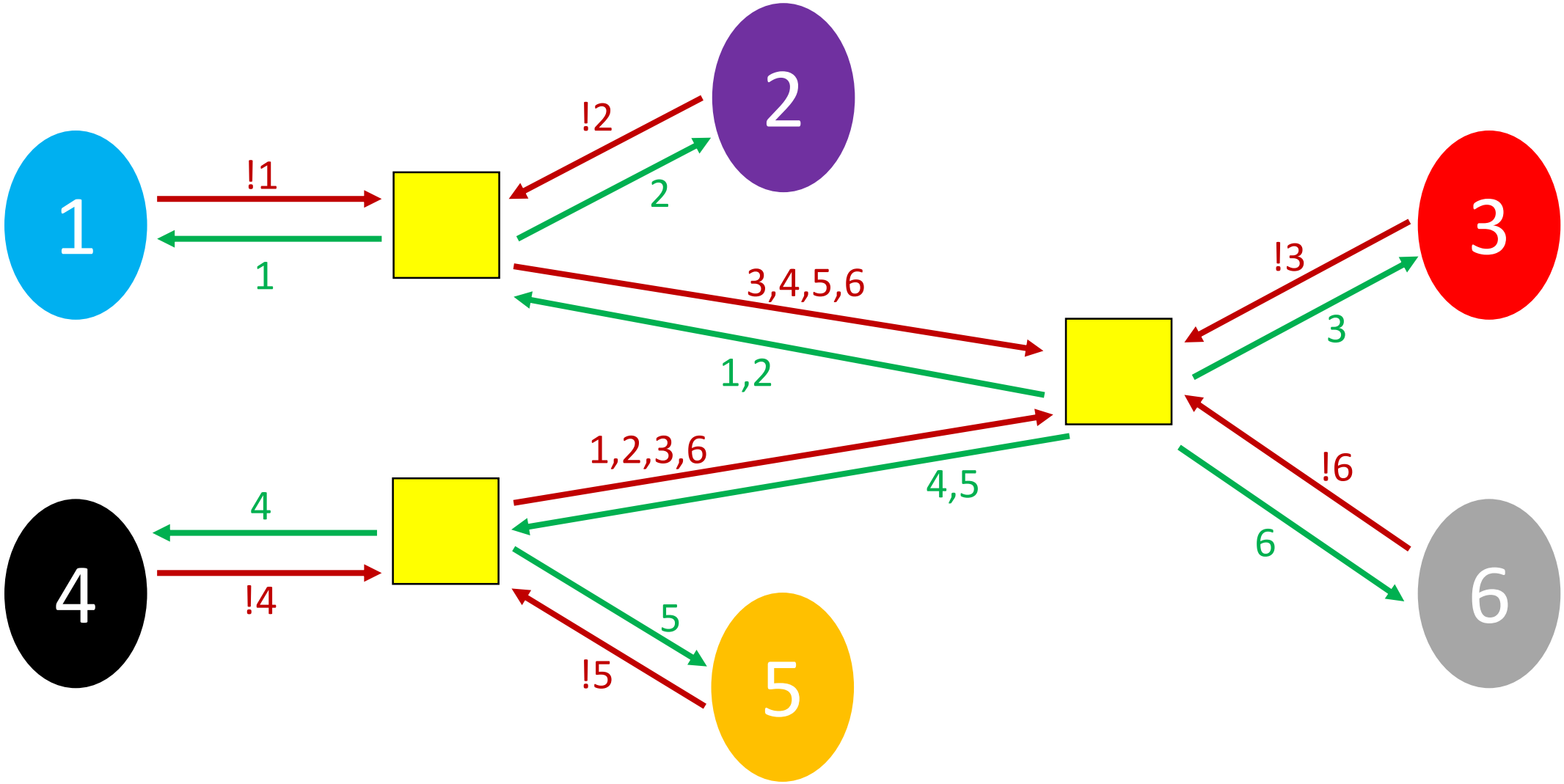


Internet Protocol (IP)

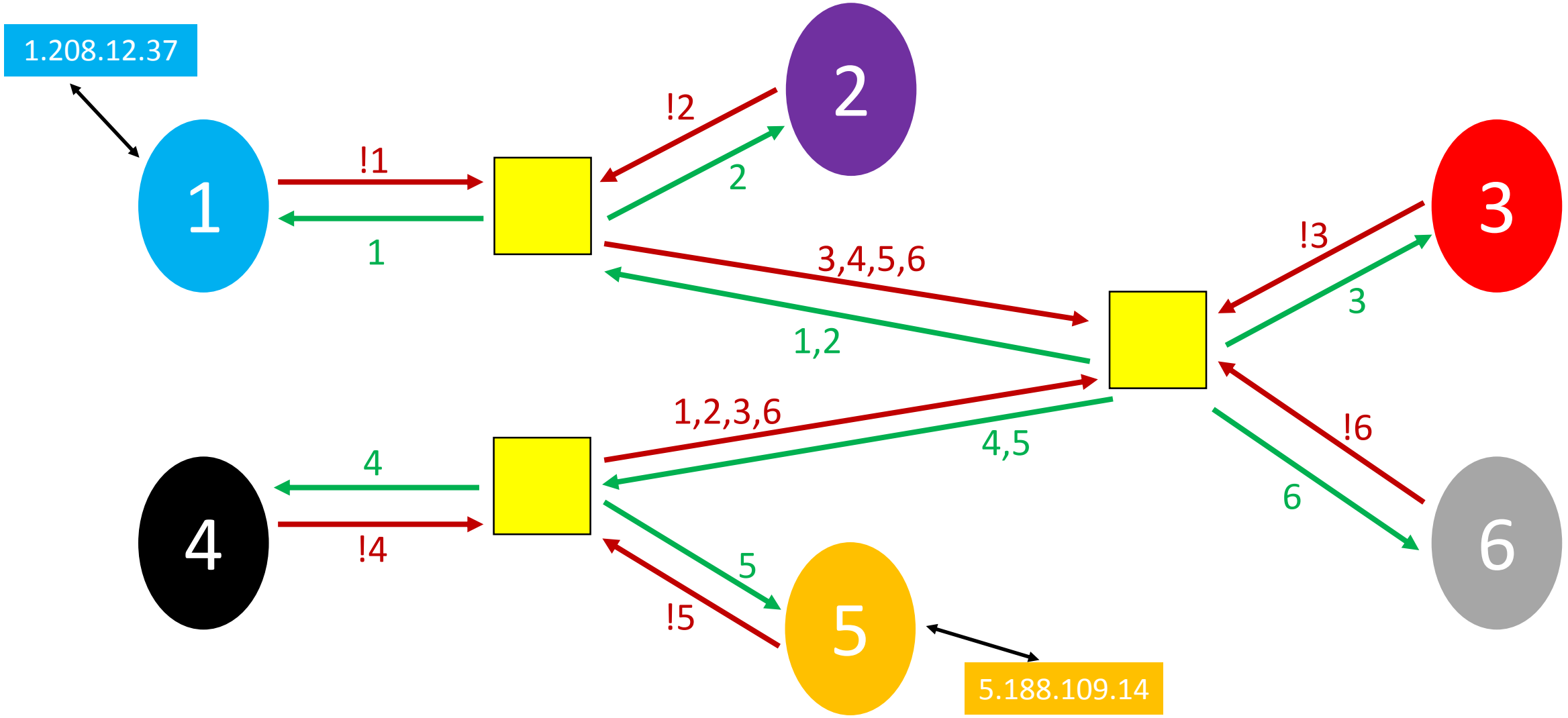
- Now the networks are not directly connected to each other at all, and rely on routers to distribute communications.
- On a small scale, this configuration may actually be more inefficient than just having direct connections.
- On a large scale, this configuration can dramatically reduce the costs of network infrastructure.

