

# 6.1800 Spring 2025

## Lecture #24: Tor

what to do when secure channels aren't enough

# 6.1800 in the news

## All Gmail users at risk from clever replay attack

Posted: April 22, 2025 by [Pieter Arntz](#)

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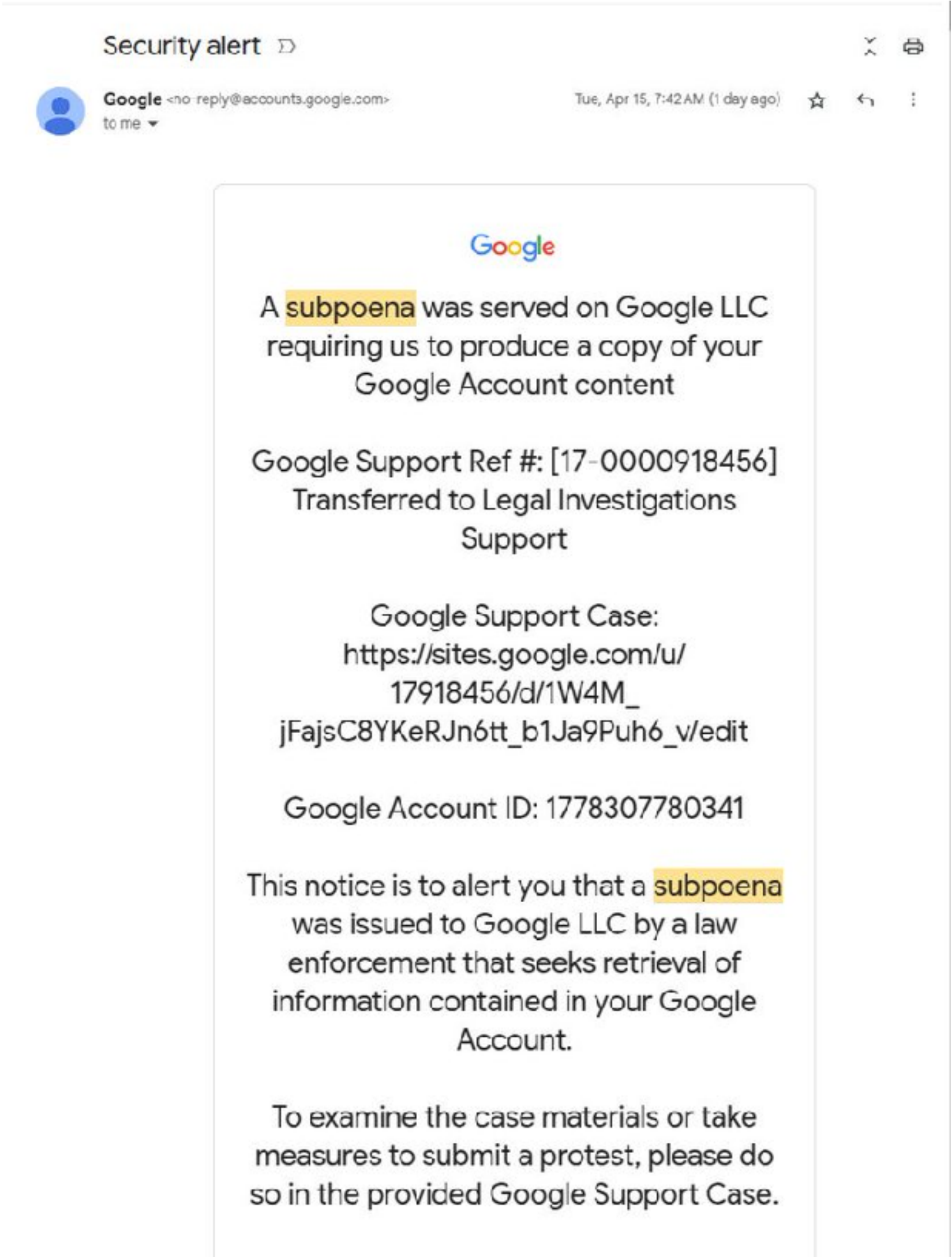
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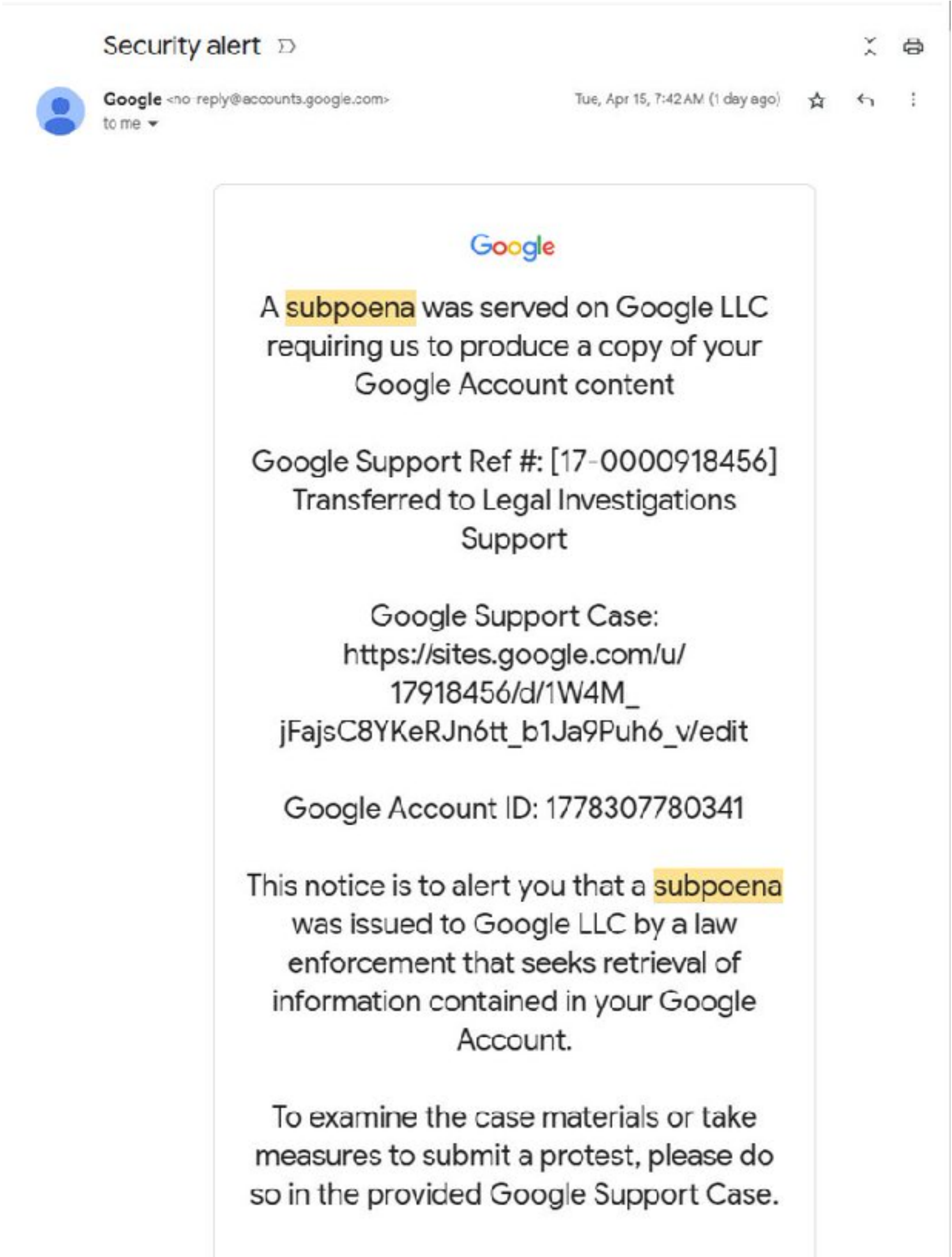
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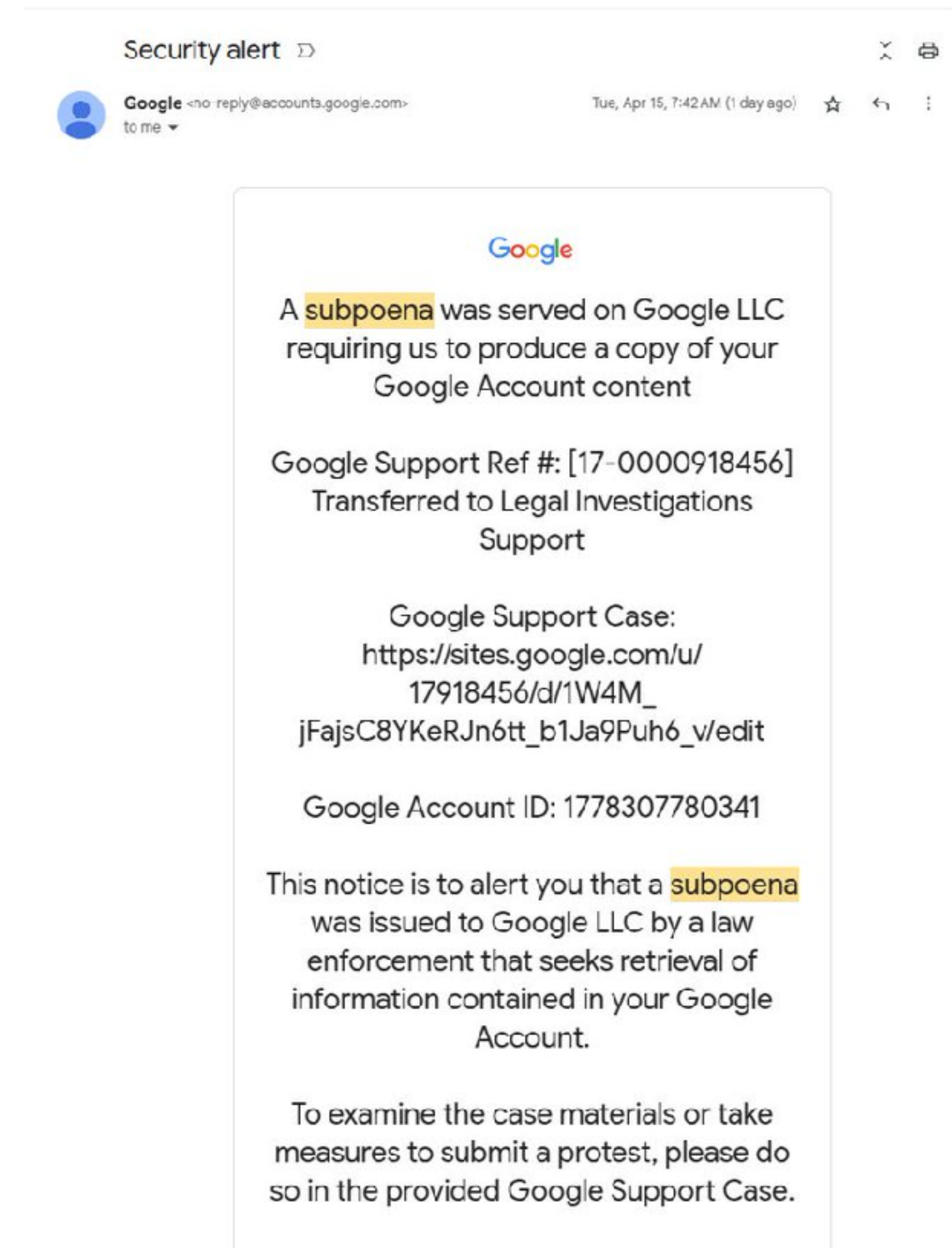
As a computer savvy person, Nick spotted that the official site should have been hosted on accounts.google.com and not sites.google.com. The difference is that anyone with a Google account can create a website on sites.google.com. And that is exactly what the cybercriminals did.



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So, what the cybercriminals did was:

- Set up a Gmail account starting with me@ so the visible email would look as if it was addressed to “me.”
- Register an OAuth app and set the app name to match the phishing link
- Grant the OAuth app access to their Google account which triggers a legitimate security warning from `no-reply@accounts.google.com`
- This alert has a valid DKIM signature, with the content of the phishing email embedded in the body as the app name.
- Forward the message untouched which keeps the DKIM signature valid.

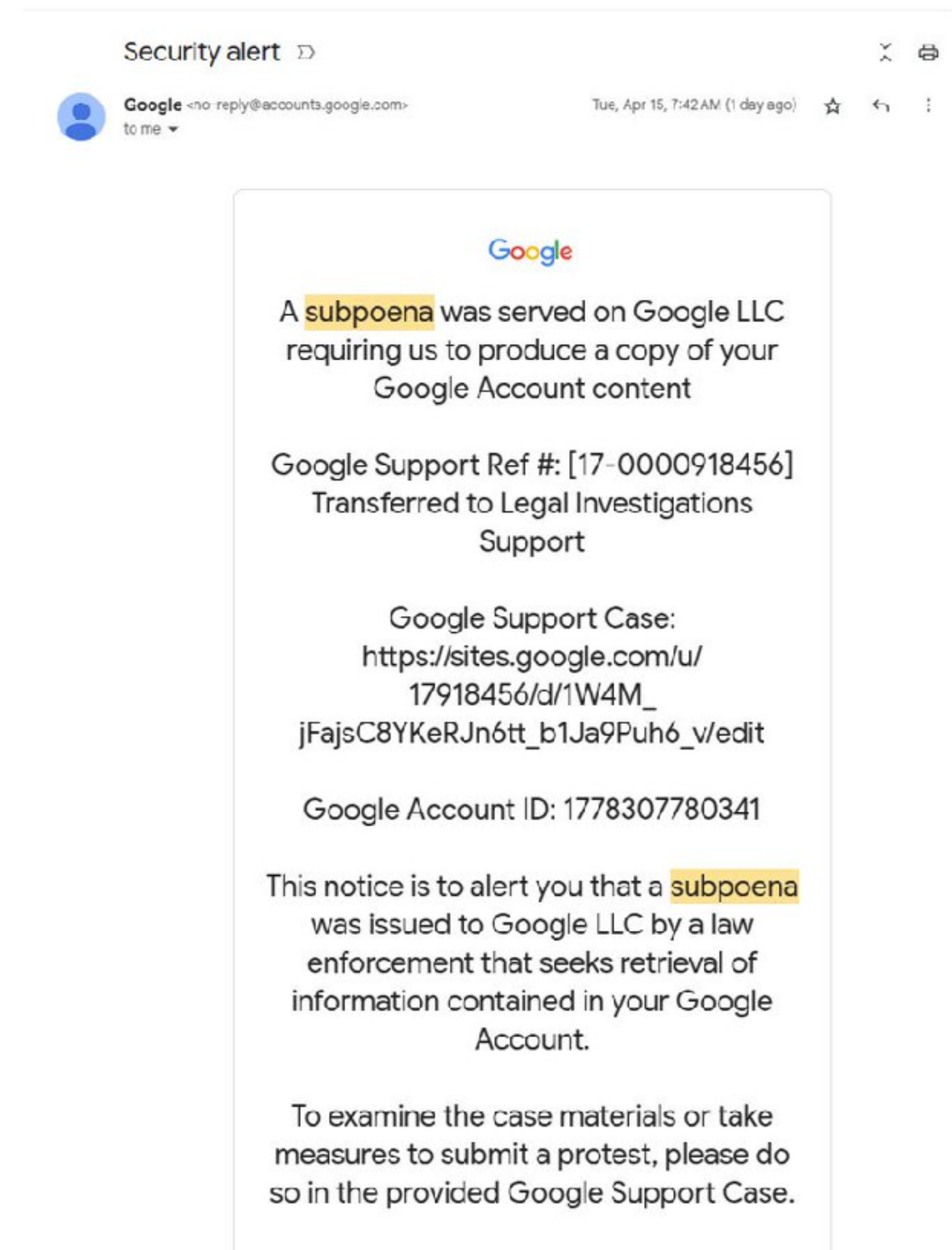


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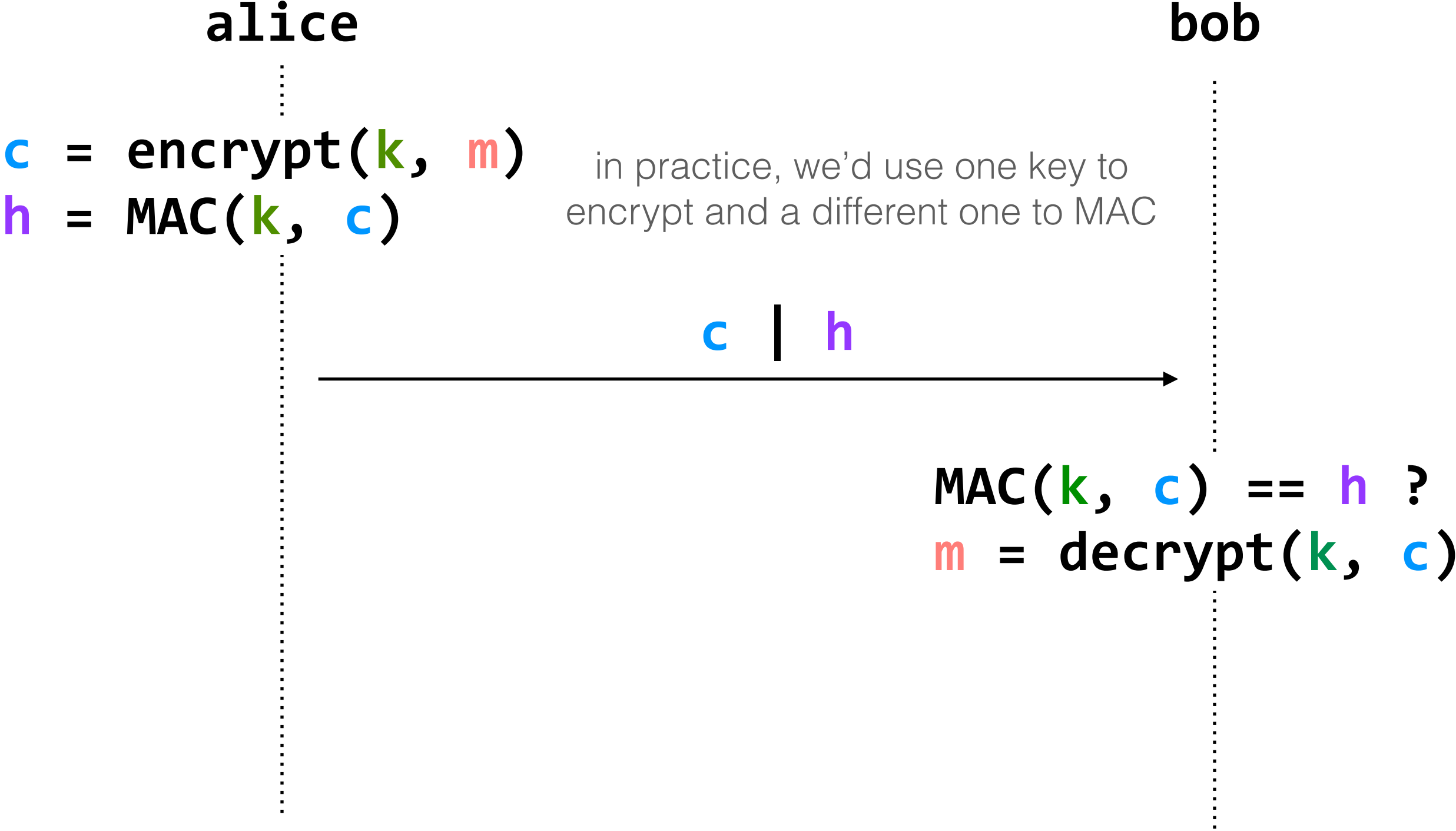
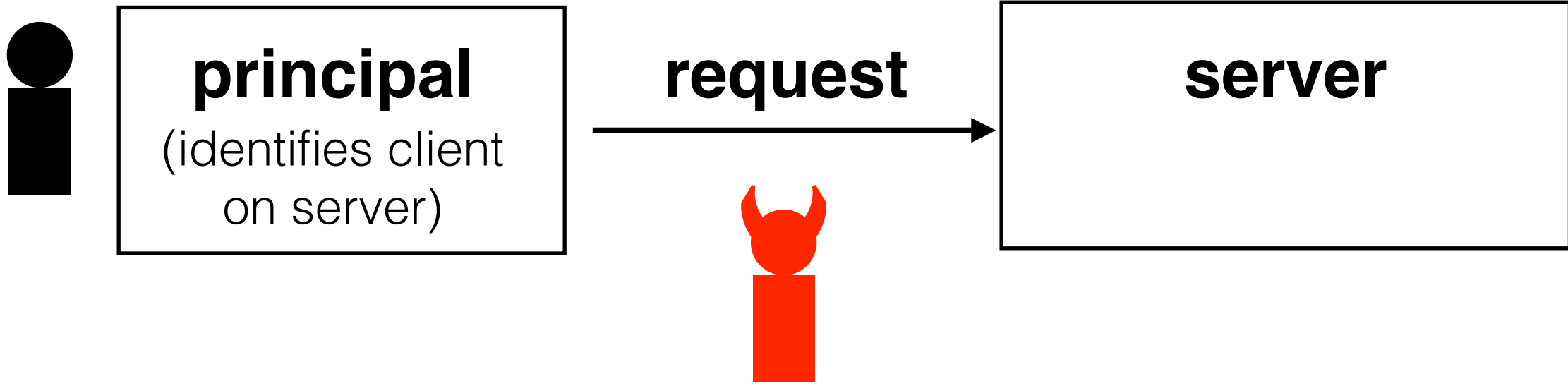
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Nick submitted a bug report to Google about this. Google originally closed the report as ‘Working as Intended,’ but later Google got back to him and said it had reconsidered the matter and it will fix the OAuth bug.