Internet Protocol (IP)



From: 1.208.12.37
To: 5.188.109.14

Internet Protocol (IP)



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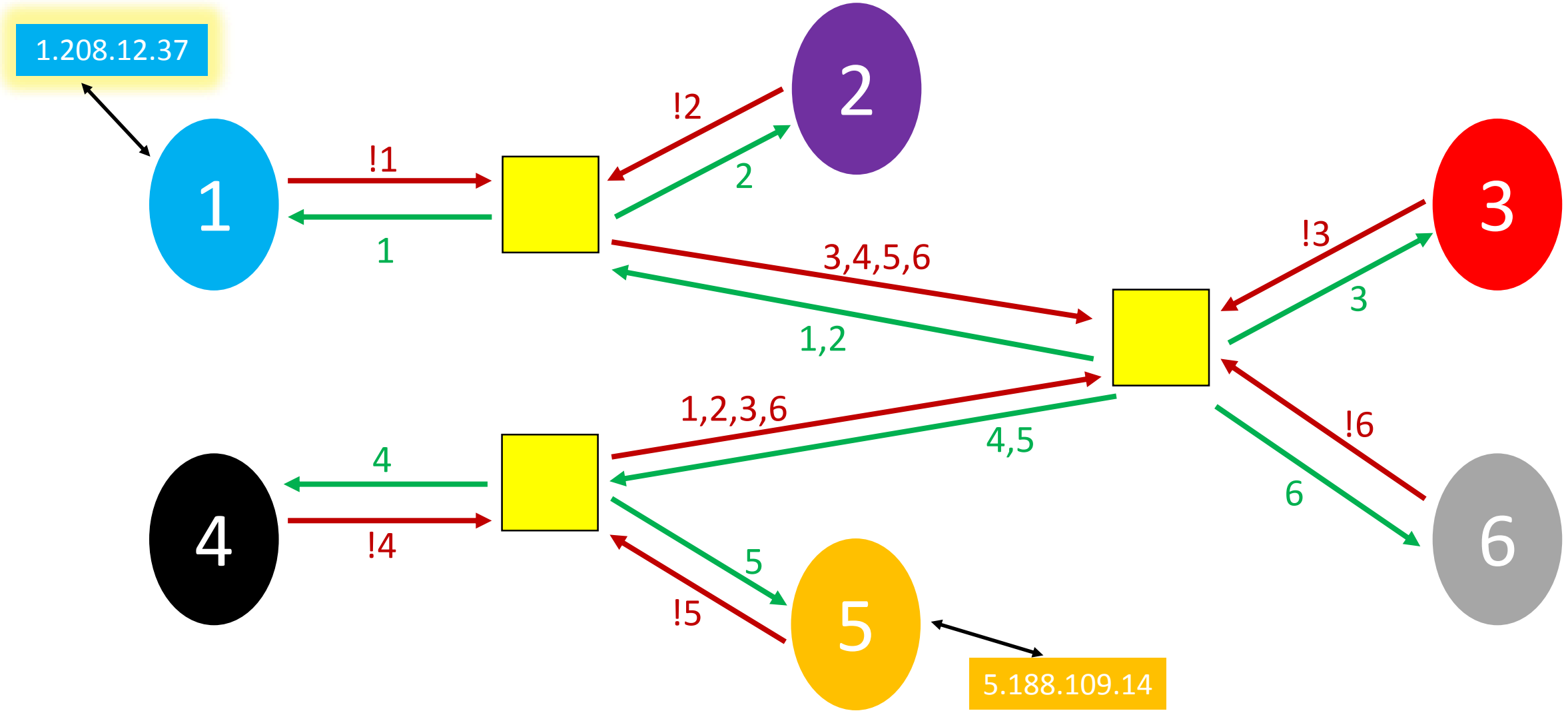

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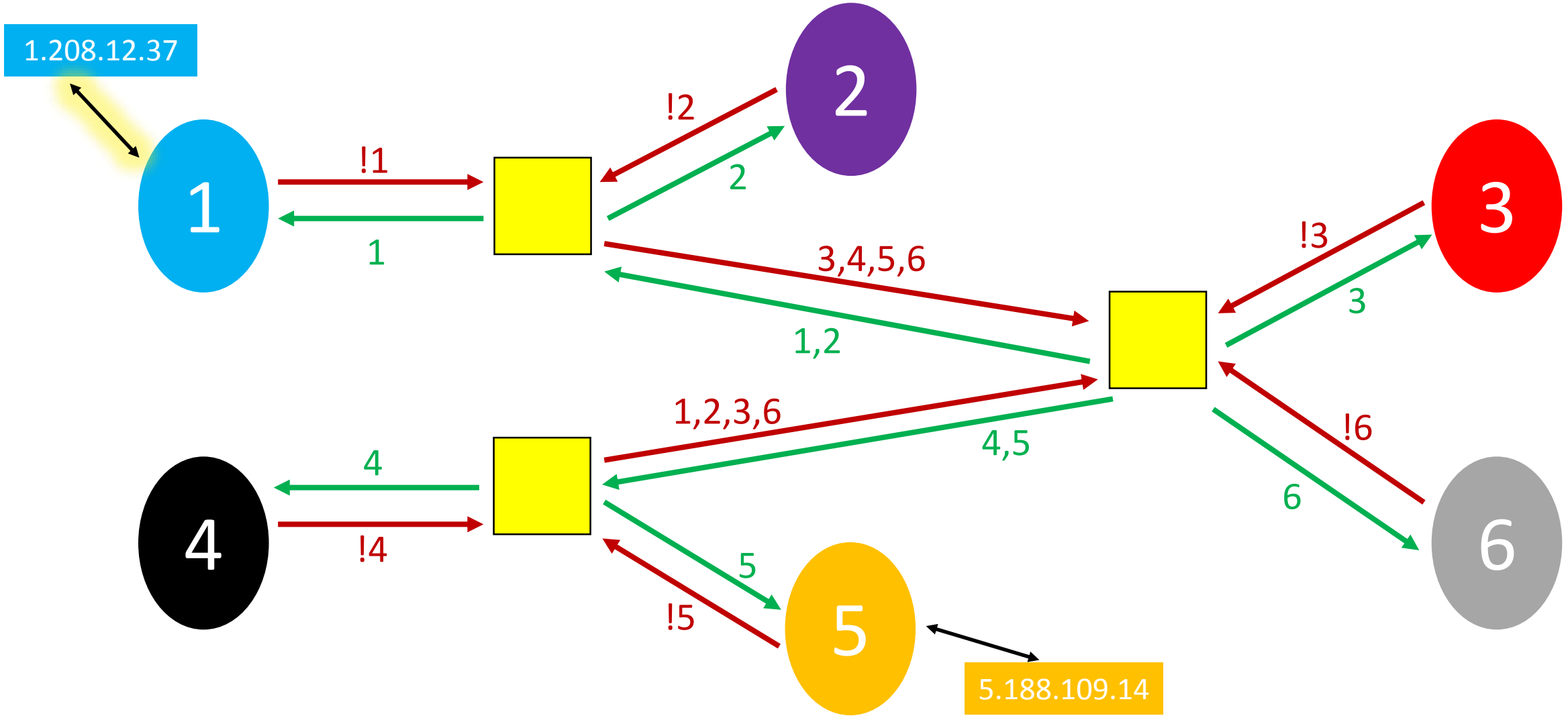