today, we're still considering  
adversaries that are observing  
data on the **network**

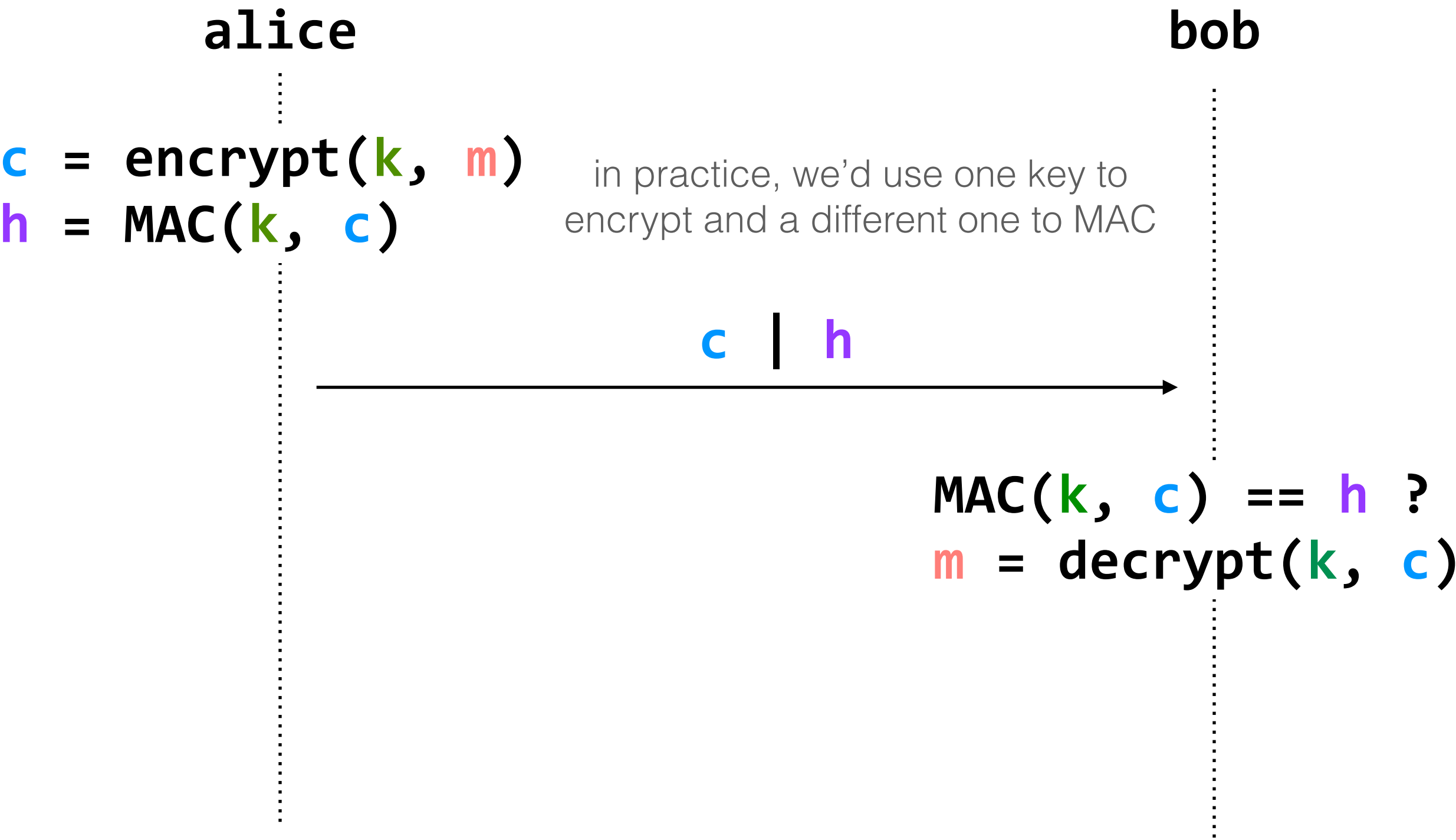
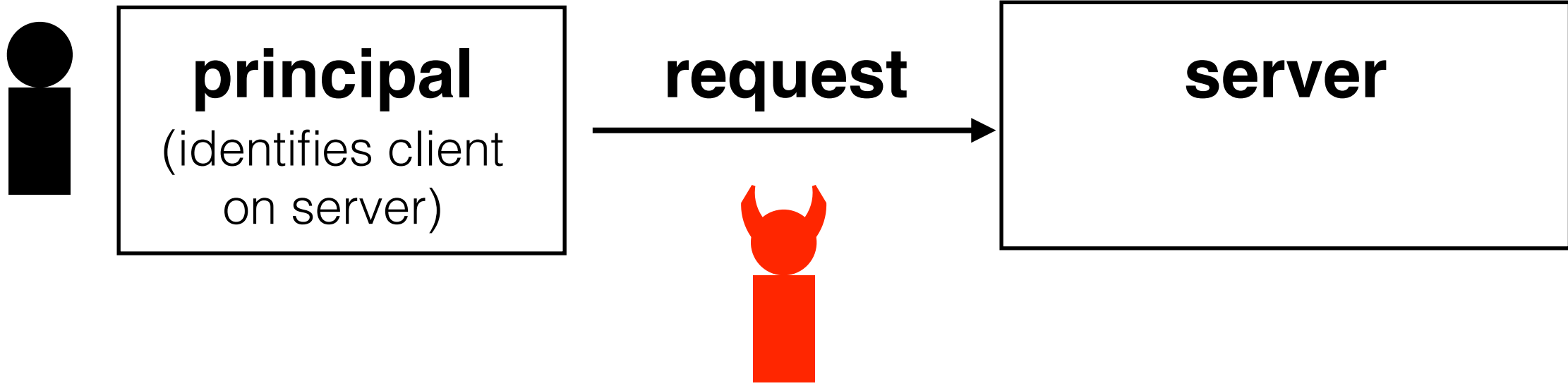




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**symmetric-key cryptography:** the  
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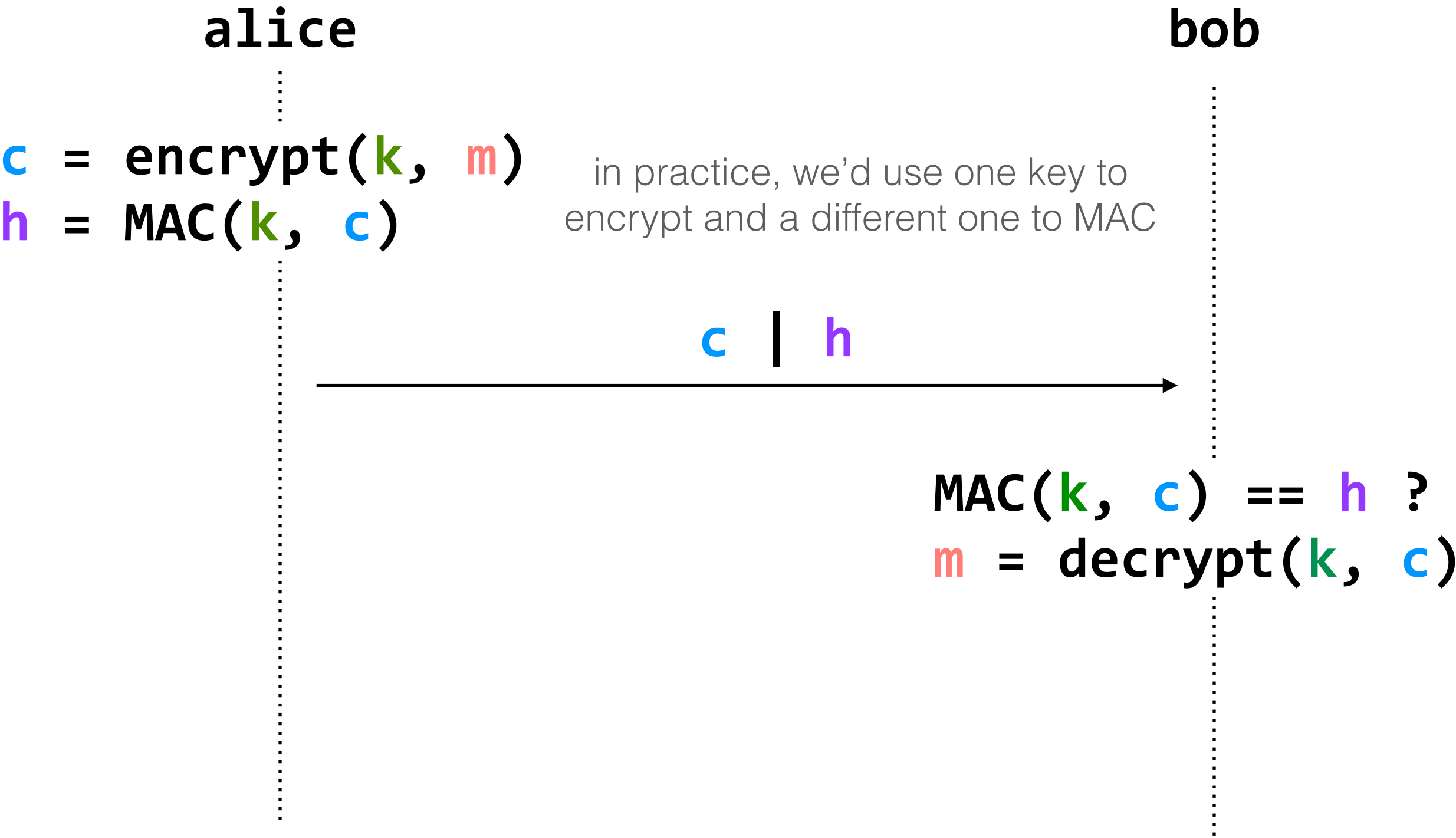
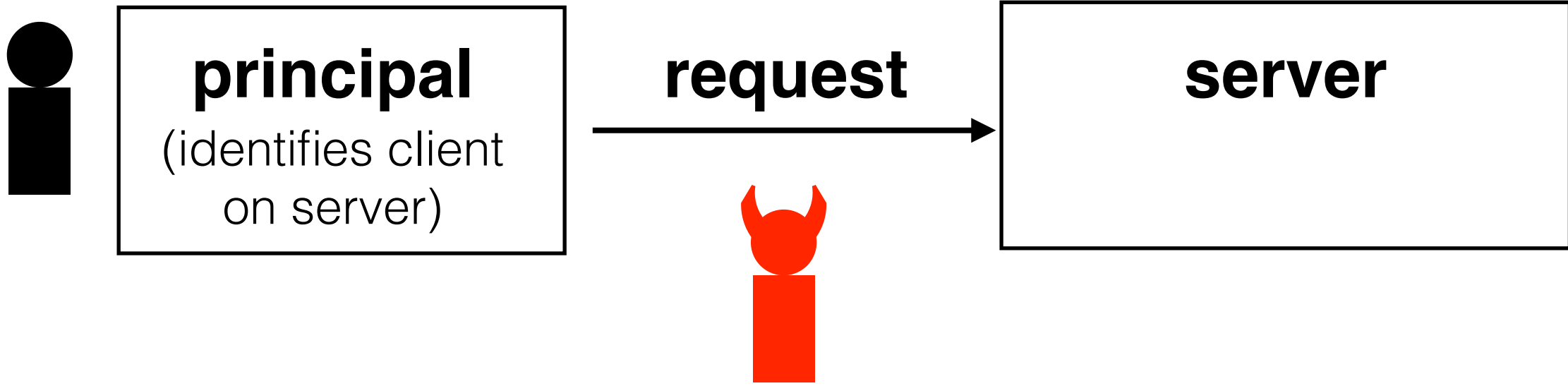


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this is how we performed encryption for  
secure channels in the last lecture. Alice and  
bob shared the same key, and that key  
needed to be secret from everyone else  
(which brought us to the problem of how to  
exchange the key in the first place)



**public-key cryptography:** a message to **x** is encrypted with **x**'s public key; only **x**'s secret key can decrypt the message



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**A**  
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**S**  
{**PK<sub>s</sub>**, **SK<sub>s</sub>**}





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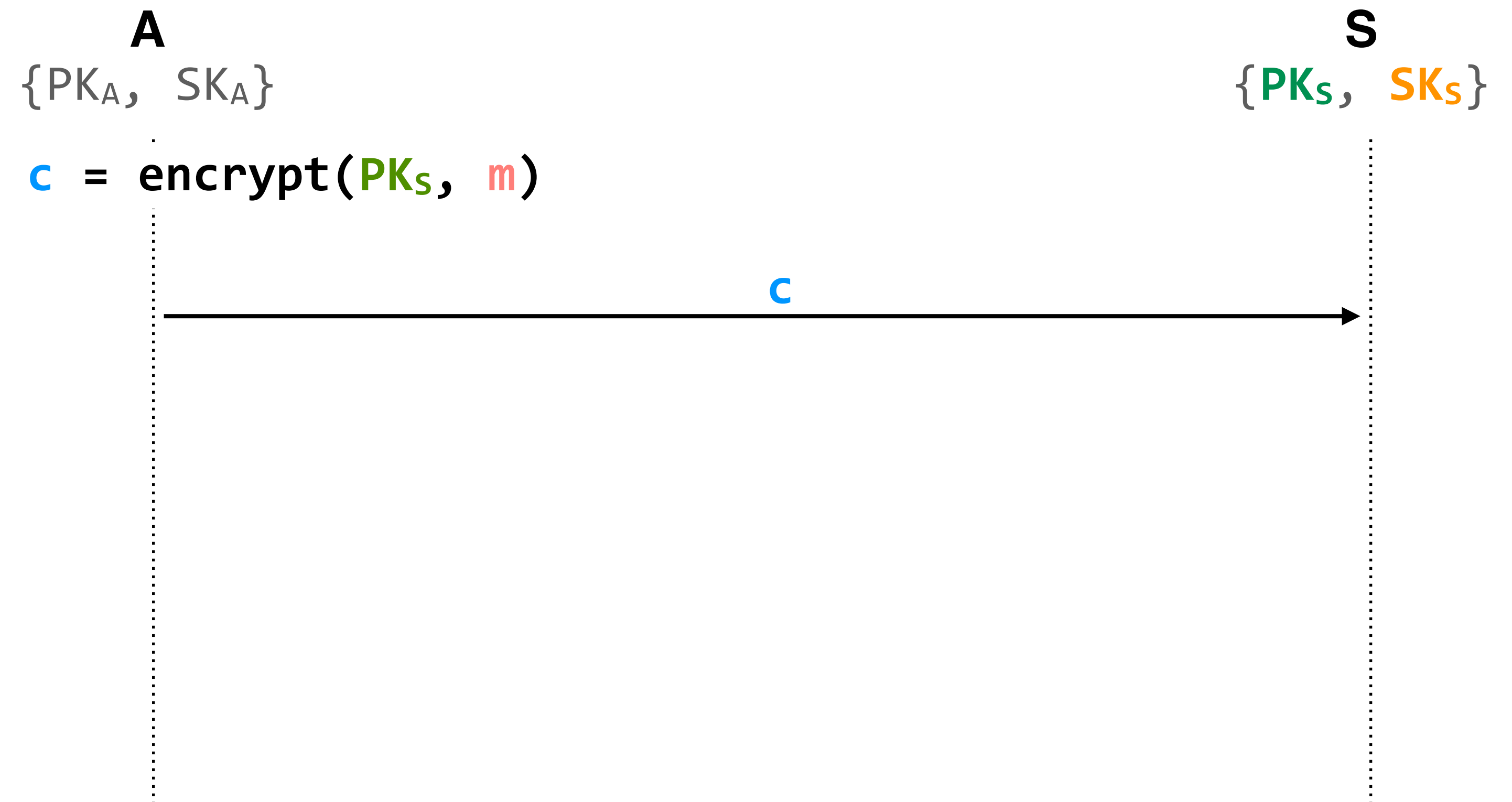
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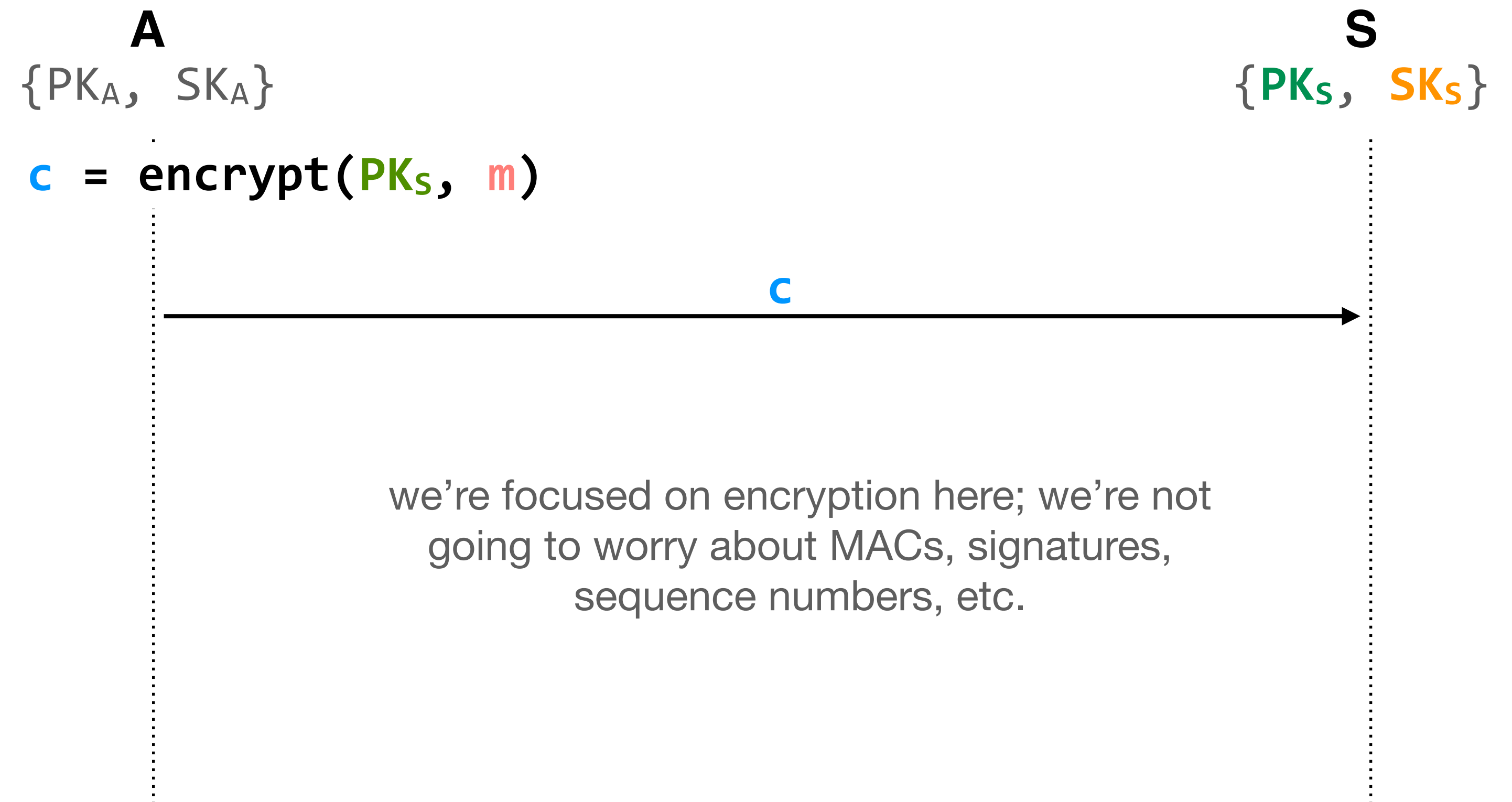


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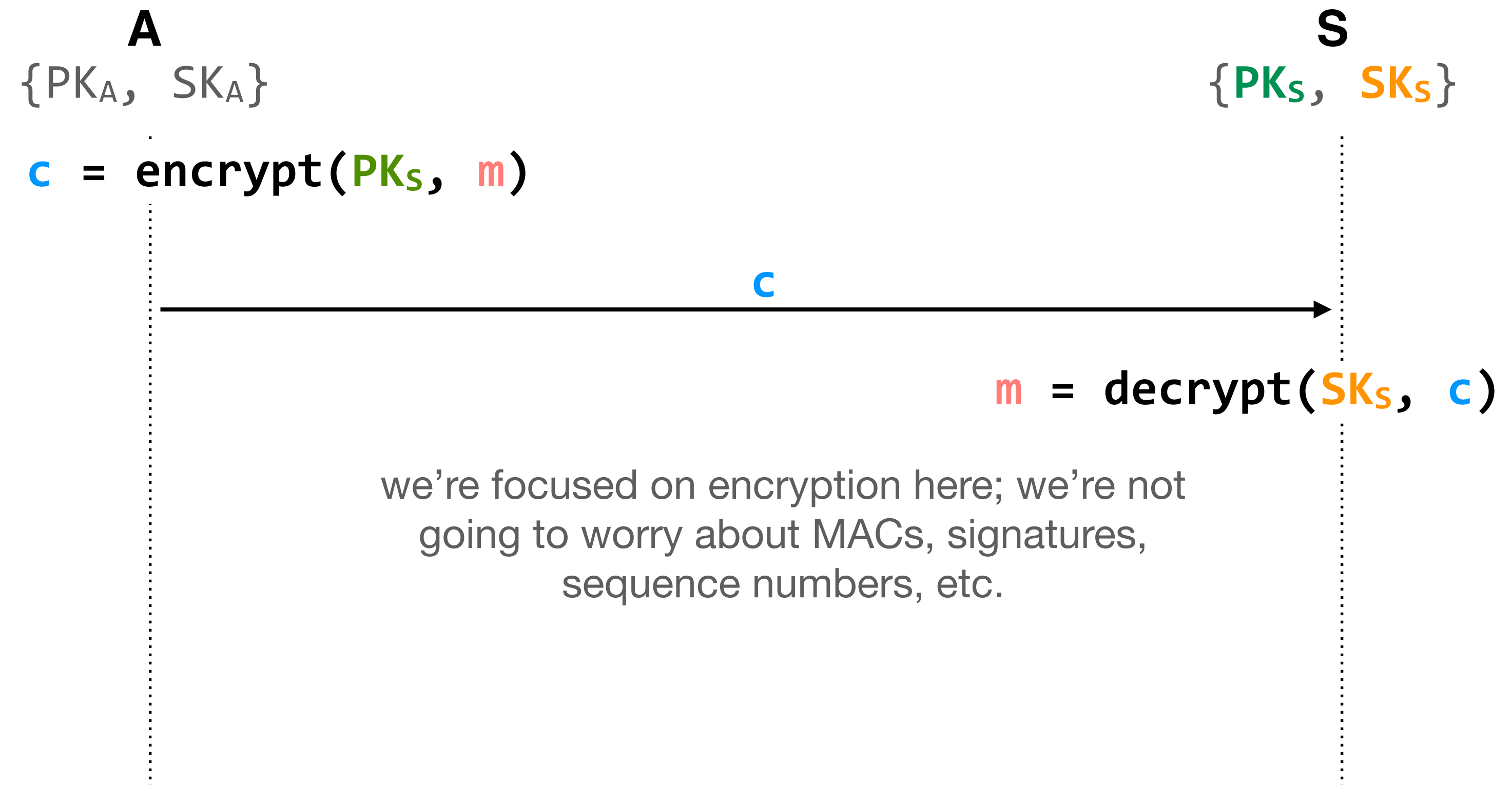


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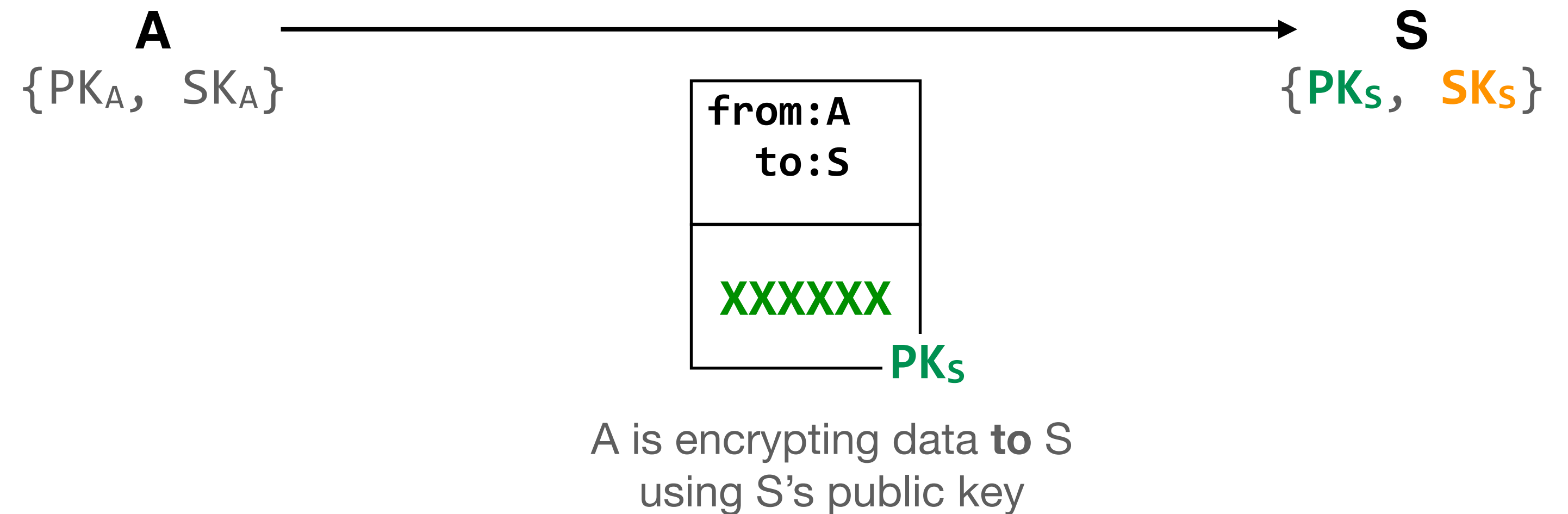


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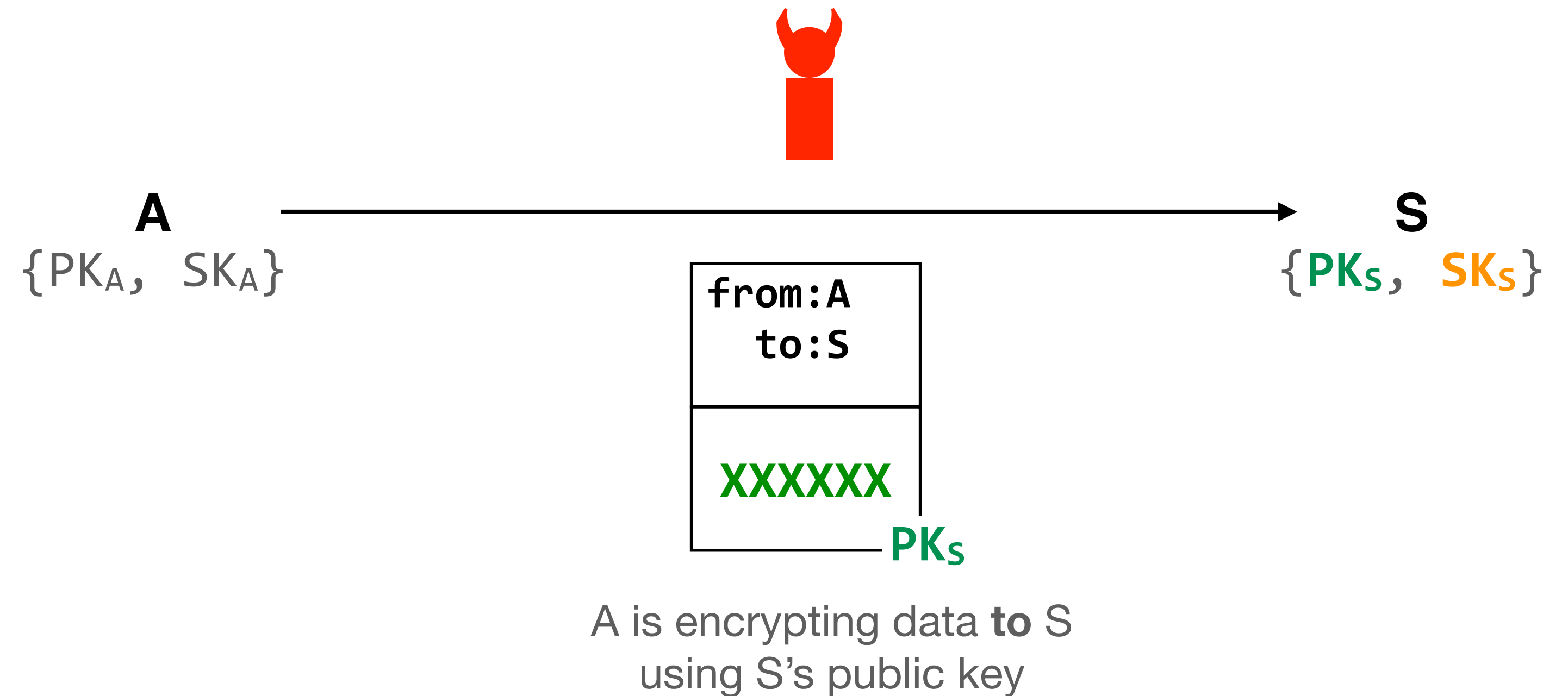


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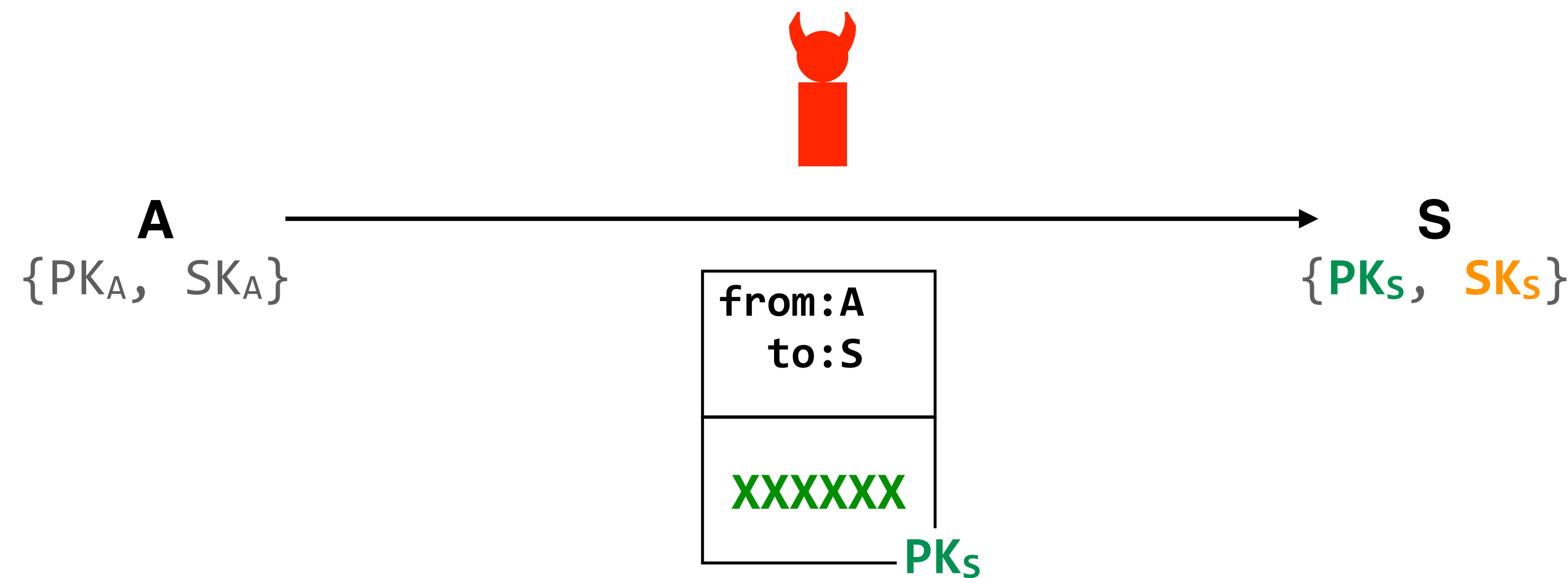
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A is encrypting data **to** S using S's public key

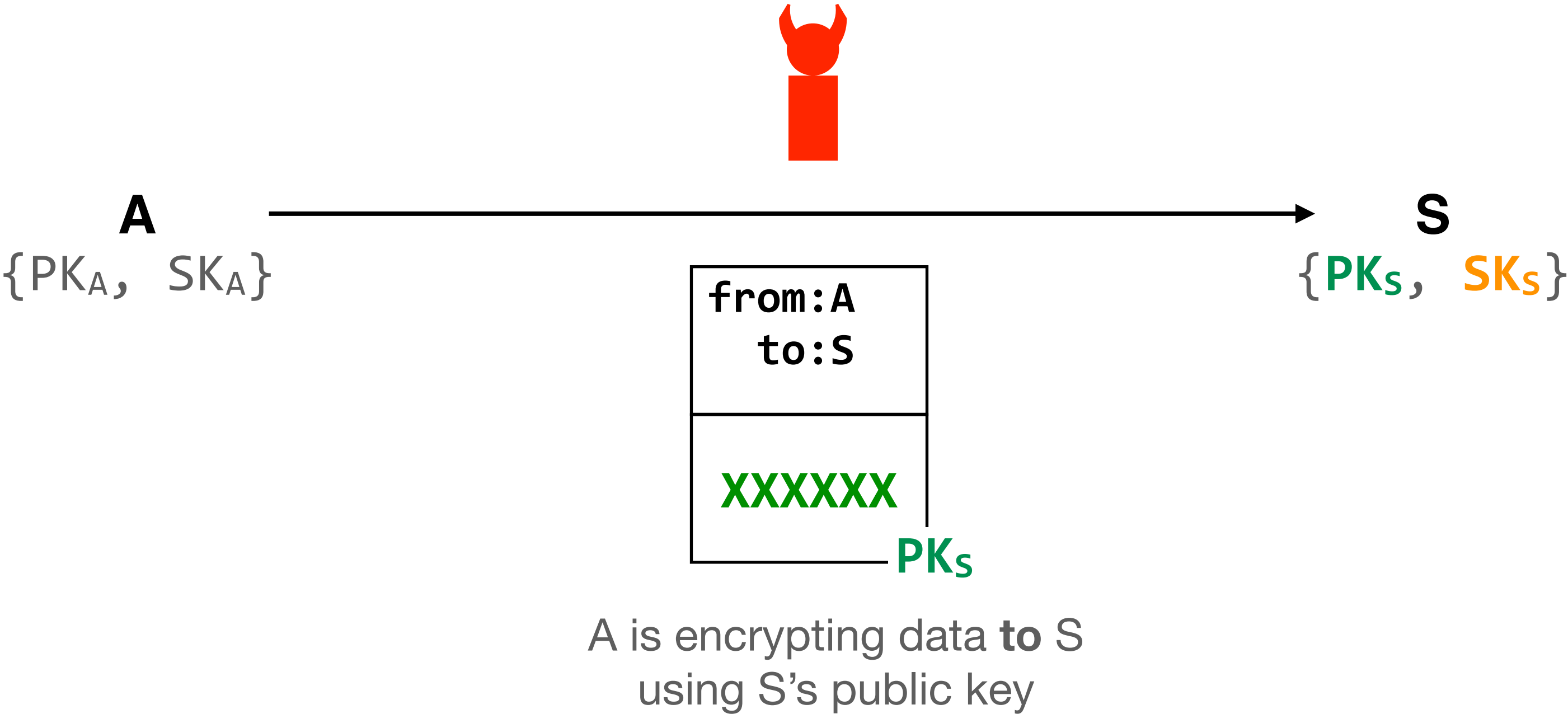
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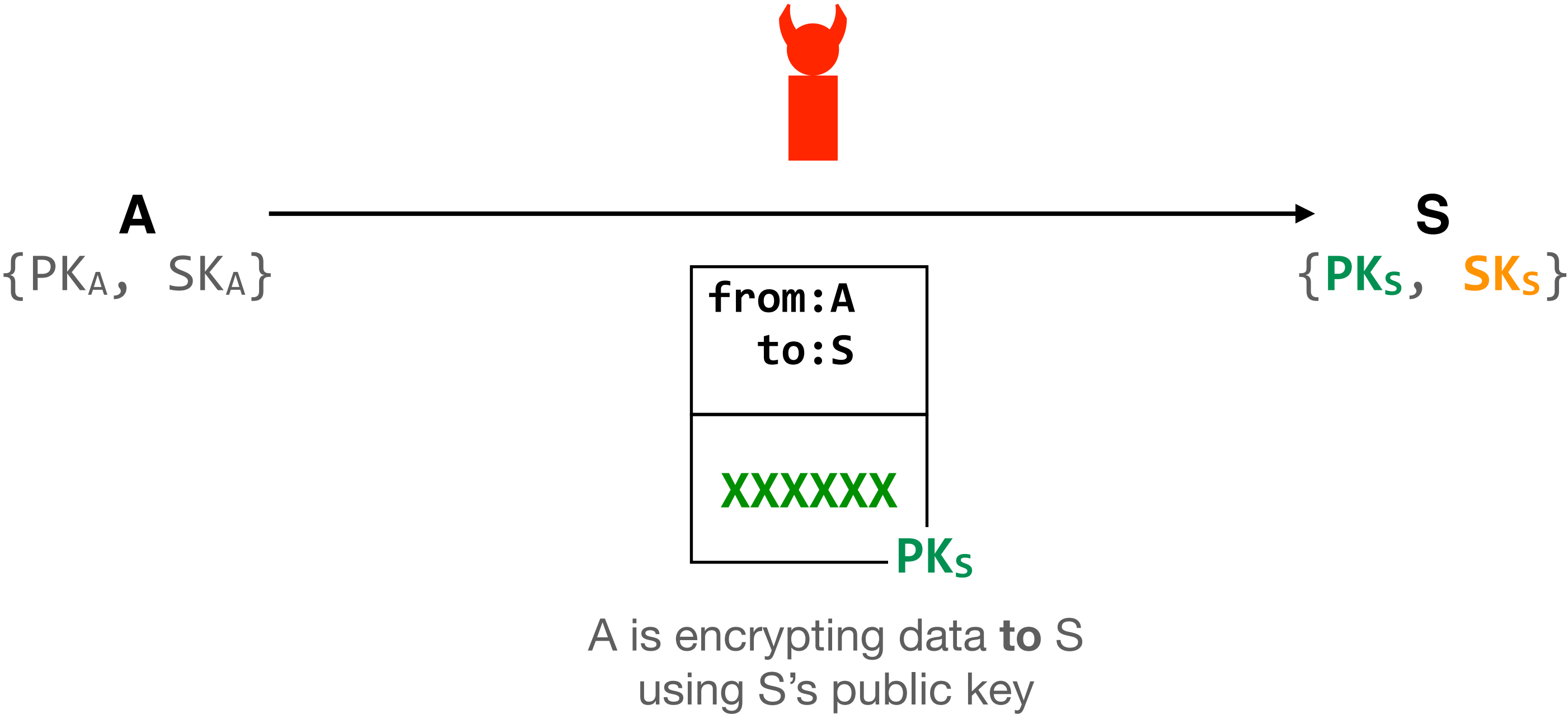
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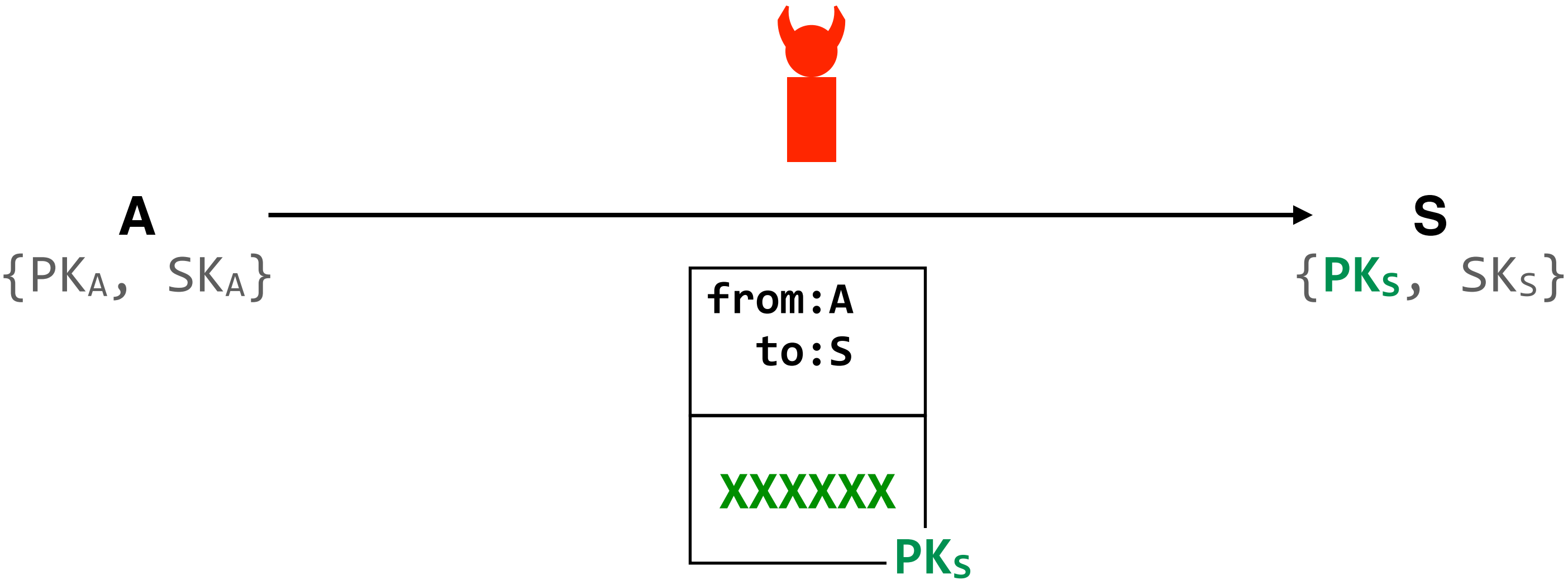
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no packet should say “from: A; to: S”