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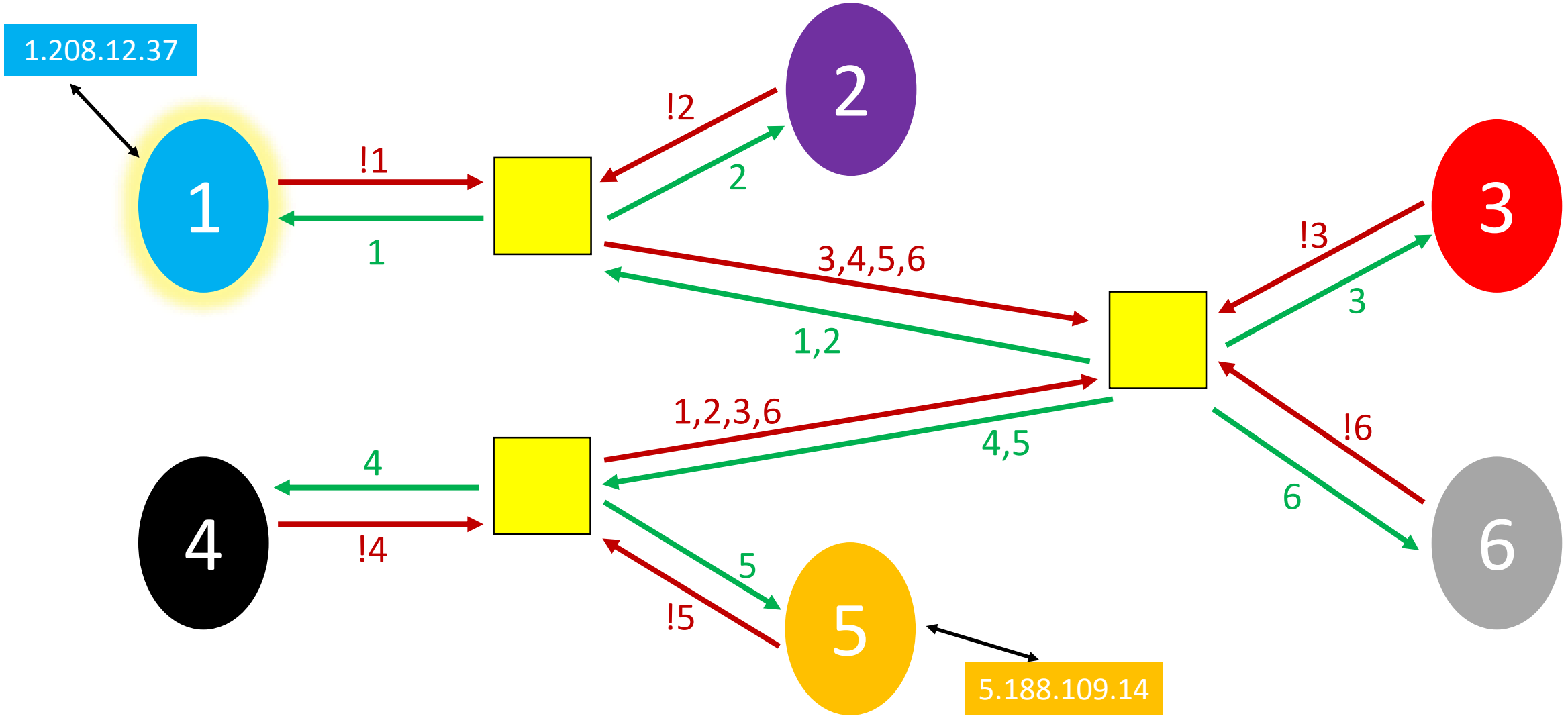

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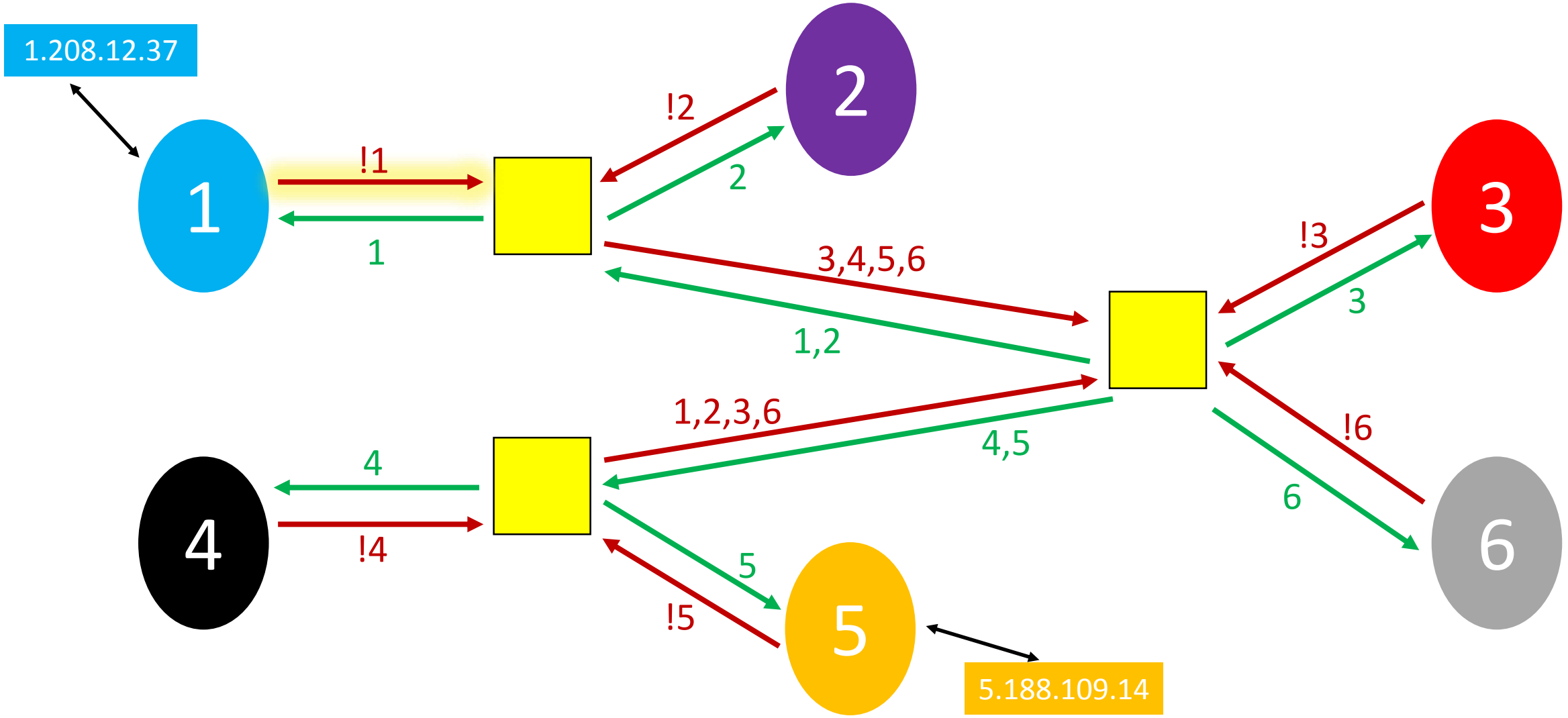