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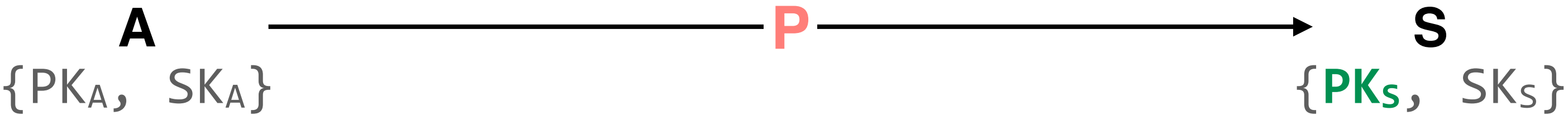
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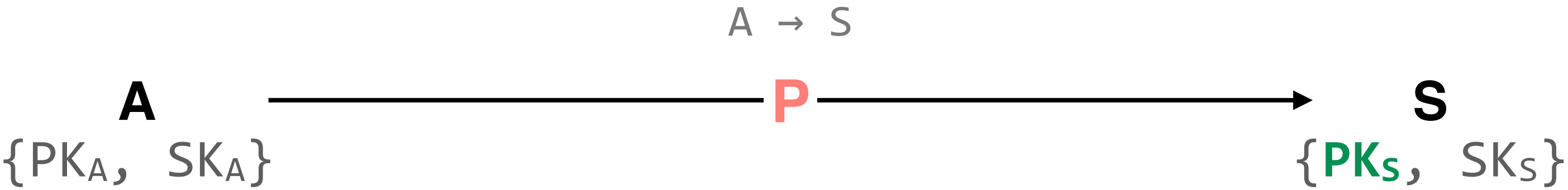
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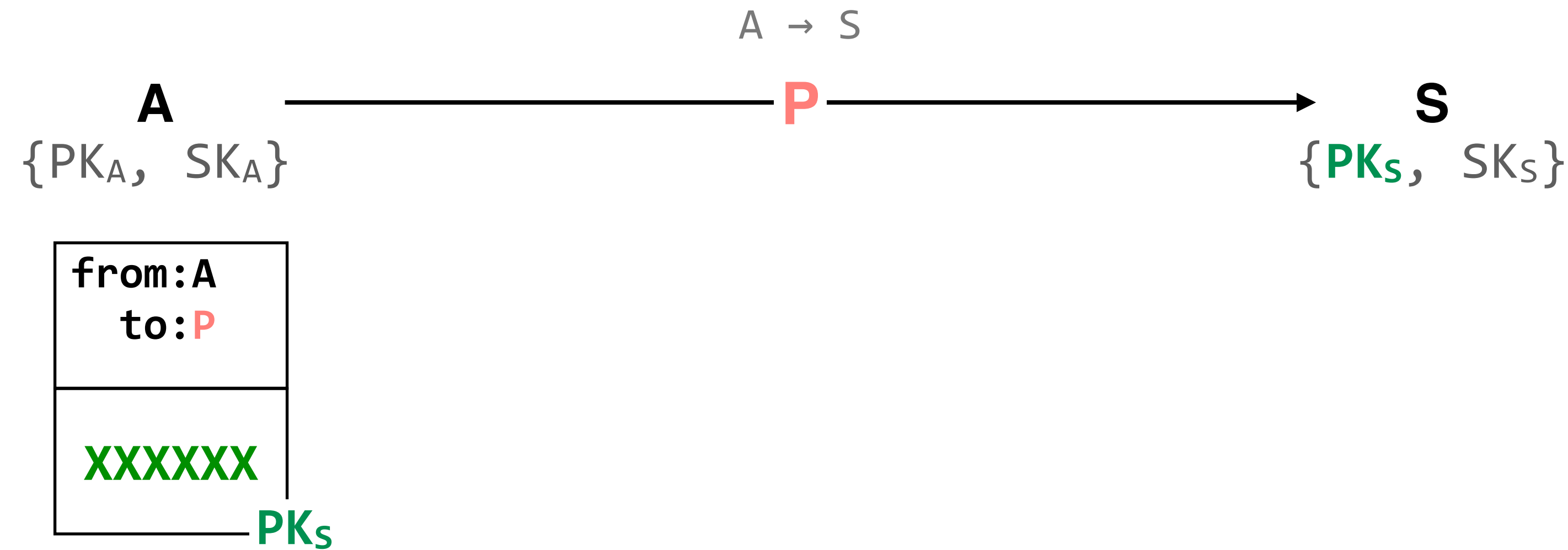
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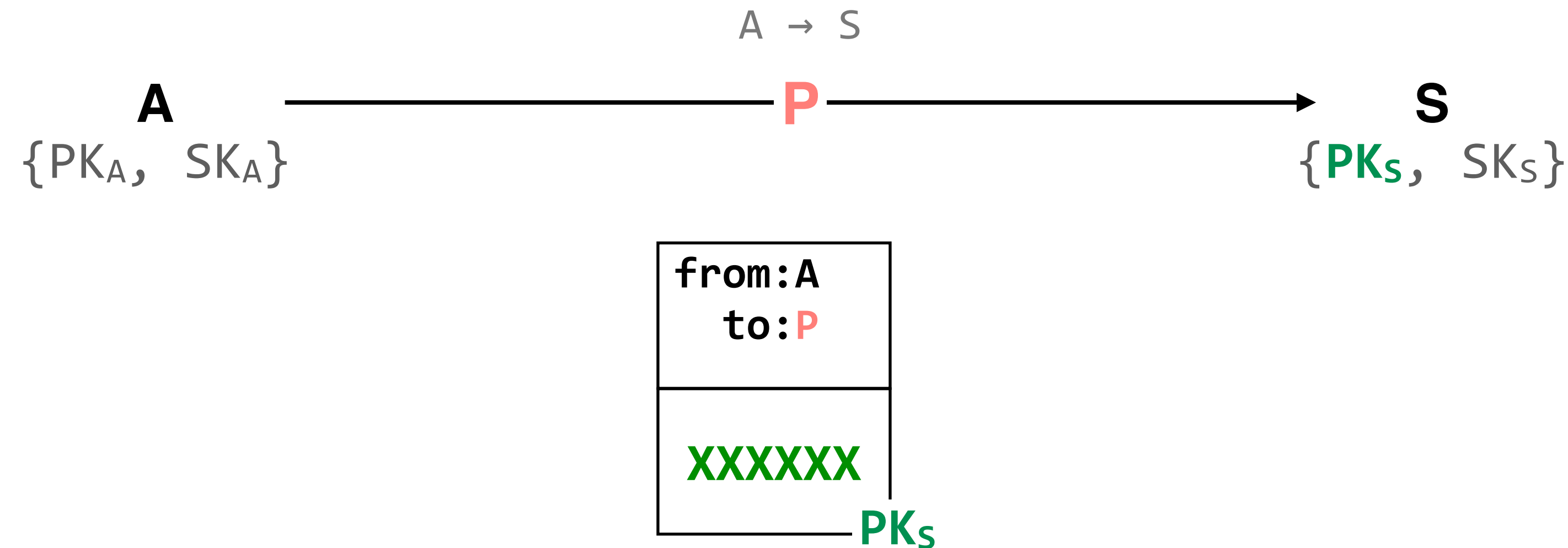
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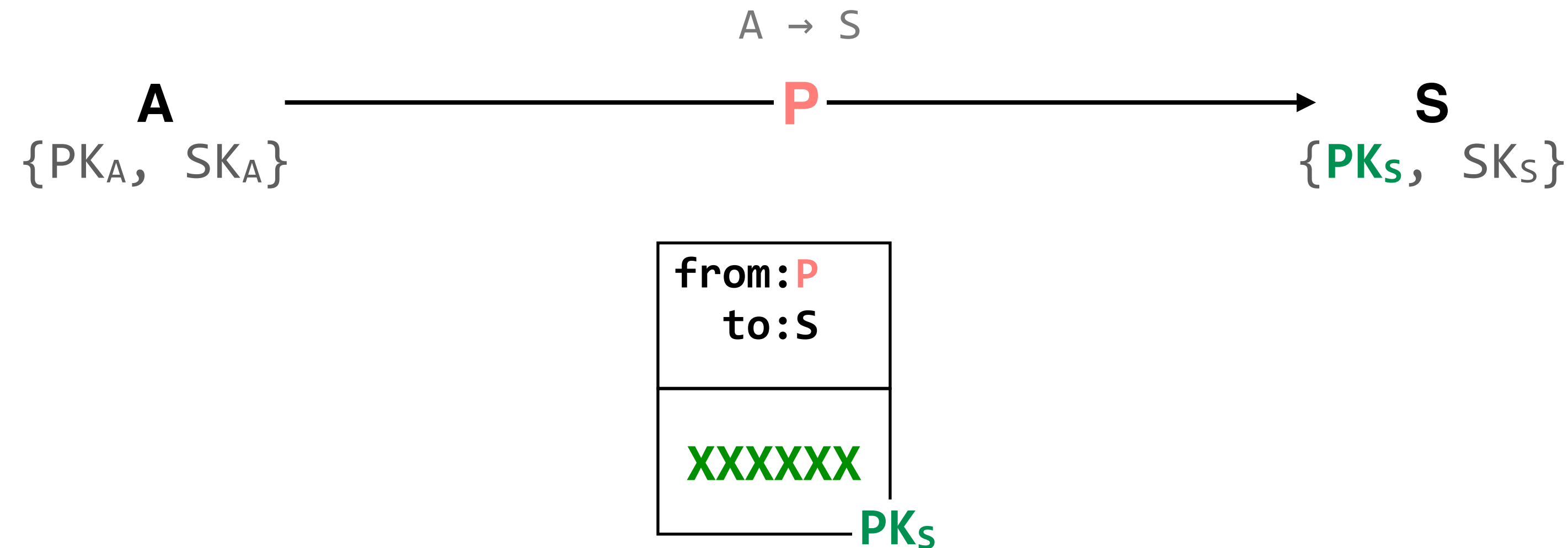
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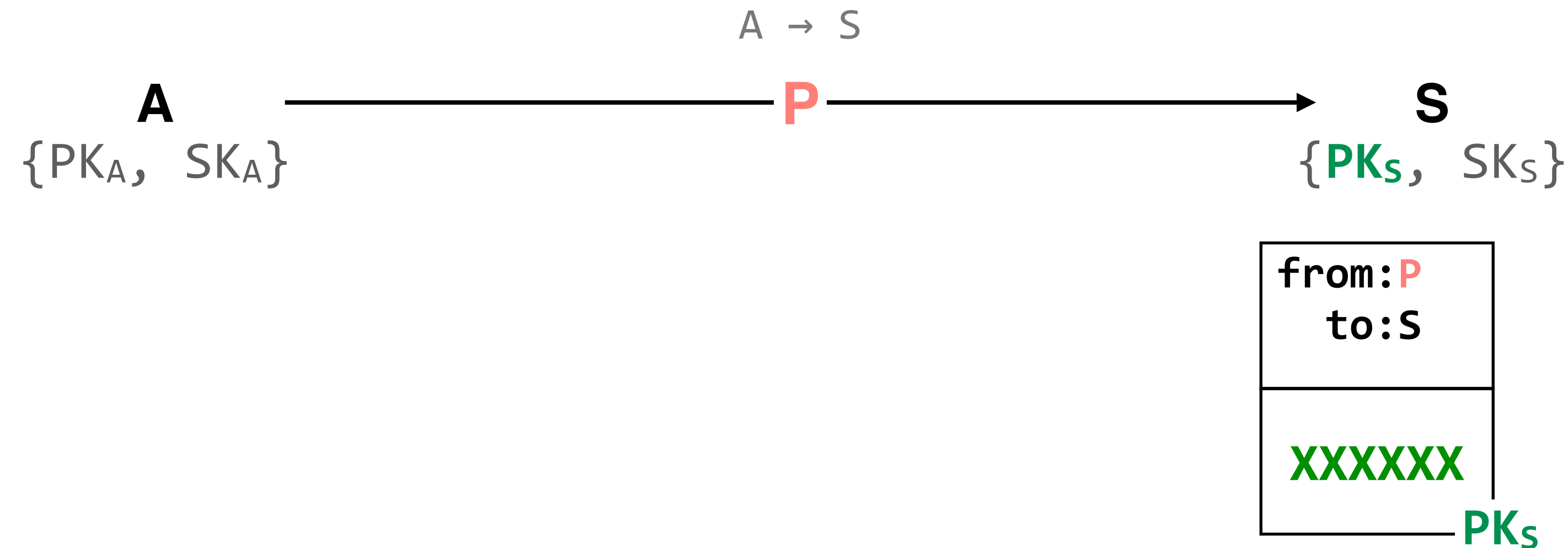
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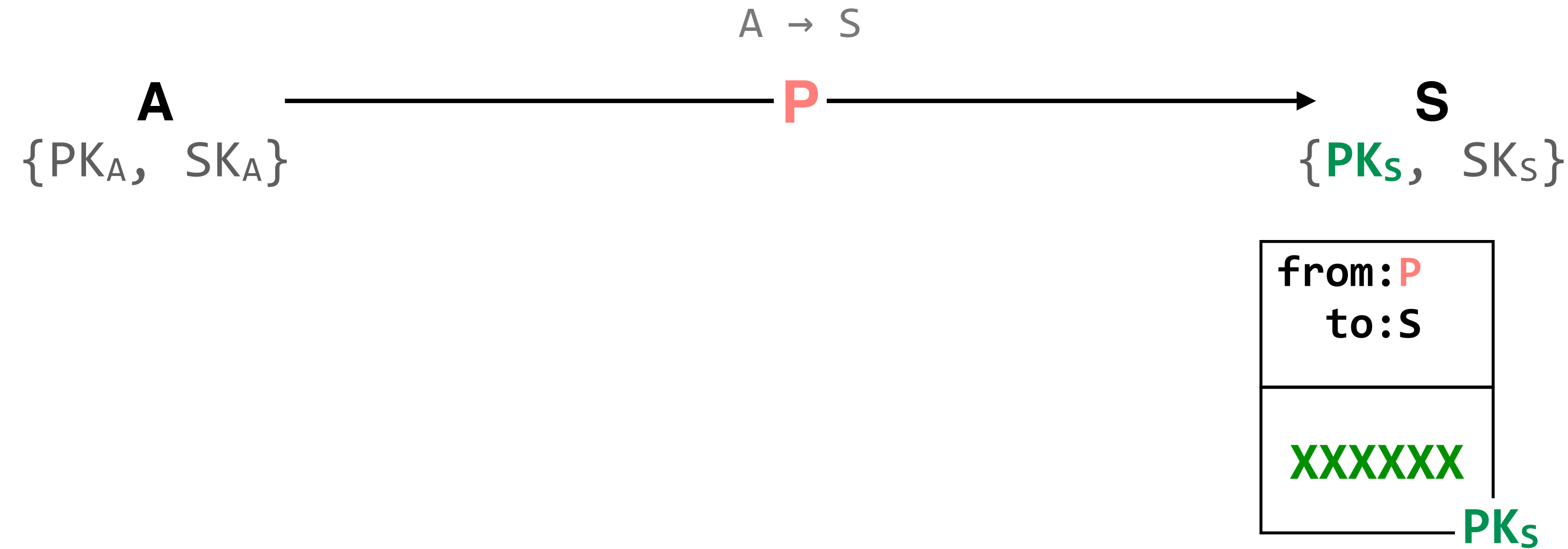
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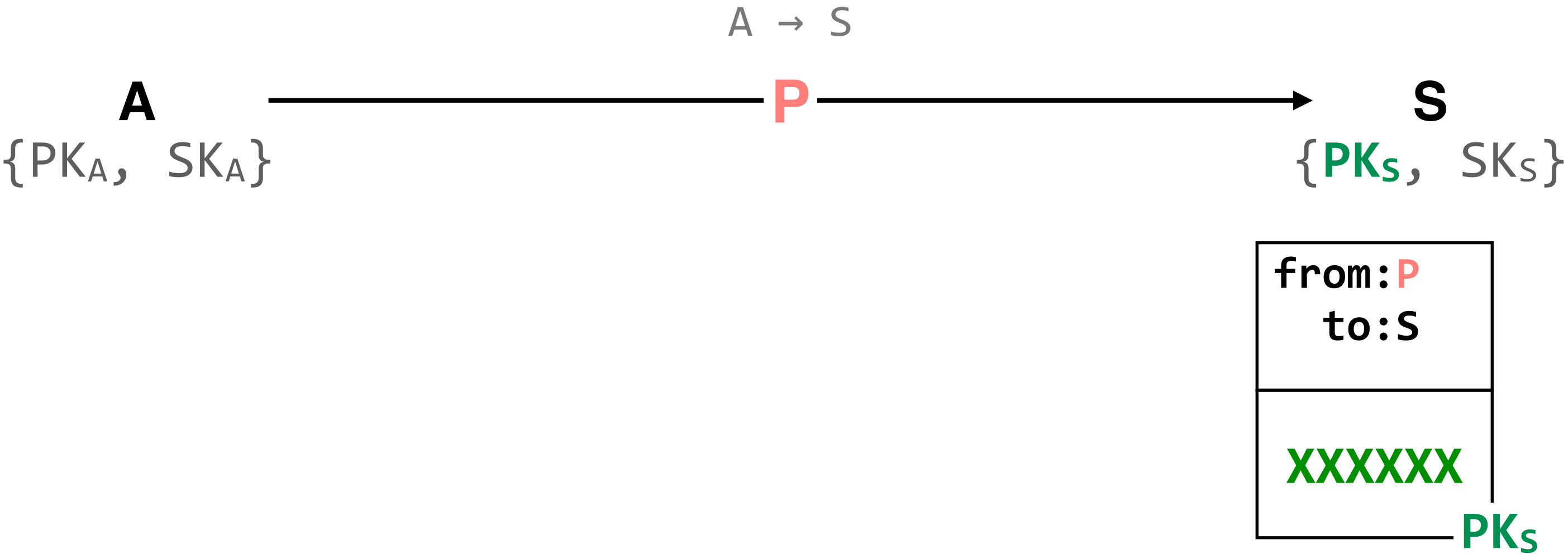
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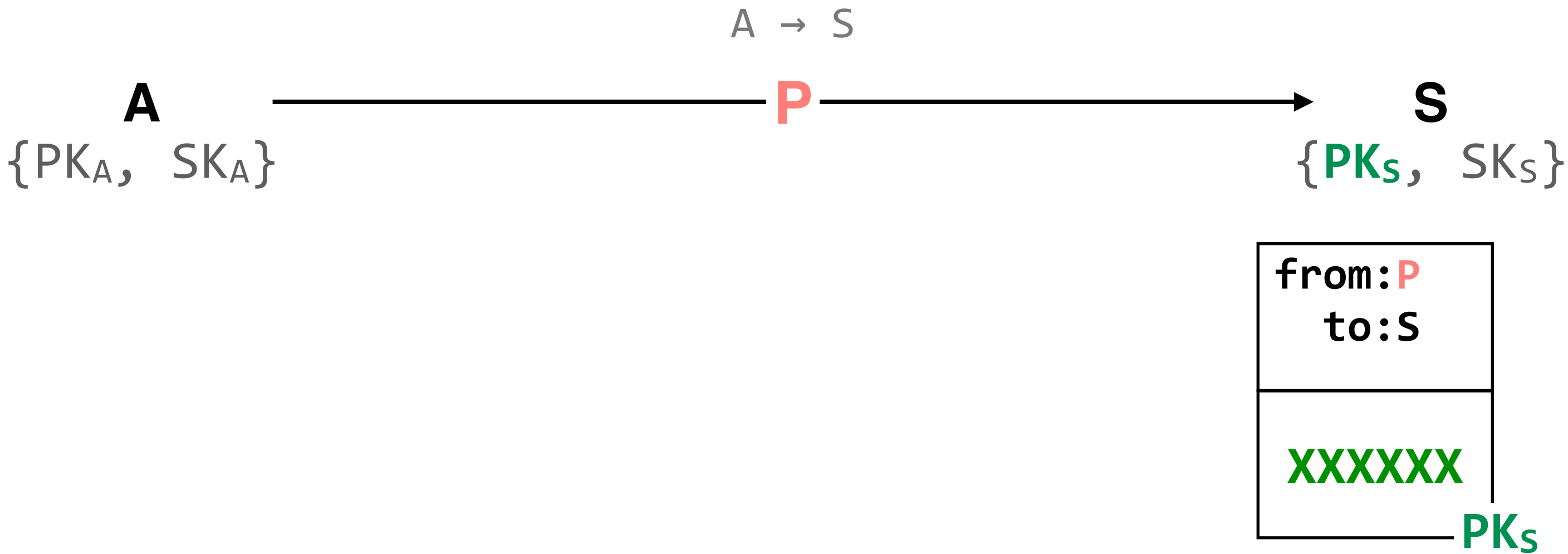
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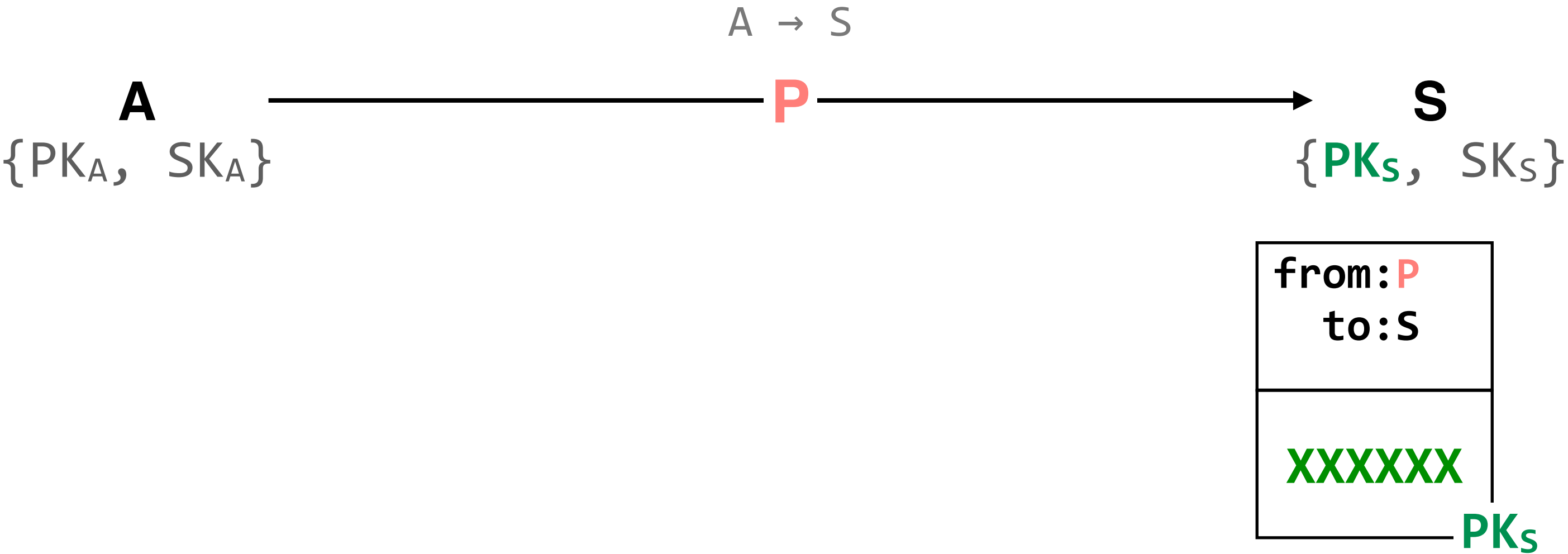
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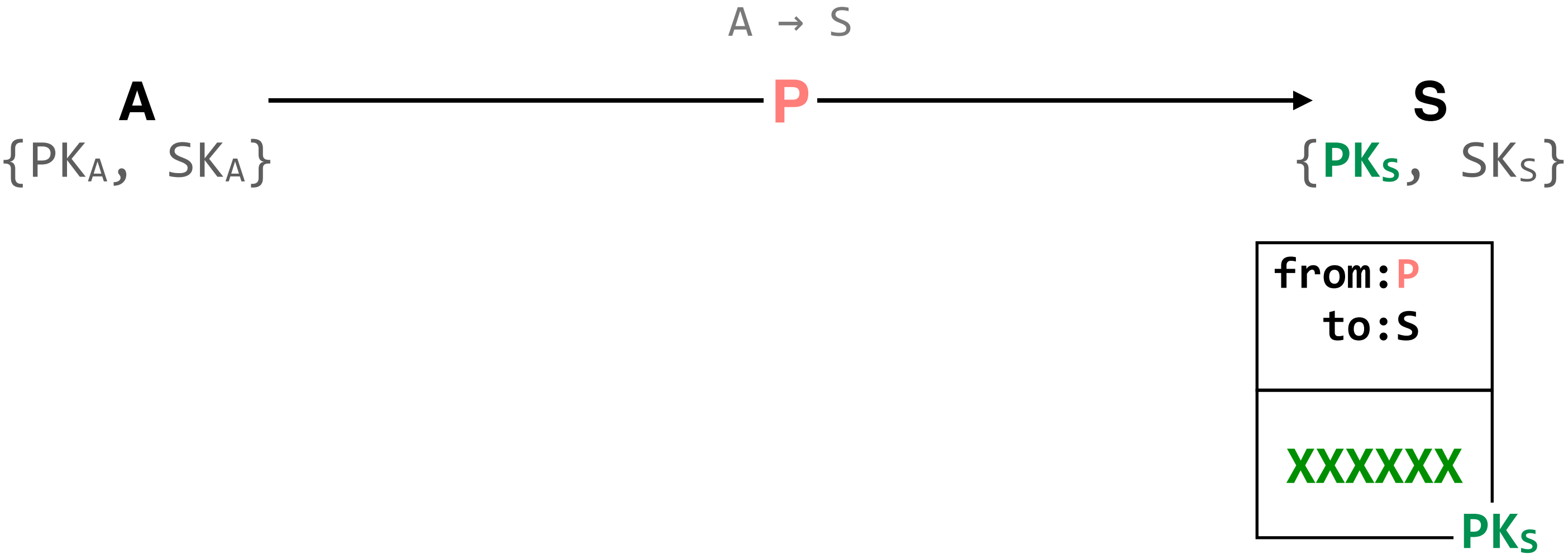
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a single proxy alone *can* be useful for other things;  
we'll return to this later in the lecture.

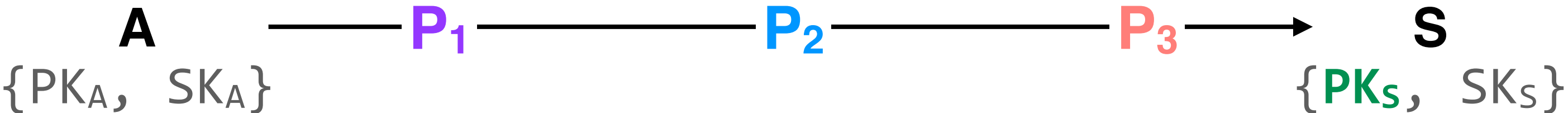
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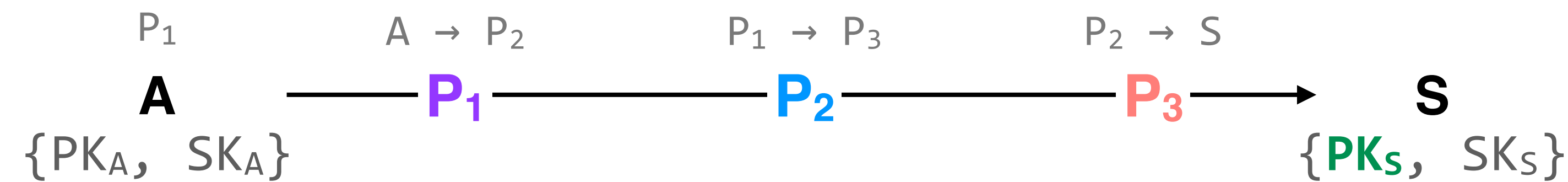
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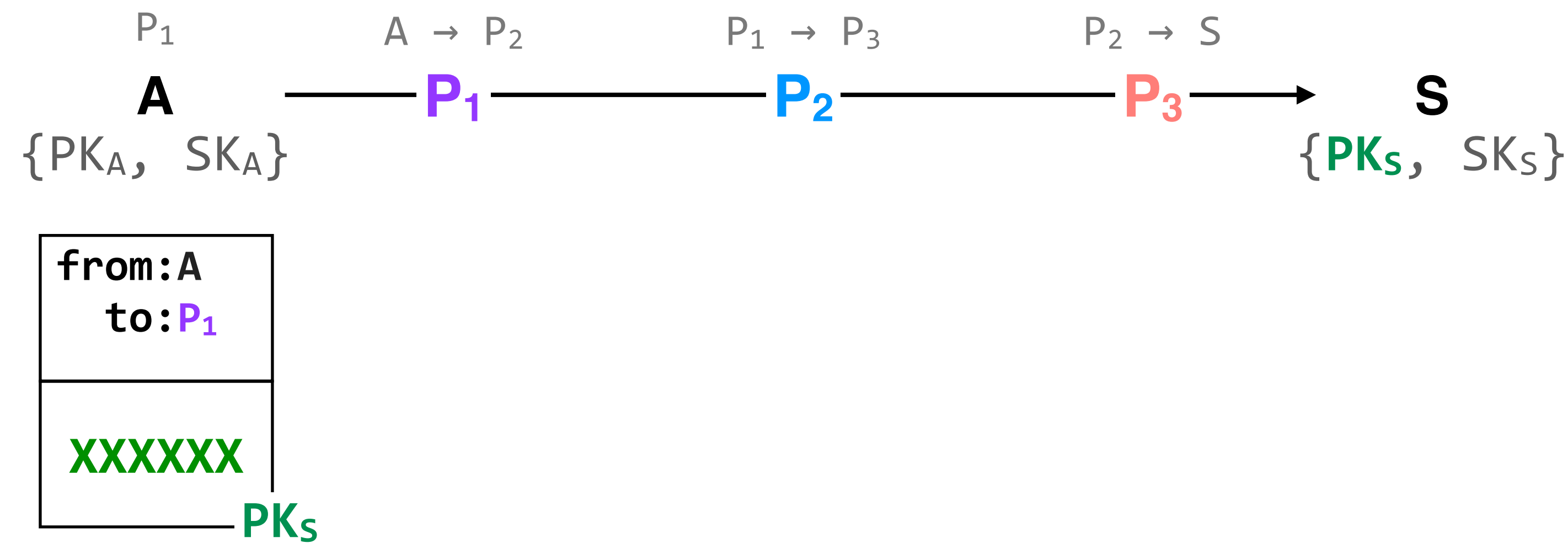
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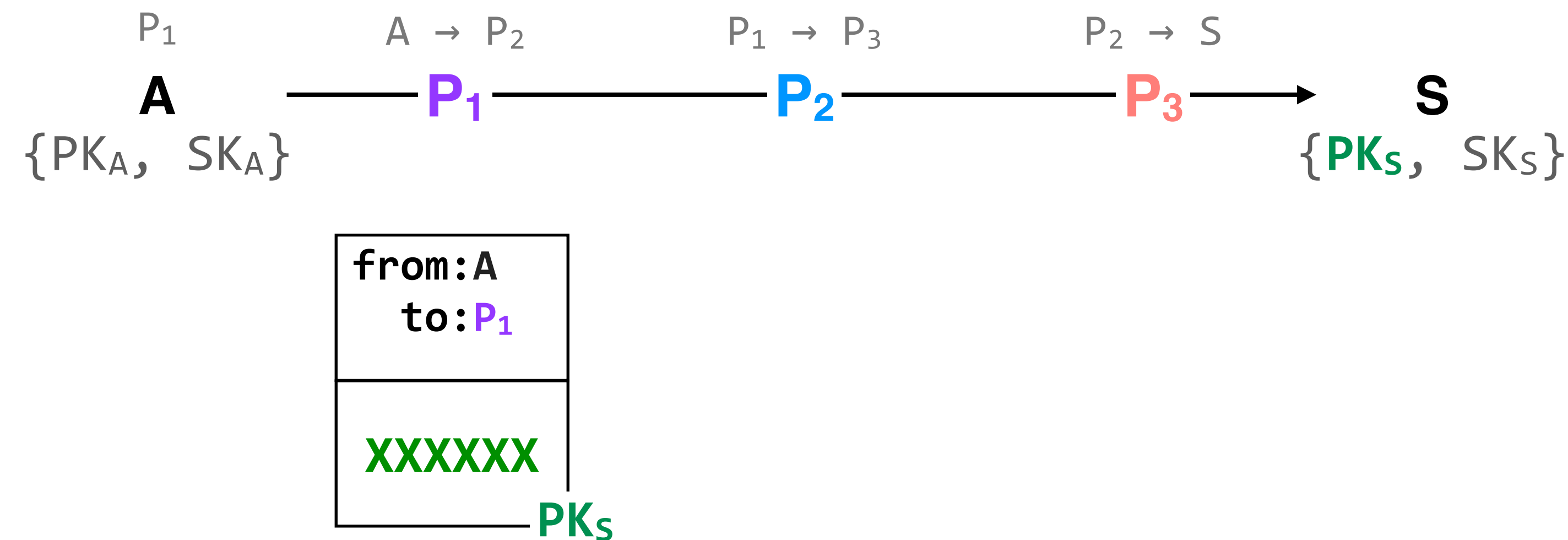