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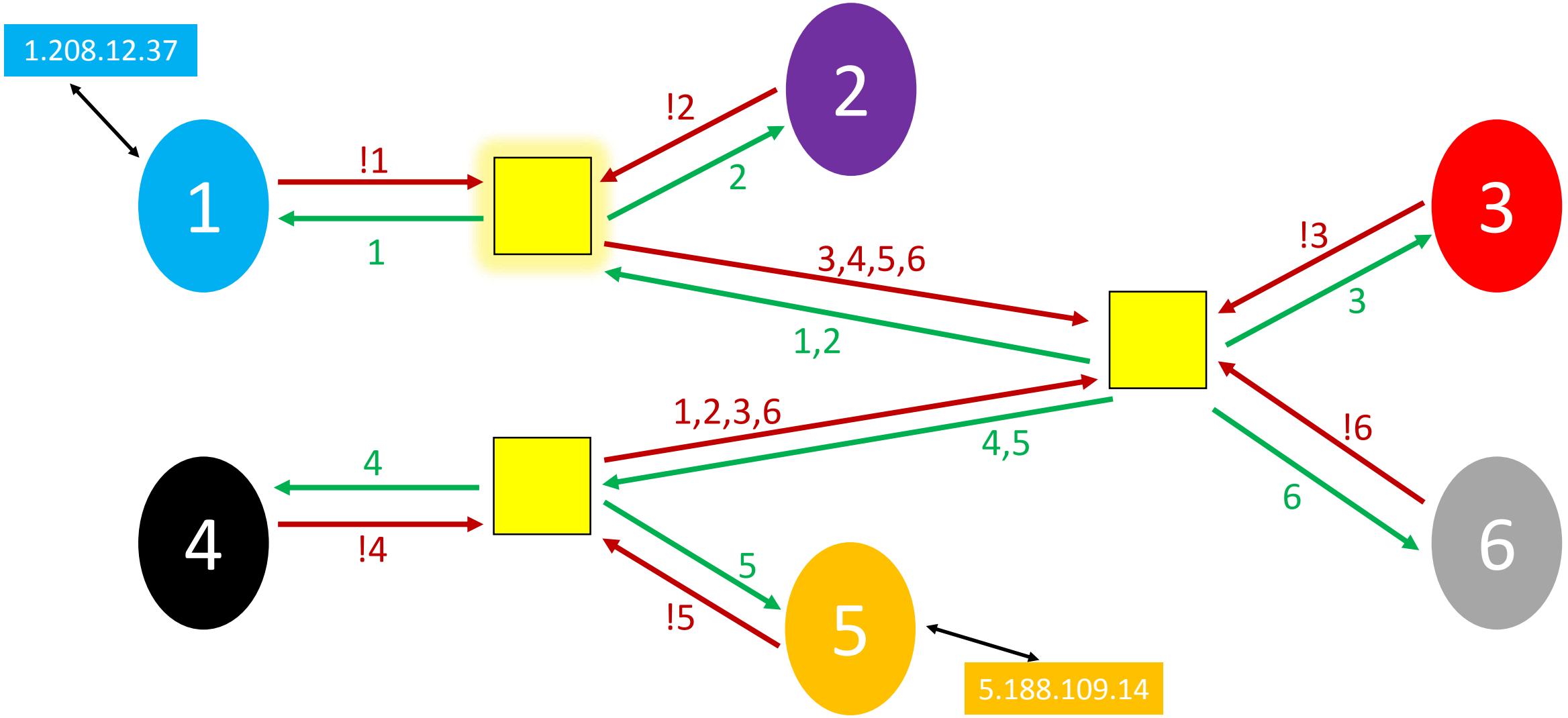

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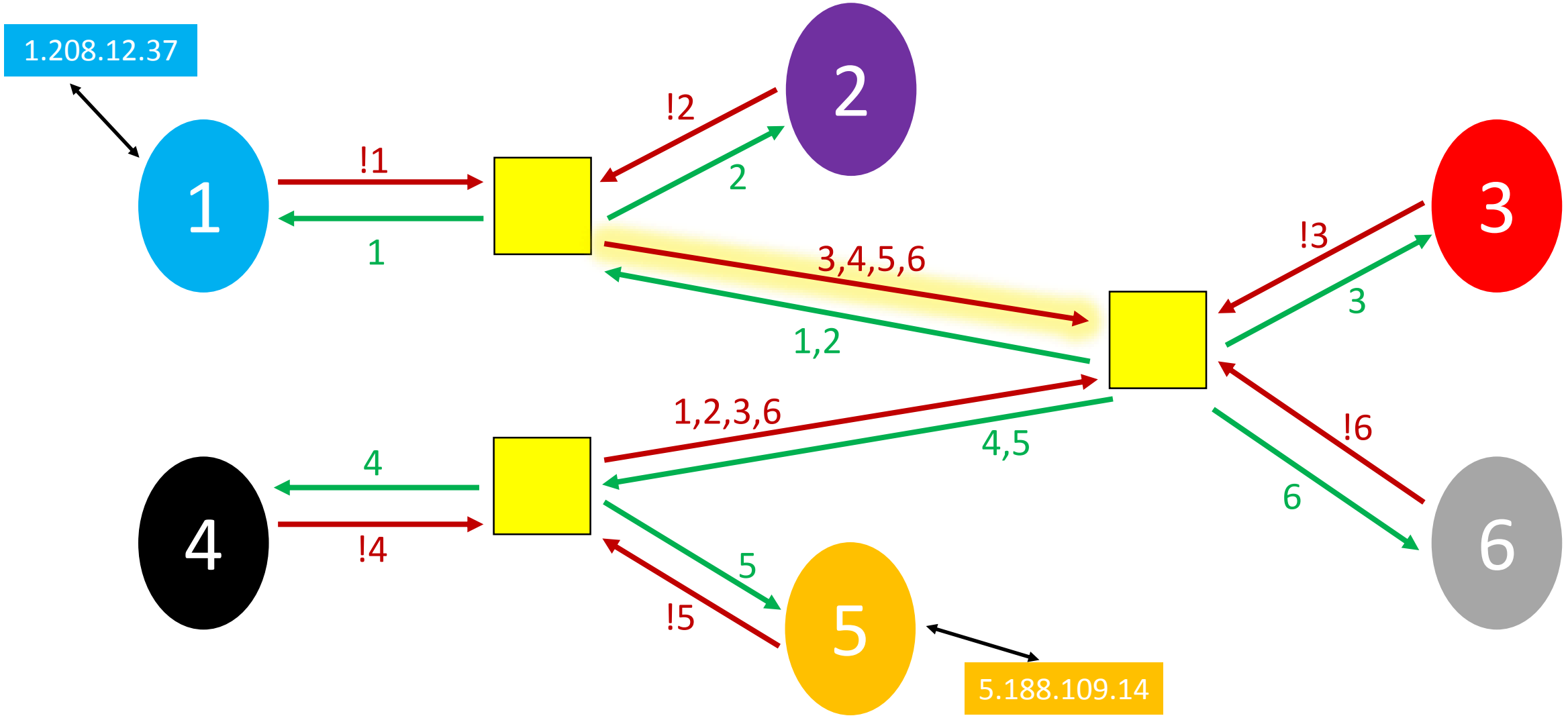

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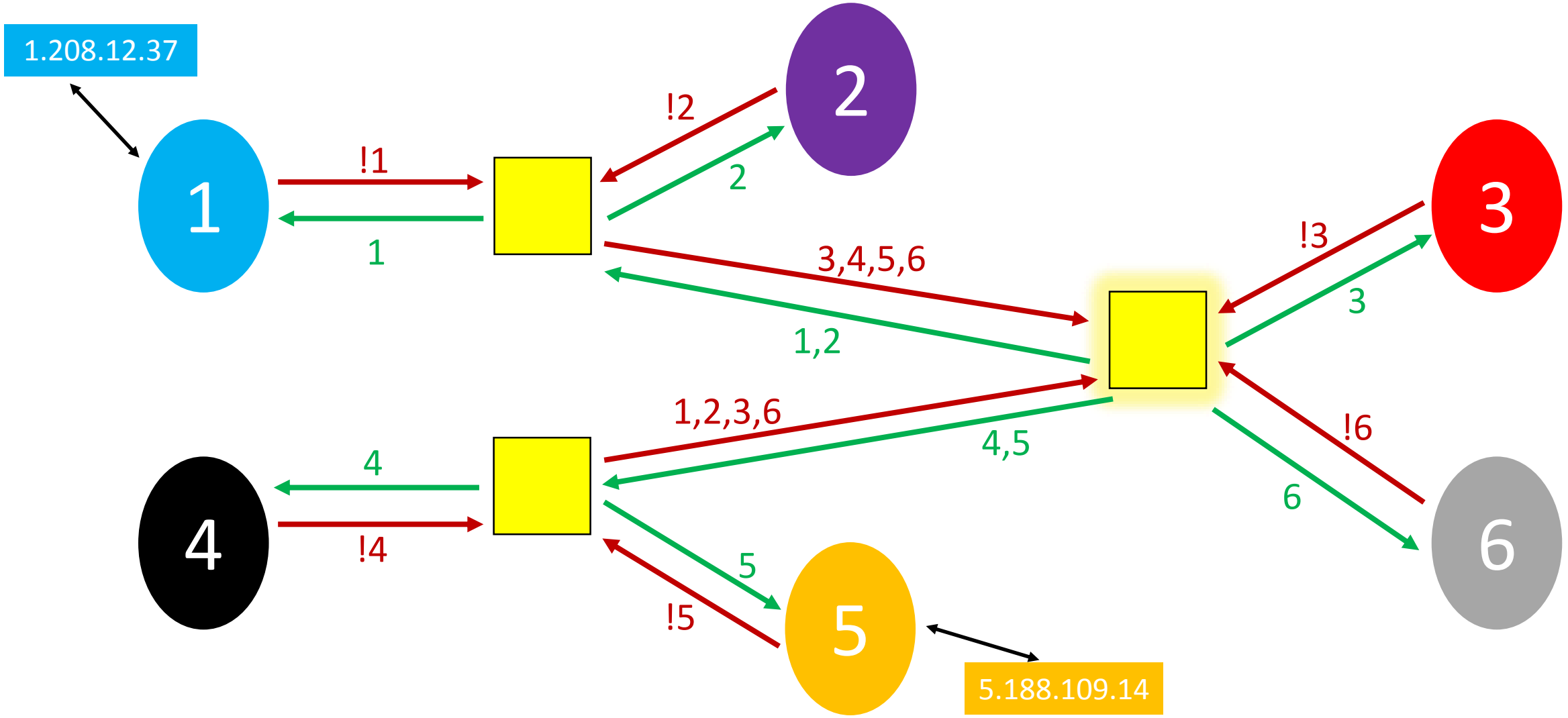