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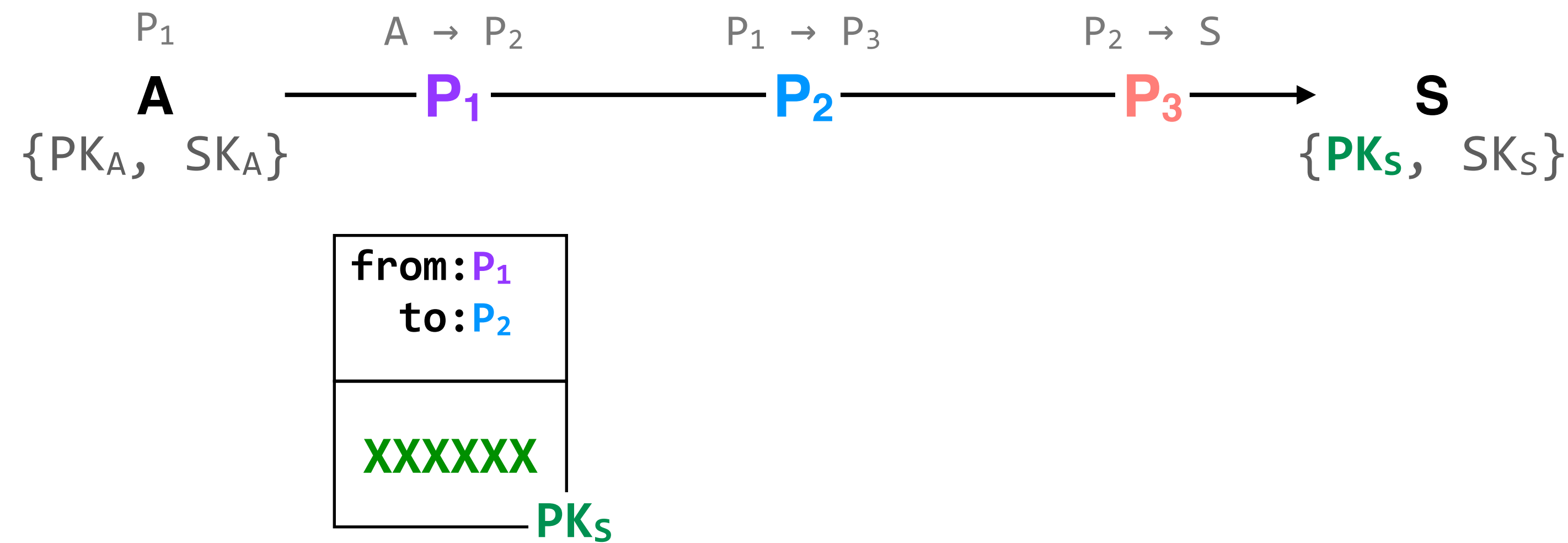
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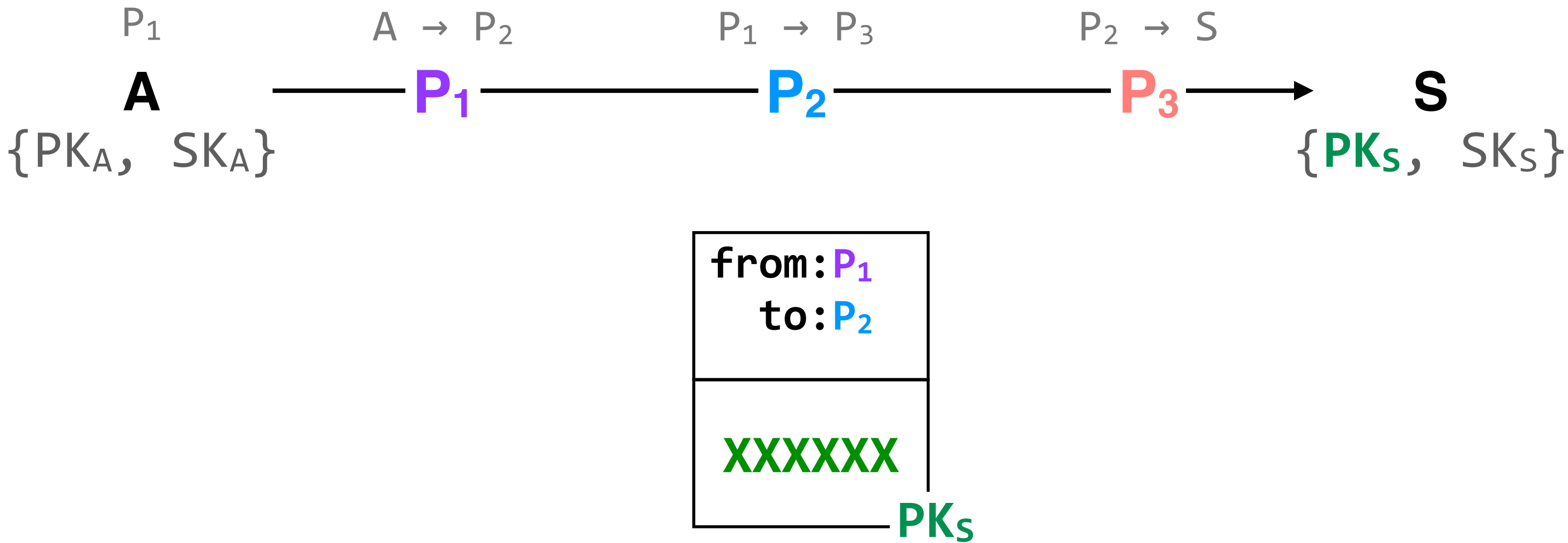
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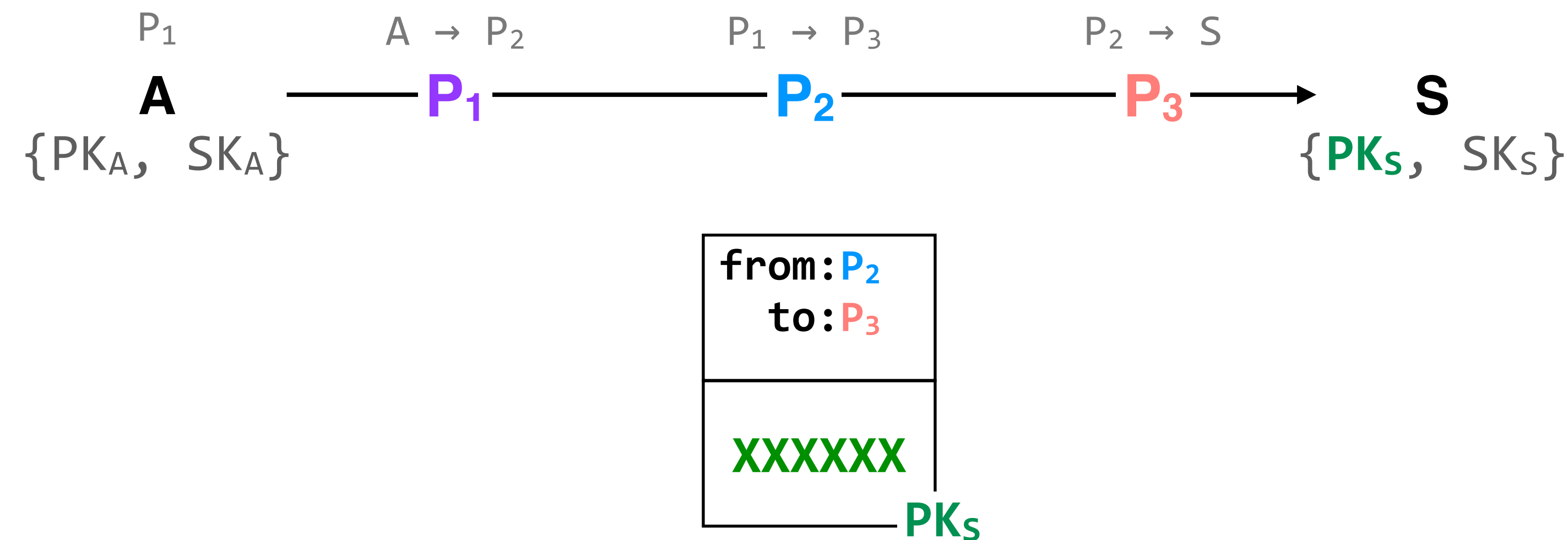
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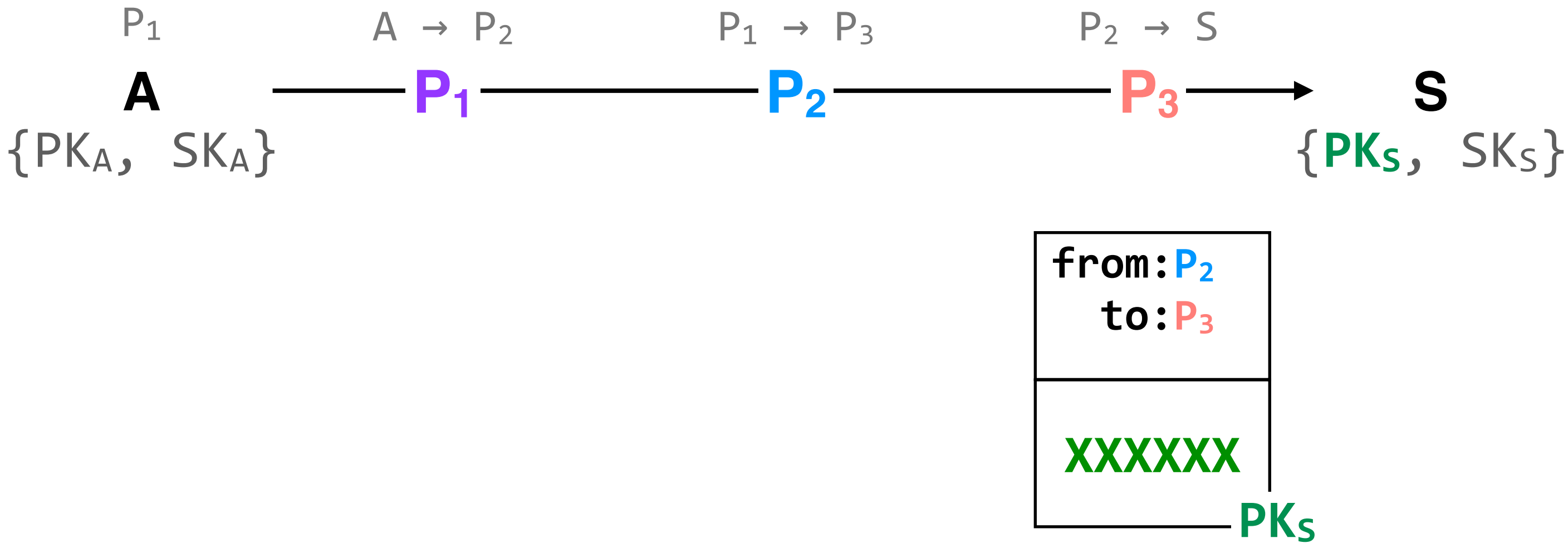
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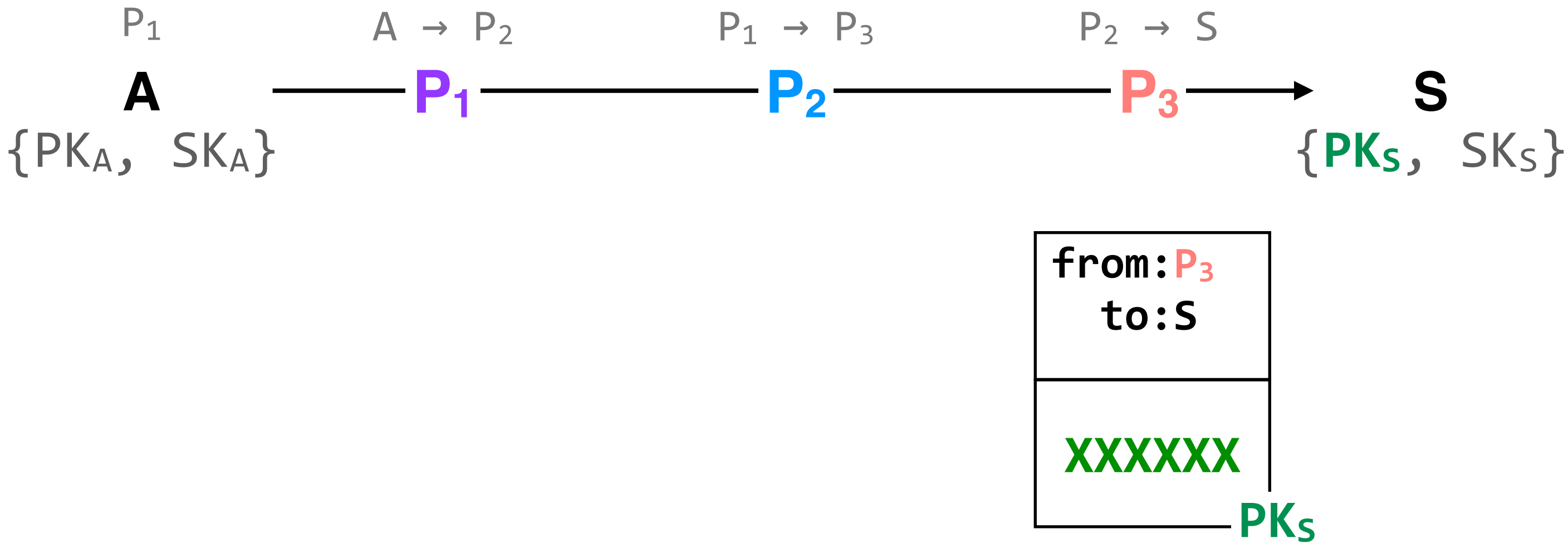