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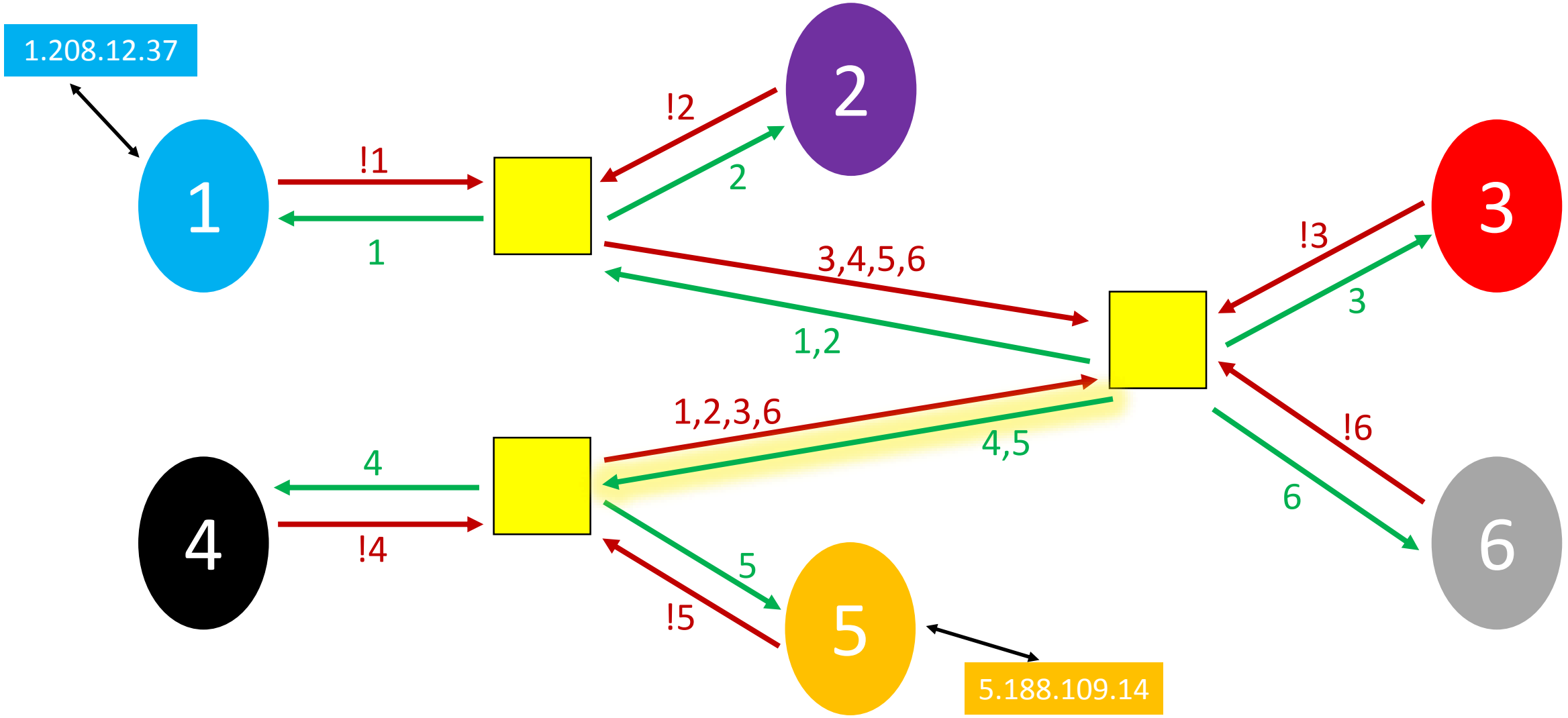

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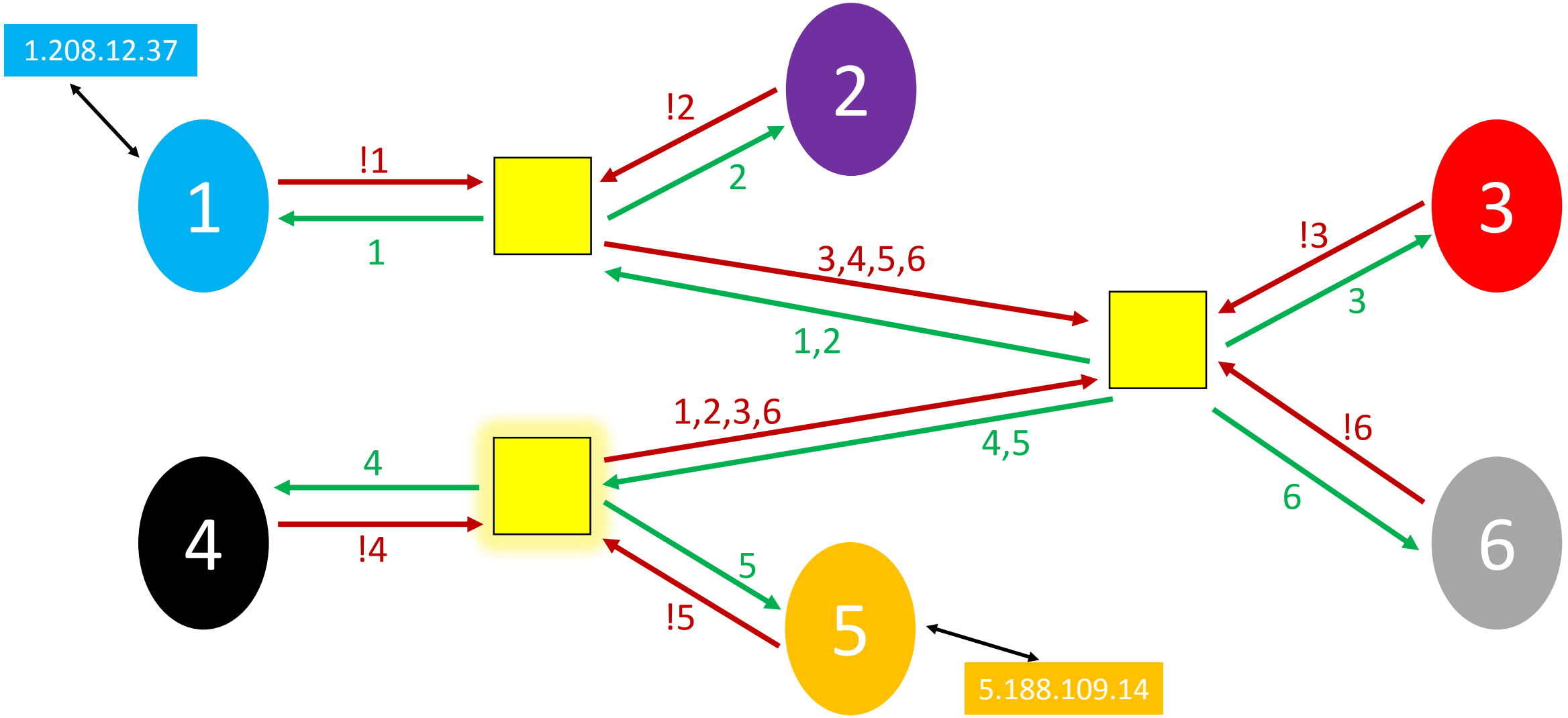

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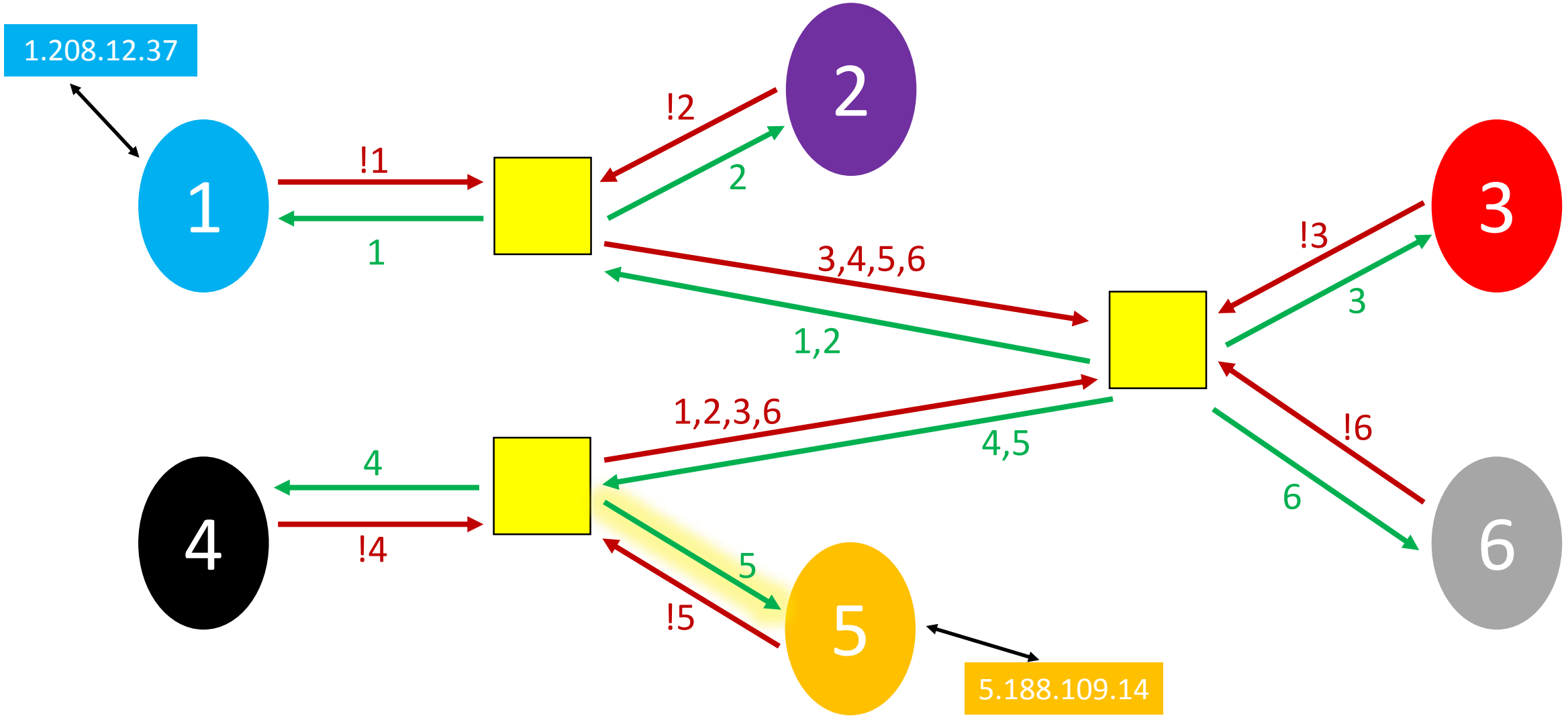

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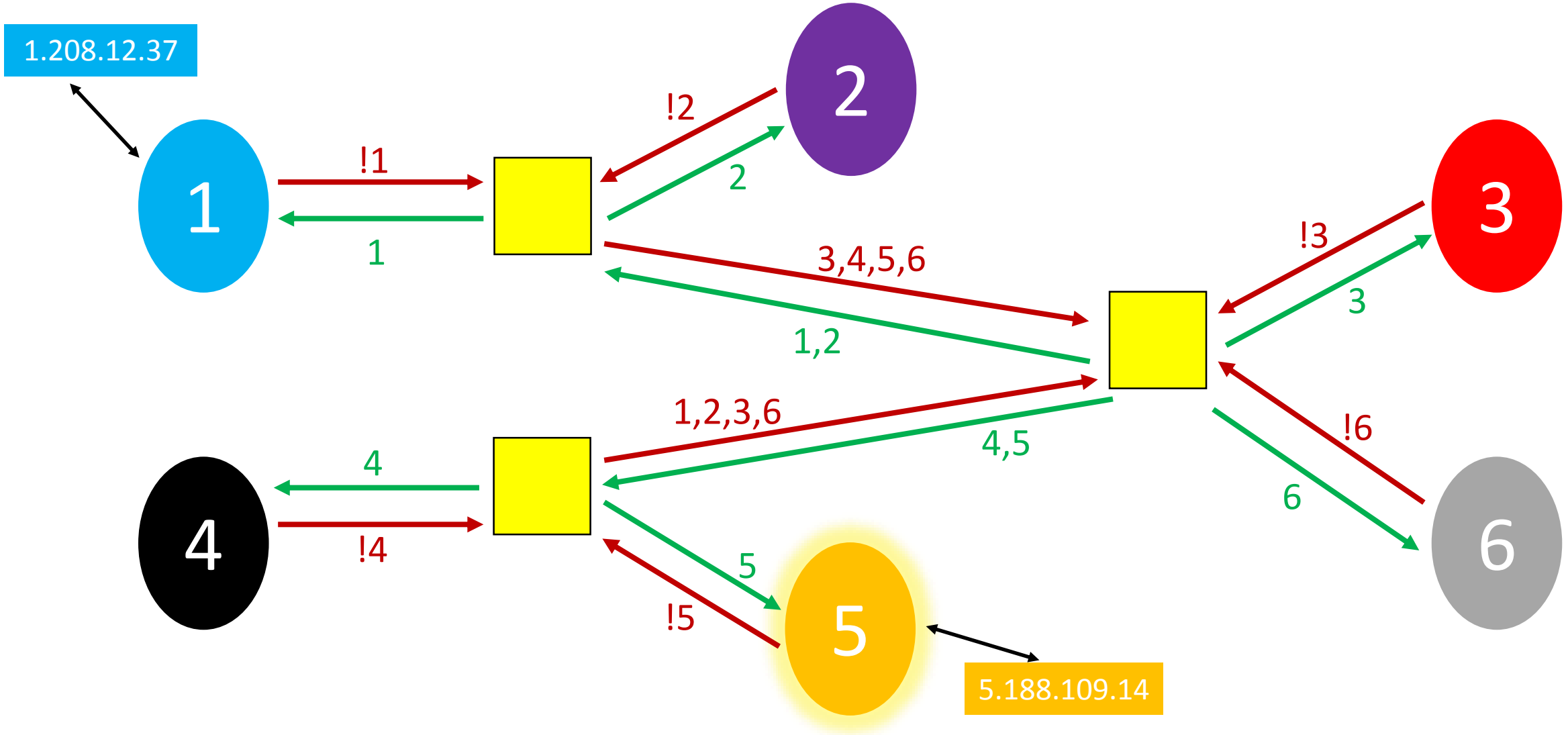