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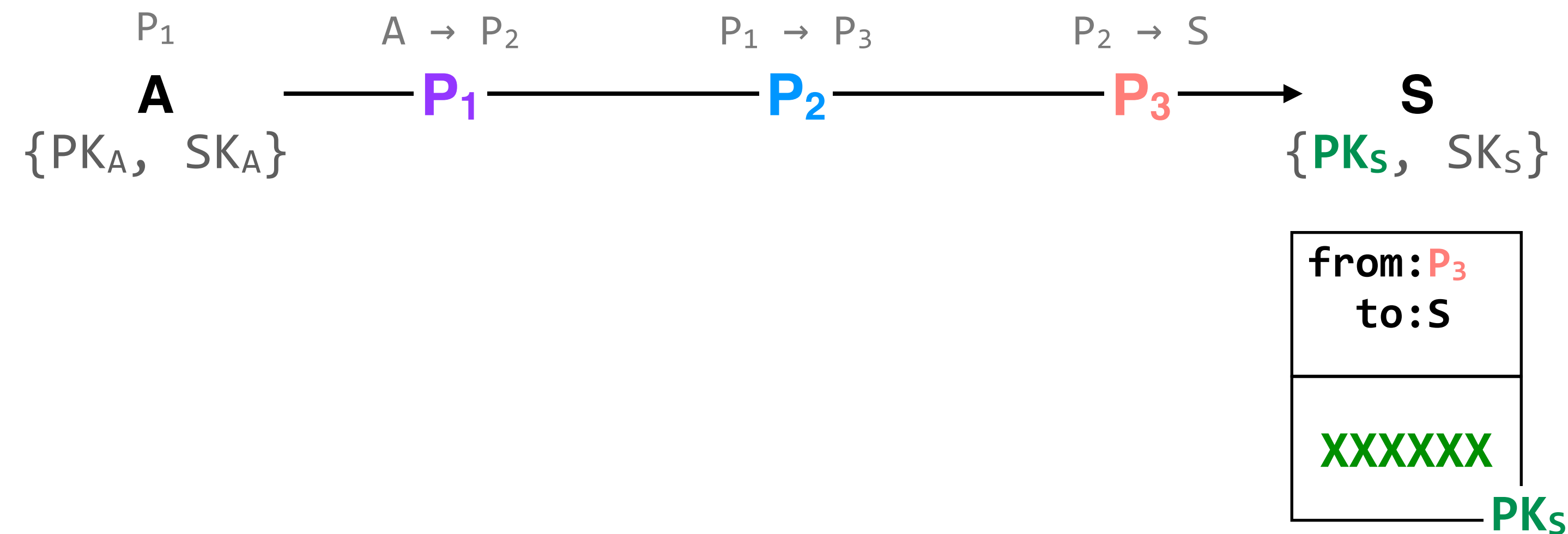
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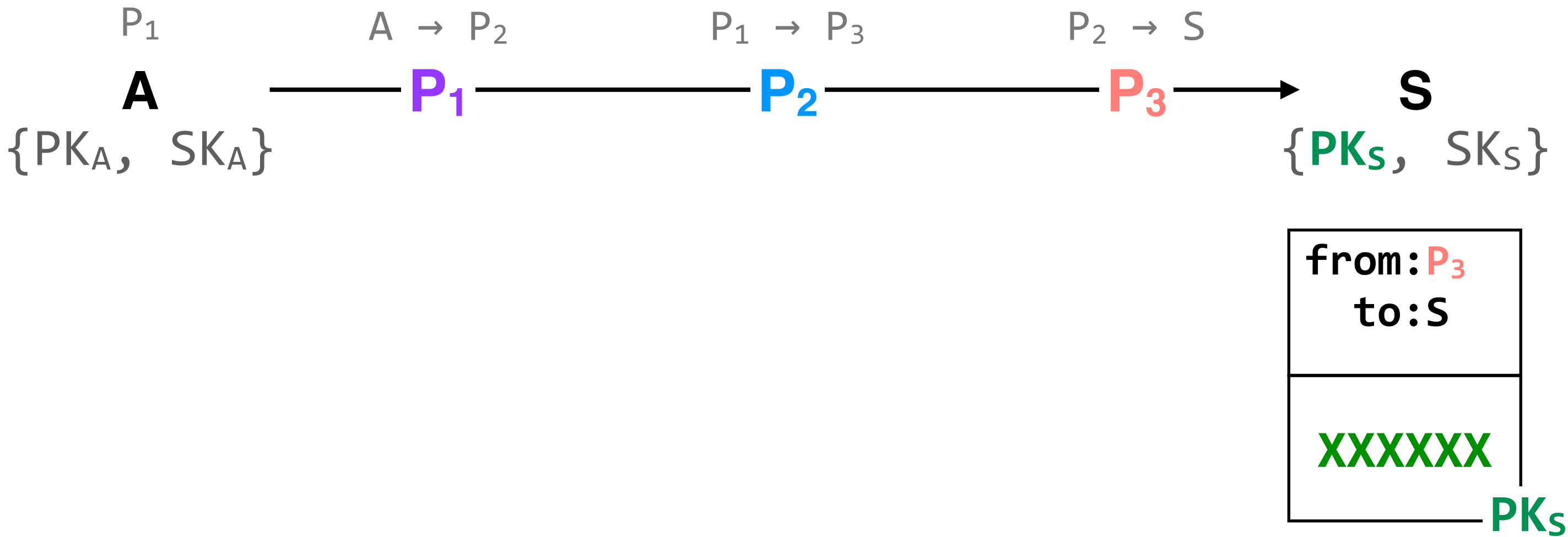
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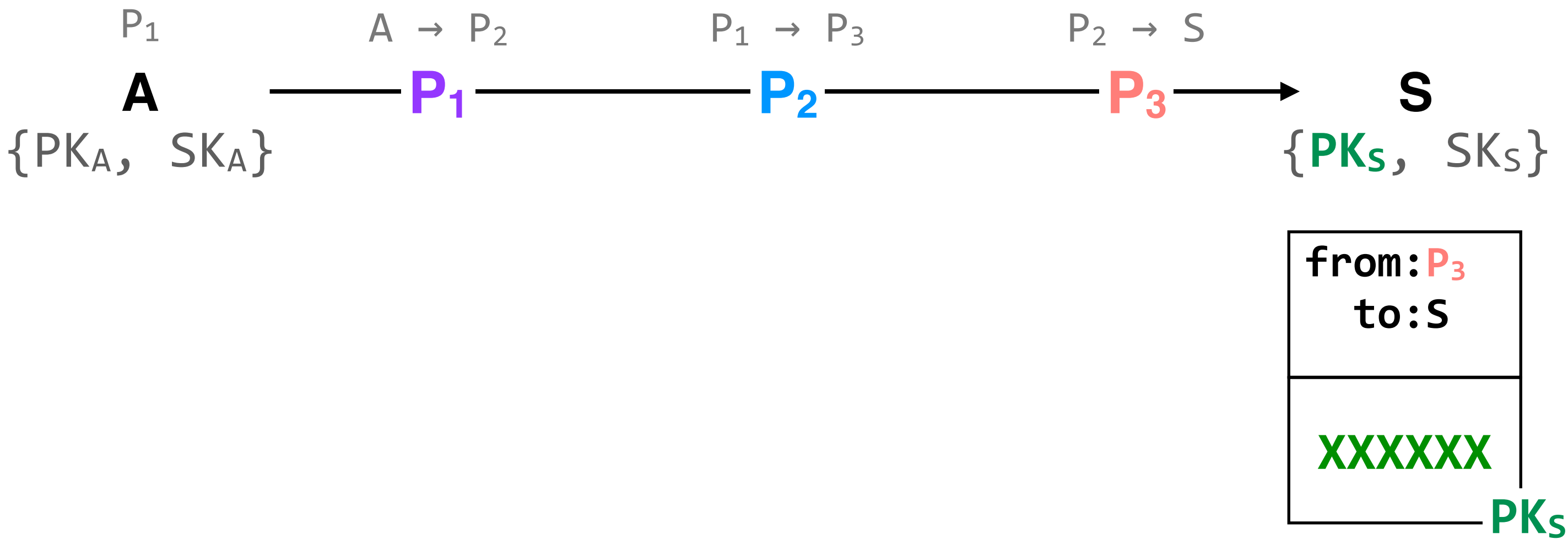
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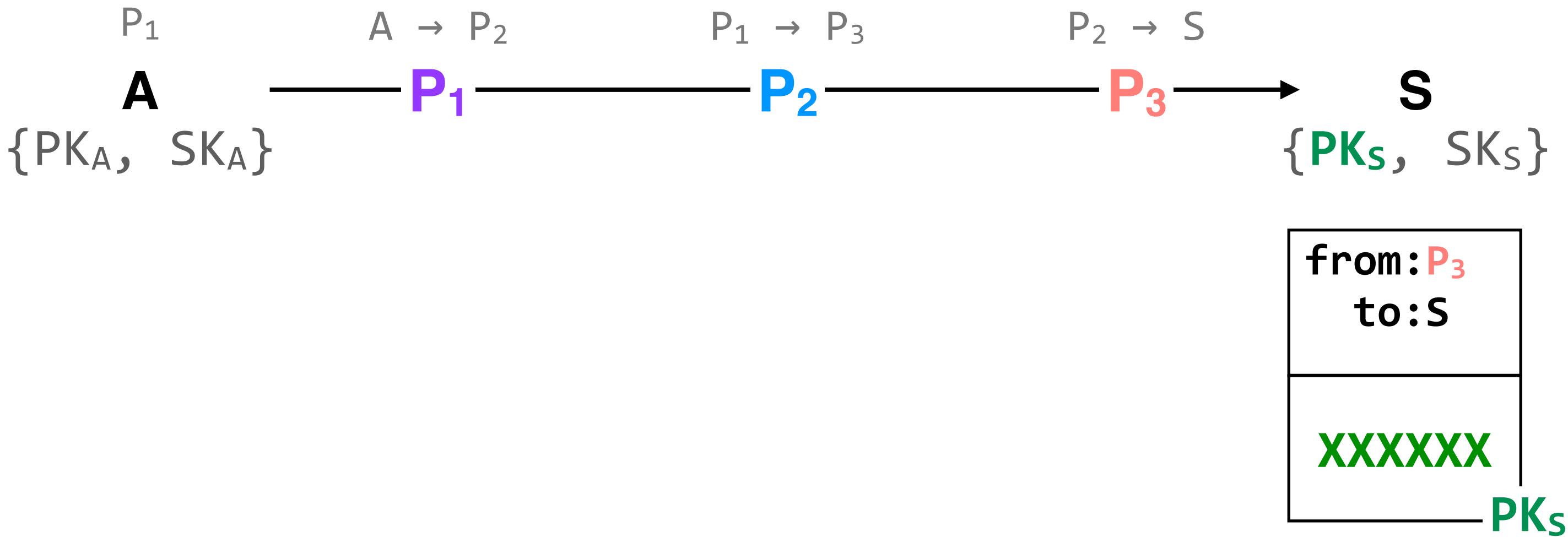
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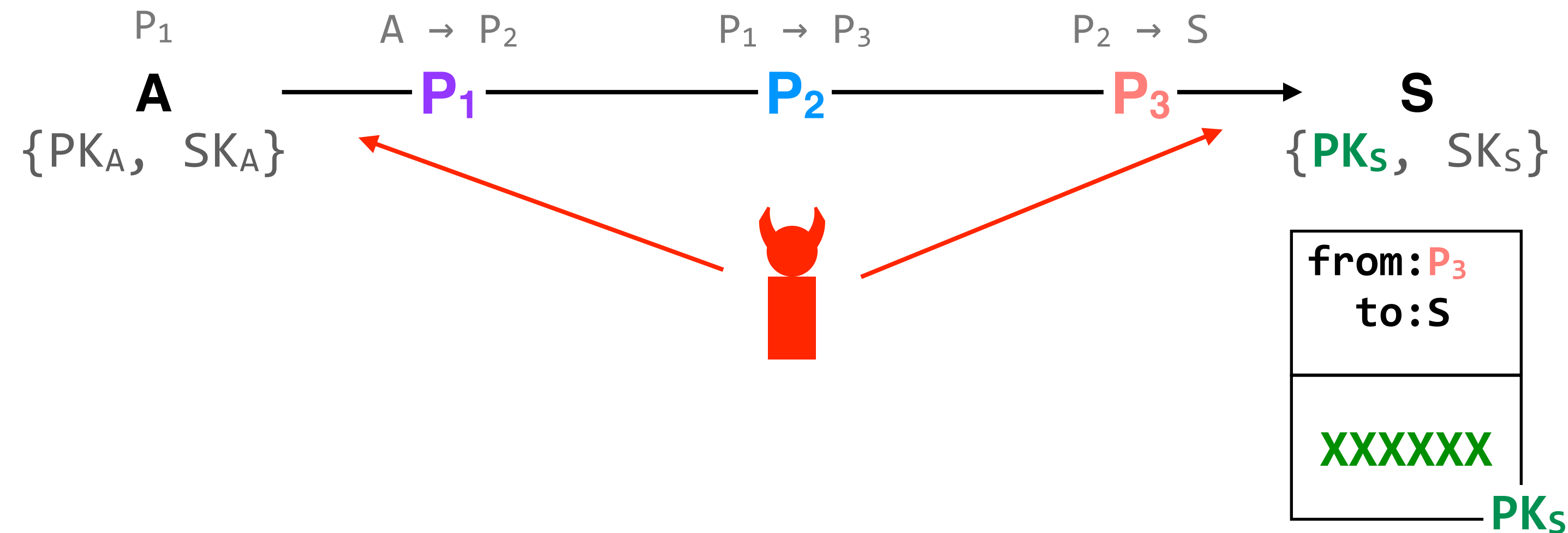
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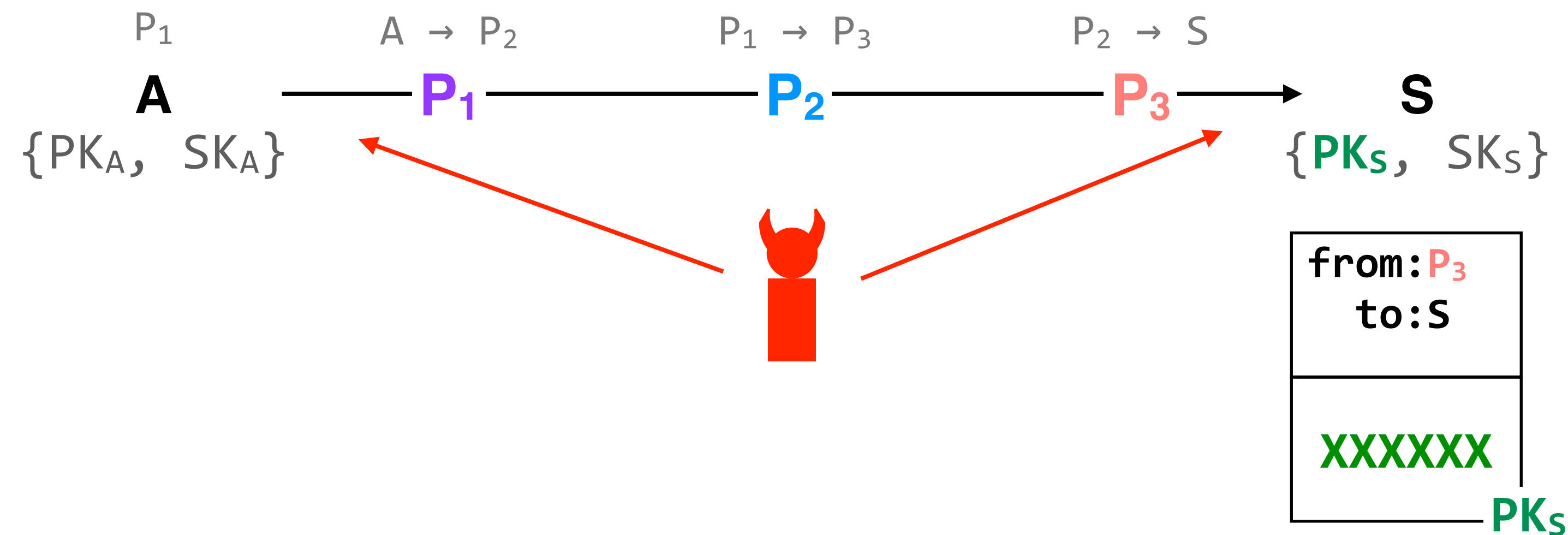
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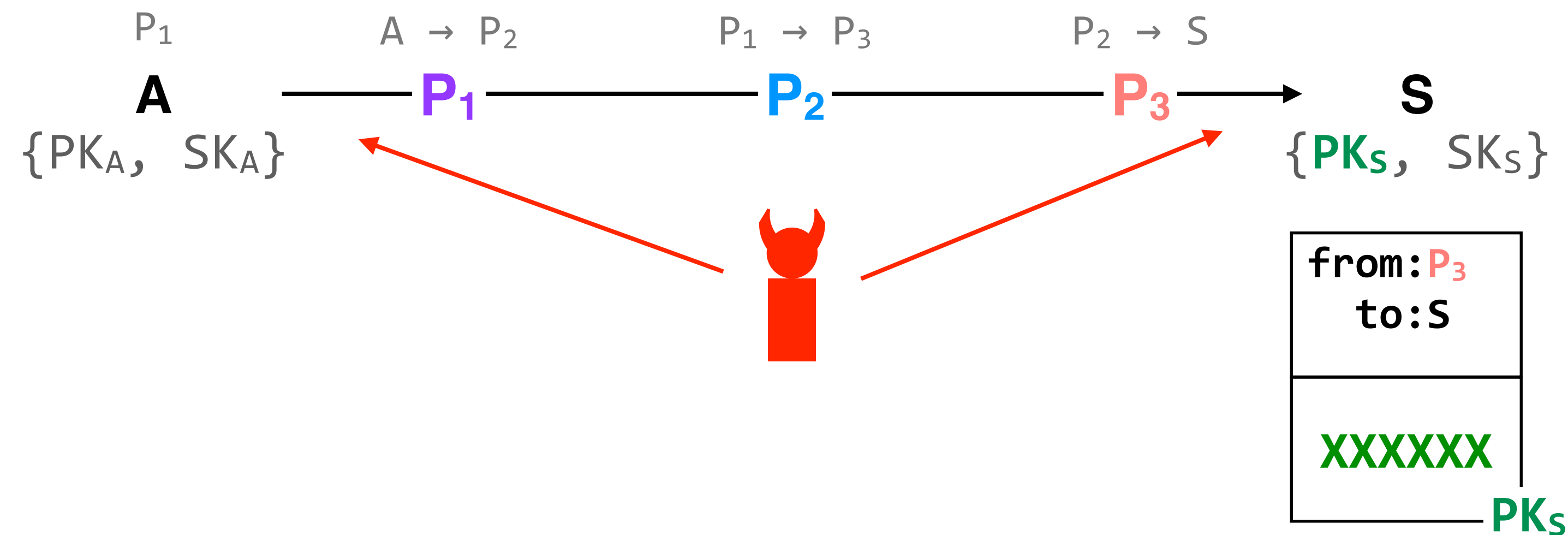
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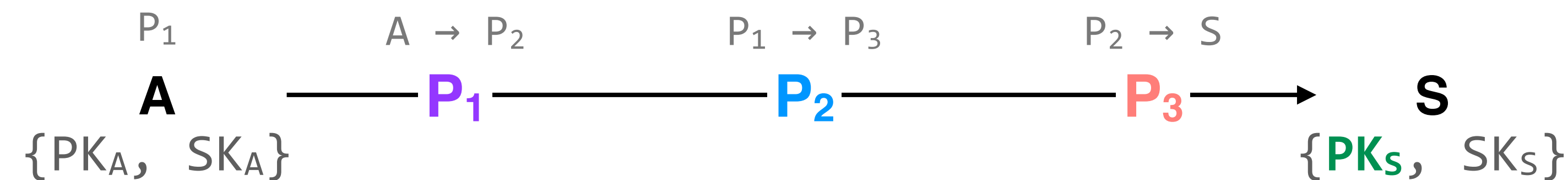
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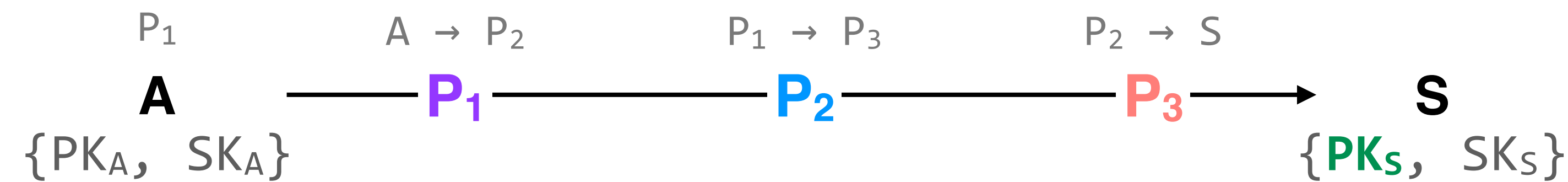
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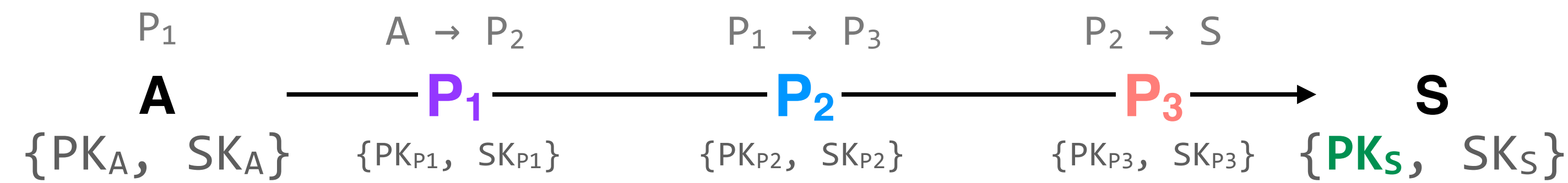
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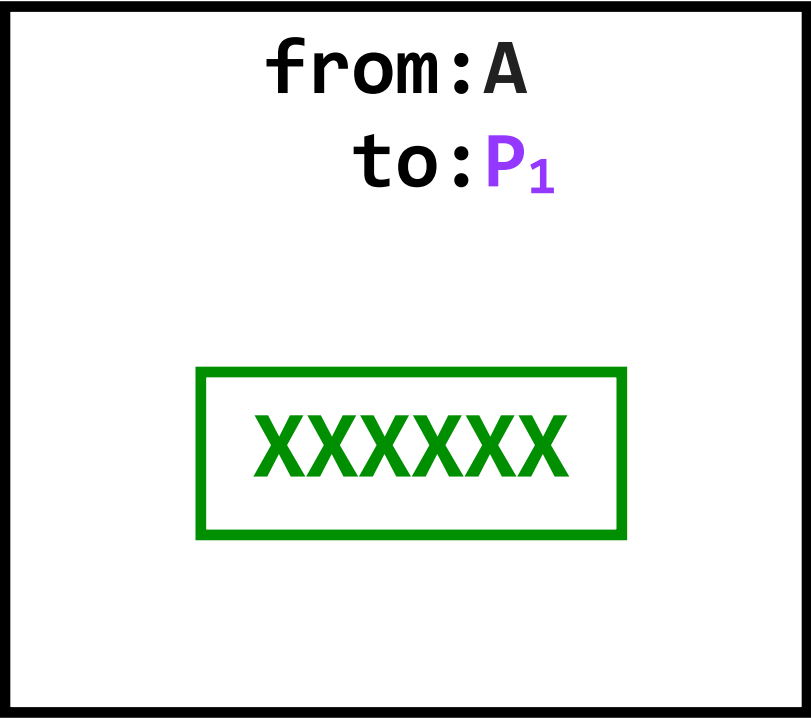
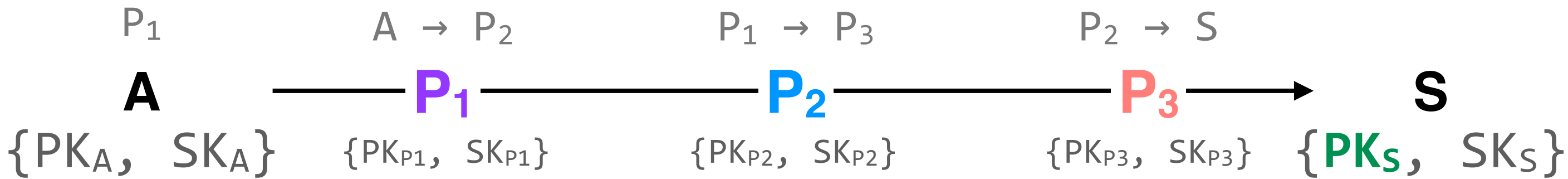
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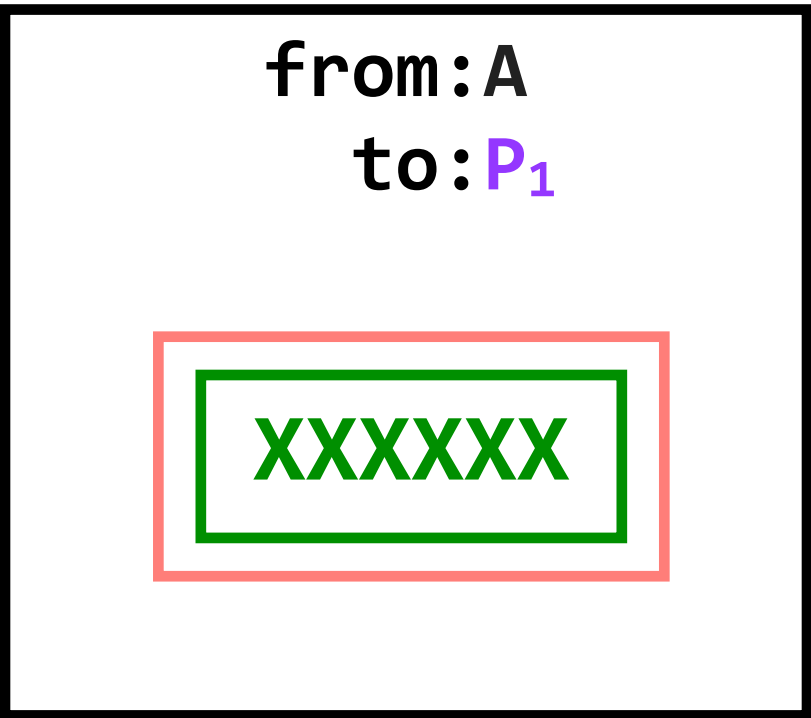
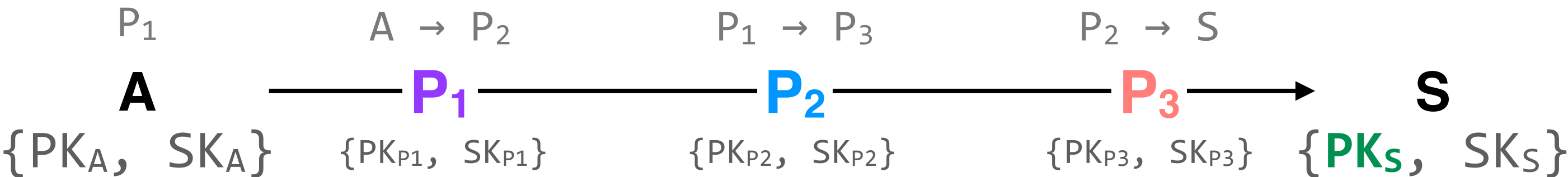