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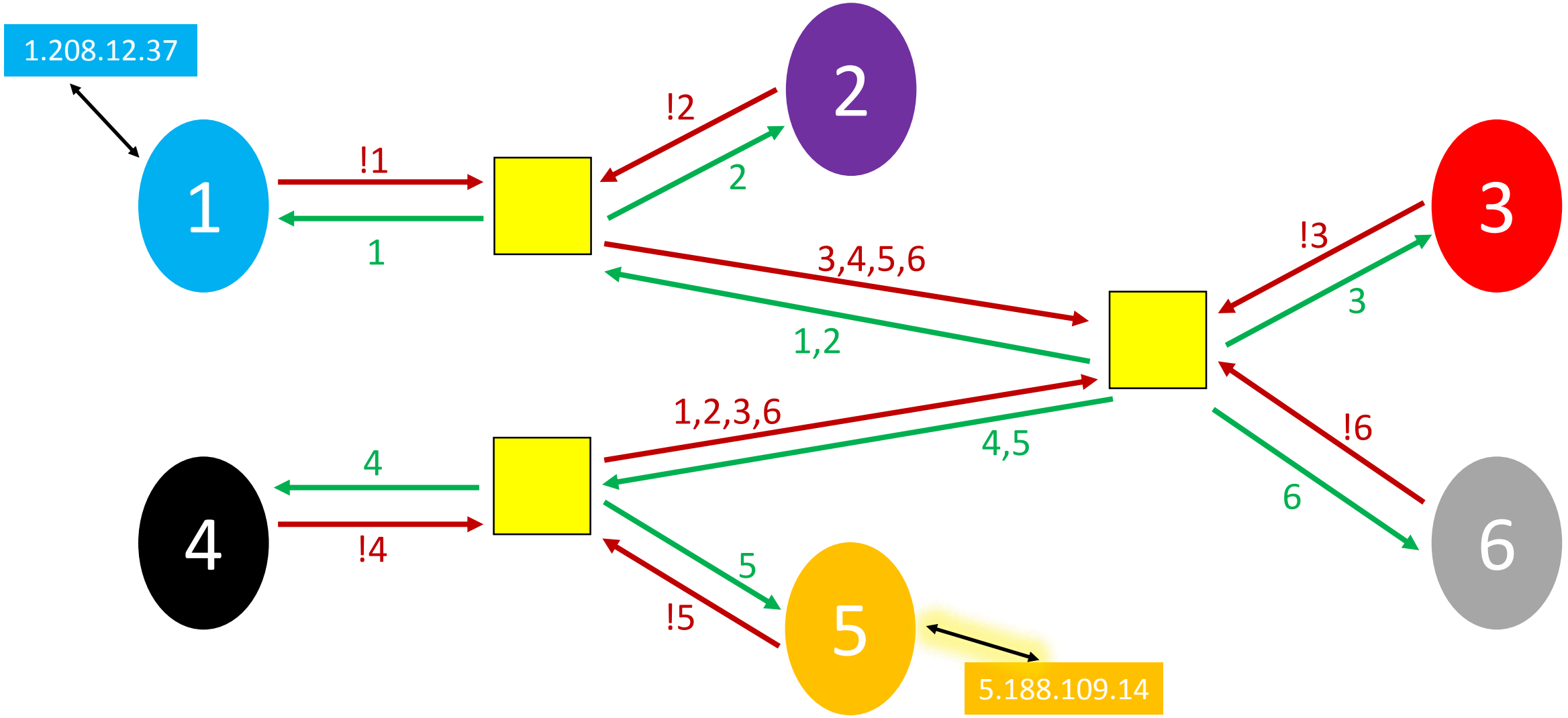

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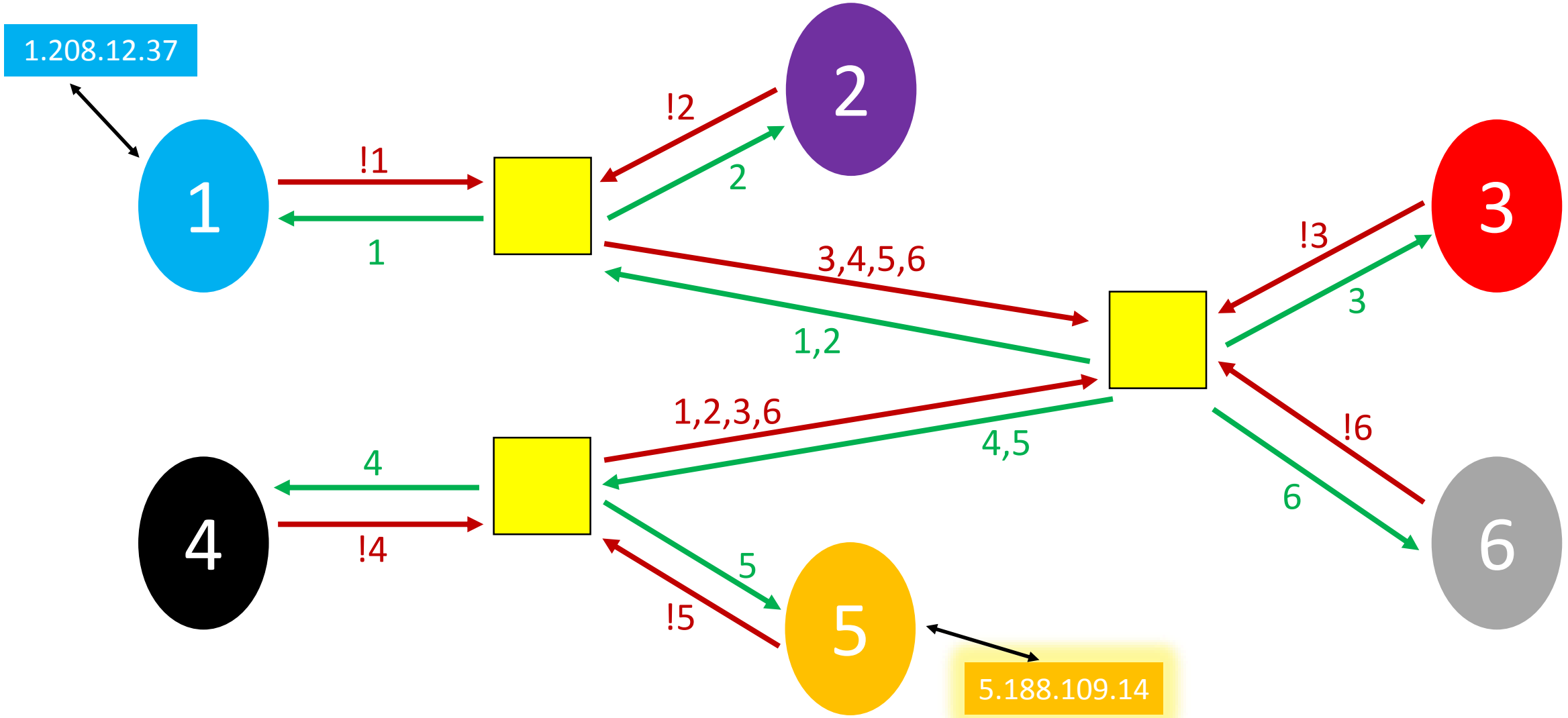

Internet Protocol (IP)

- In reality, if 1.208.12.37 (me) is sending an e-mail, FTP file transfer, or web browser request to 5.188.109.14 (you), the data isn't being sent as one huge block.

- Any slowdown that was caused by sending such a large amount of data would have a ripple effect that would throttle the network for all the other users.

- As such, another crucial part of IP is splitting data into *packets*.

Internet Protocol (IP)

- IP is also known as a *connectionless* protocol. There is not necessarily a defined path from the sender to the receiver, and vice versa.

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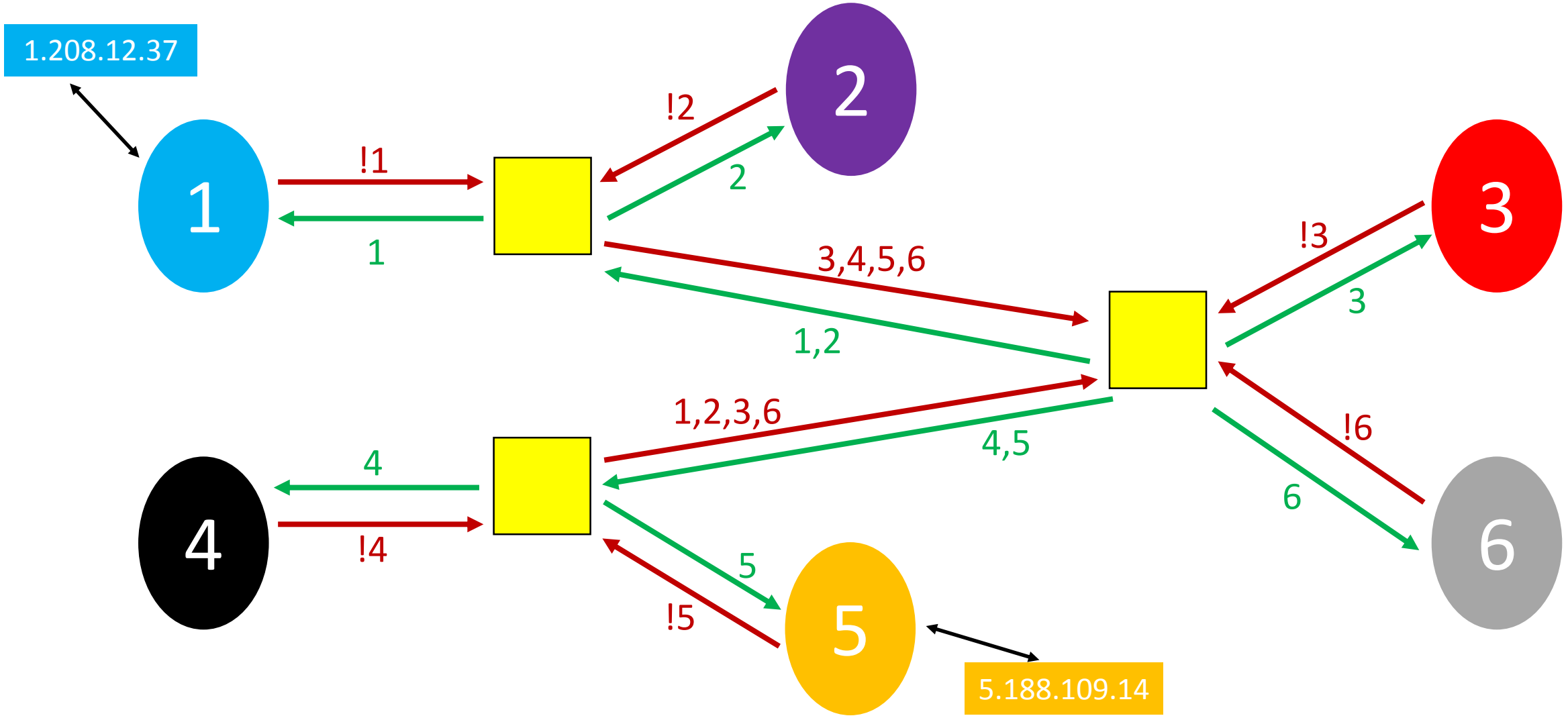
To: 5.188.109.14

Internet Protocol (IP)



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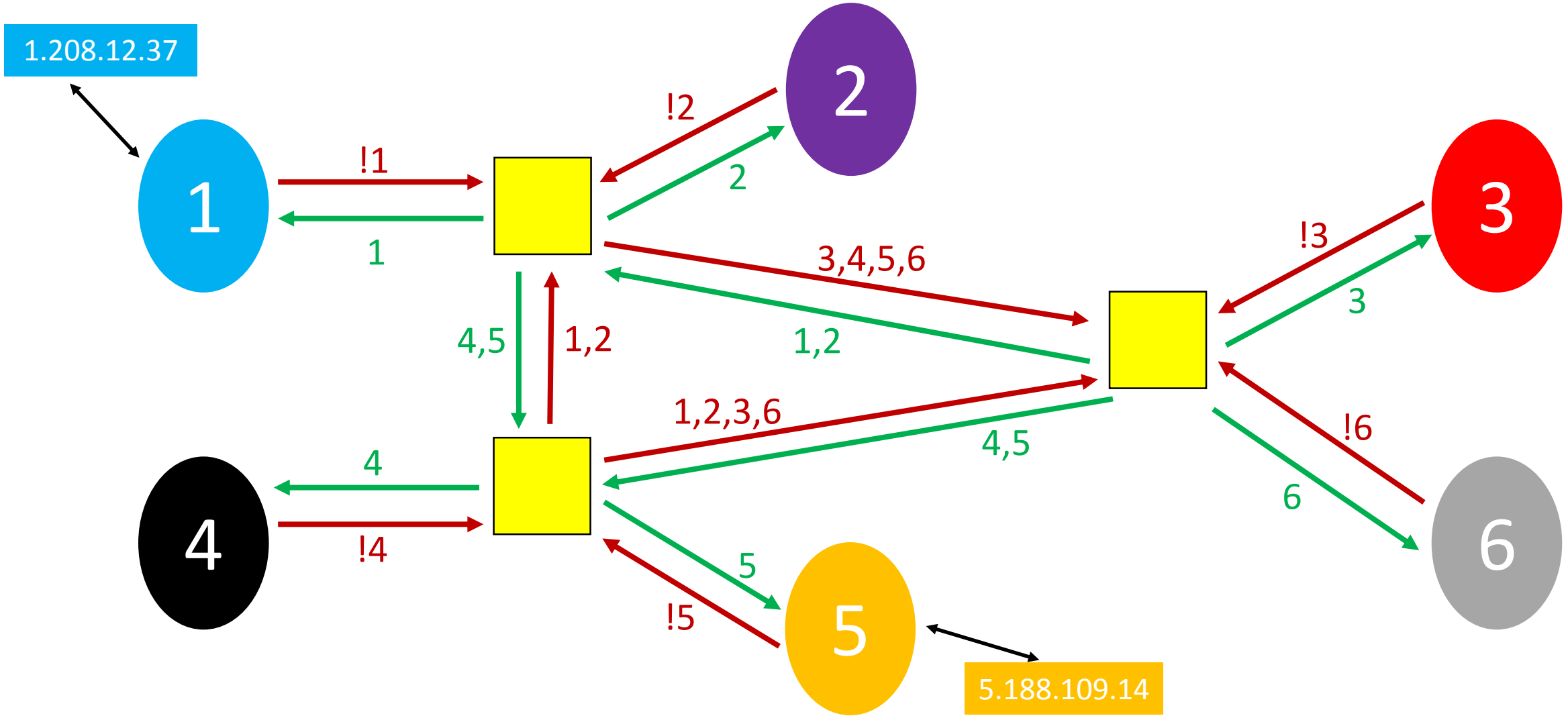

Internet Protocol (IP)

- IP is also known as a *connectionless* protocol. There is not necessarily a defined path from the sender to the receiver, and vice versa.

- This means that in response to traffic that might be “clogging” up one particular path through the Internet, some packets can be “re-routed” around the traffic jam to follow the most optimal path, based on the current state of the network.

Internet Protocol (IP)

- The routing table then probably consists of more information than just “where do I send this packet from here,” but also information “what is the cost of using that particular route?”

- Another side of effect of being connectionless is that delivery cannot be guaranteed, since the path from sender to receiver is not guaranteed to be consistent.