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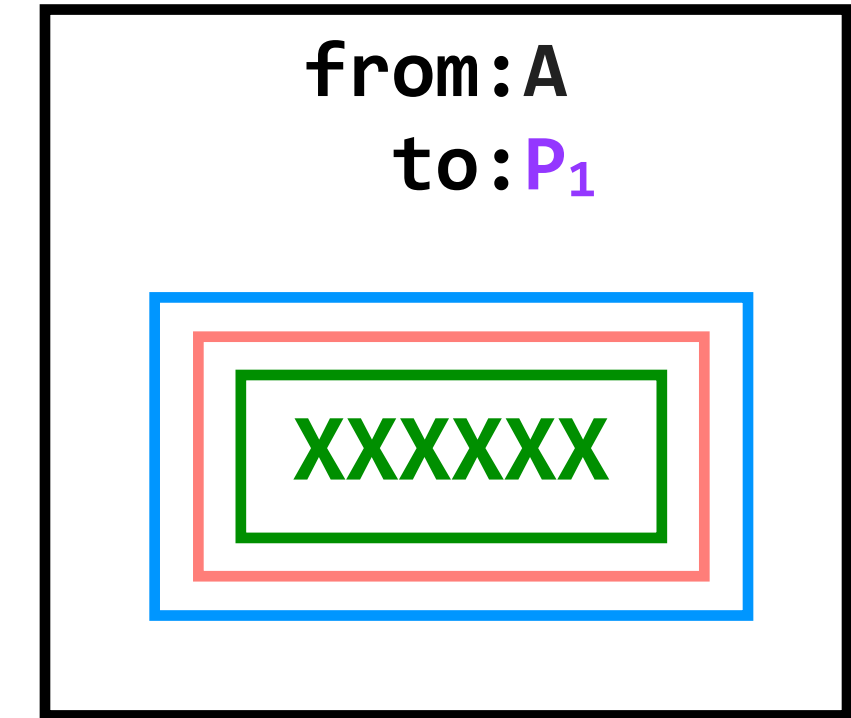
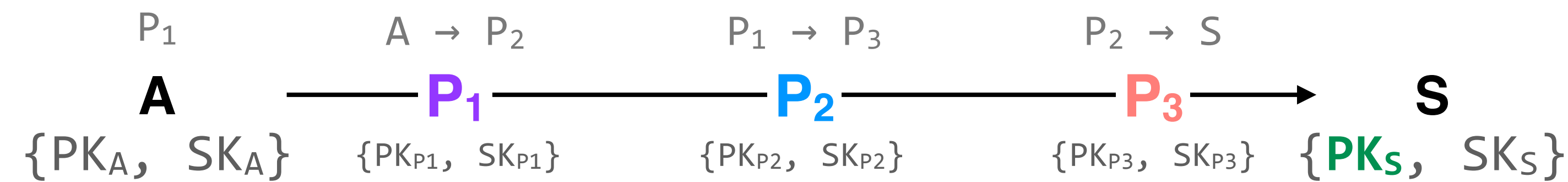
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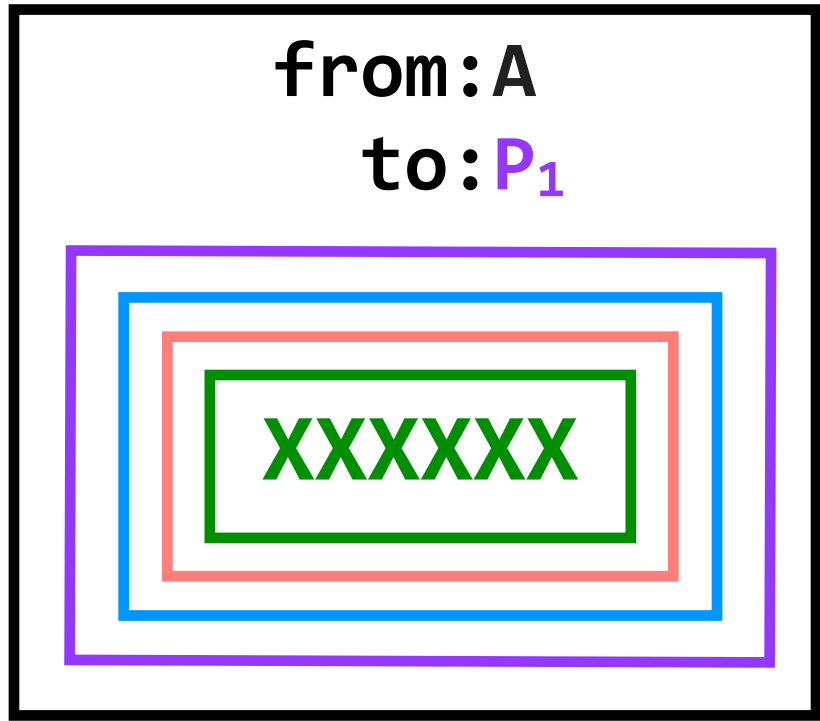
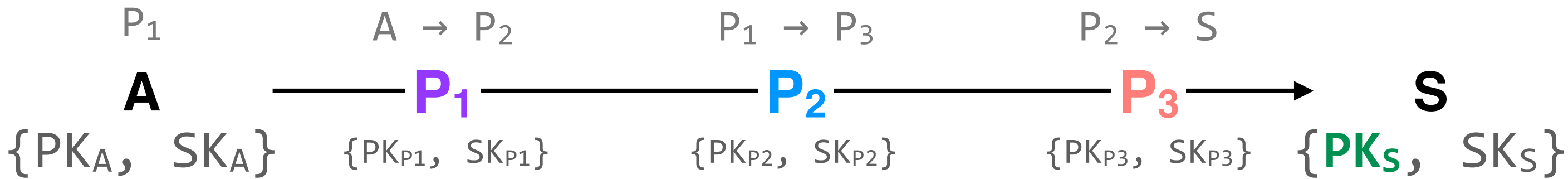
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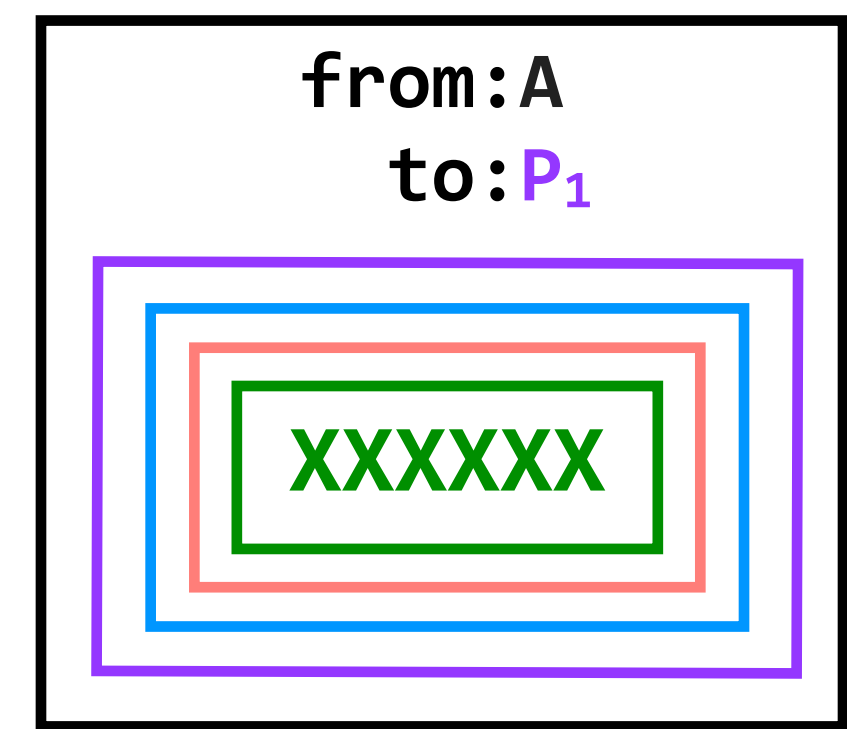
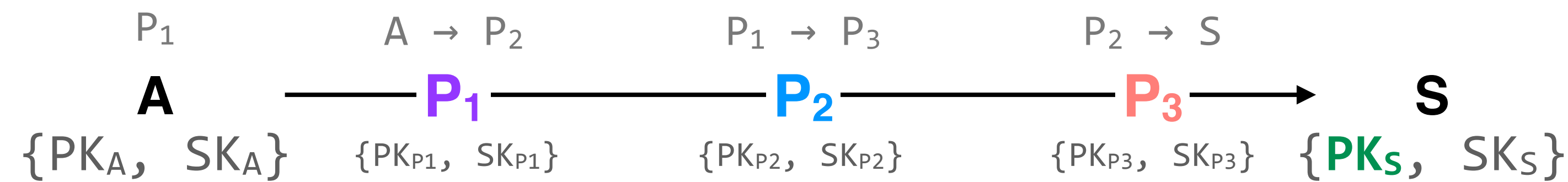
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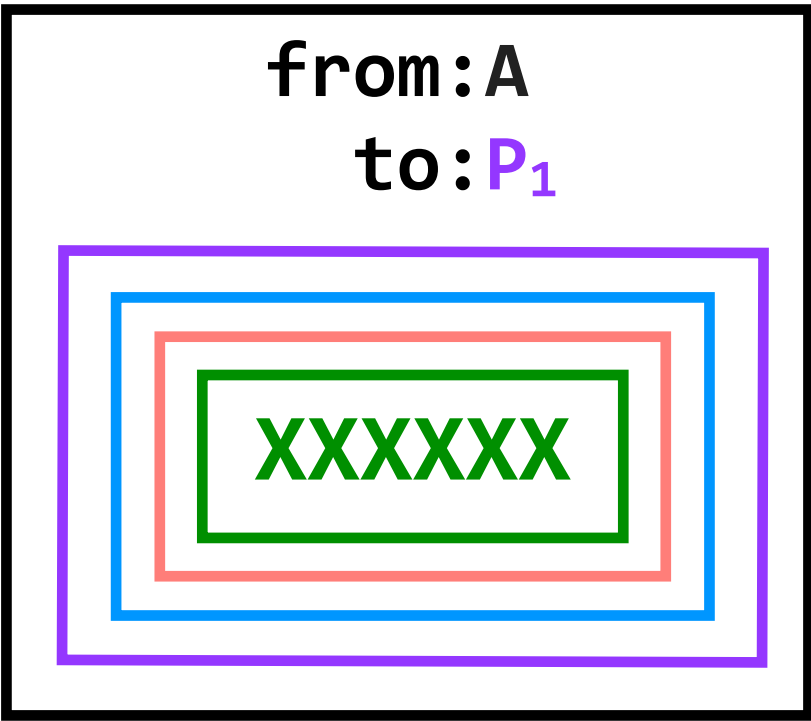
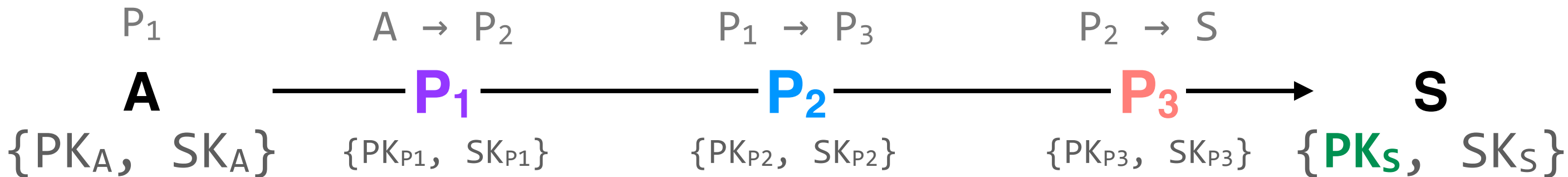
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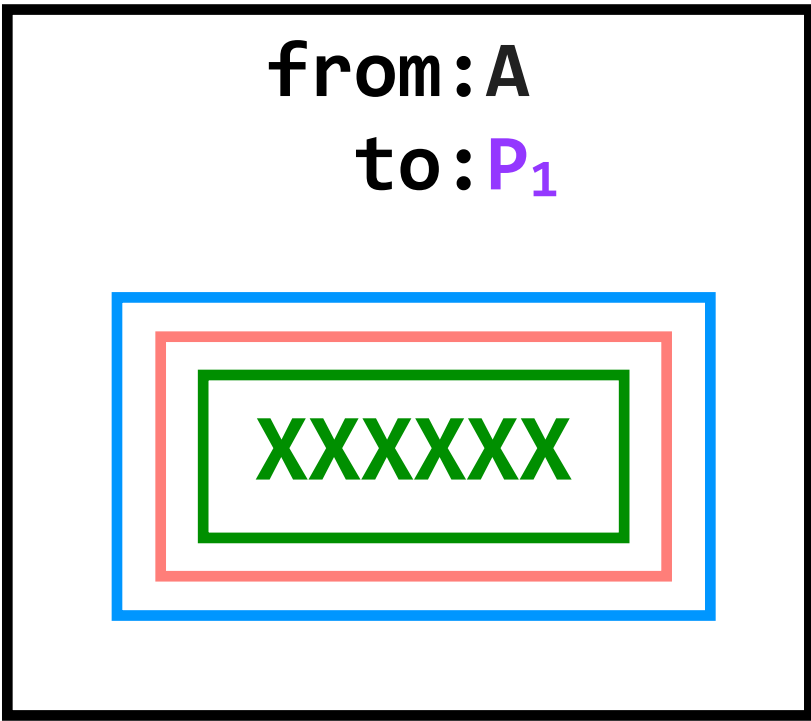
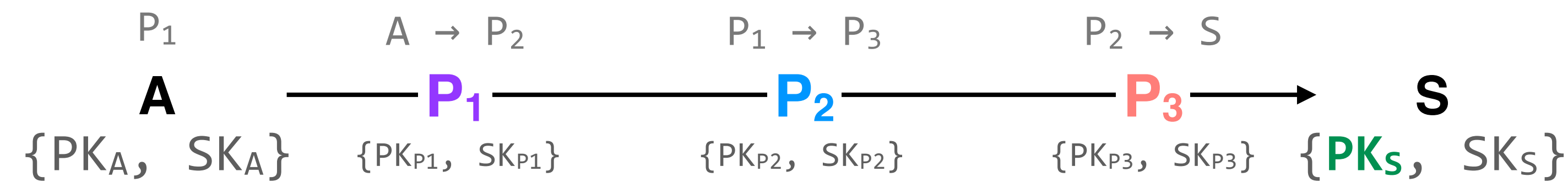
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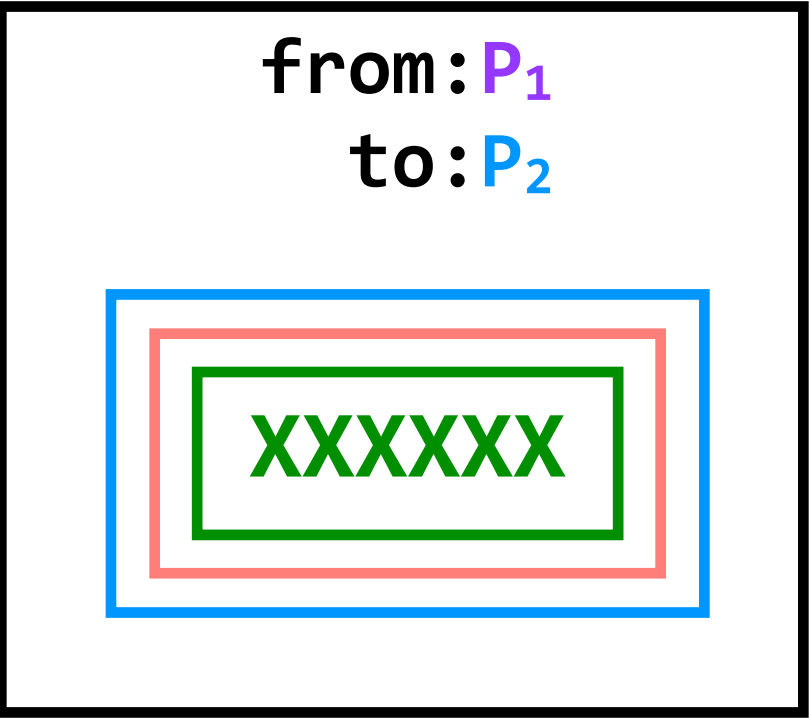
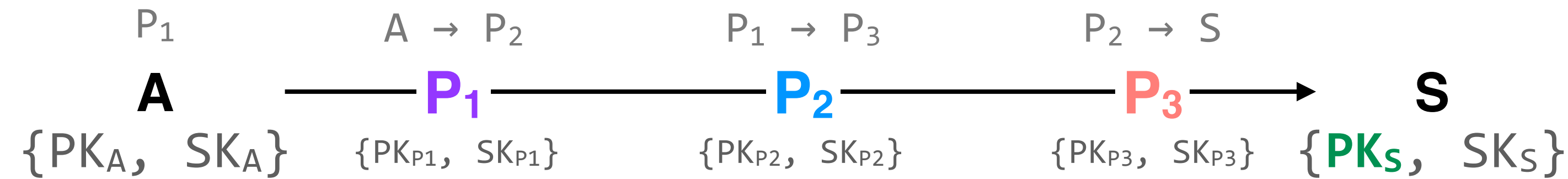
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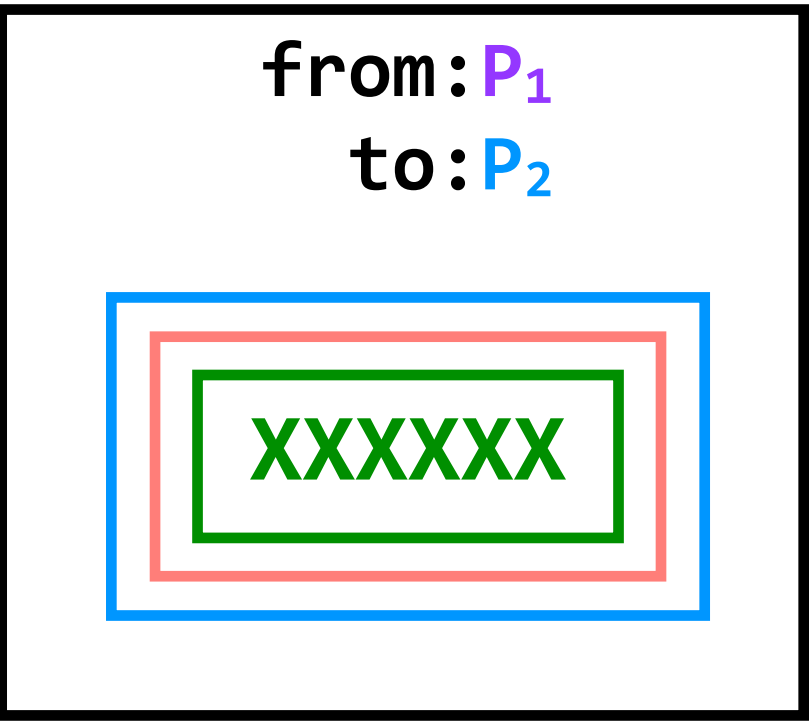
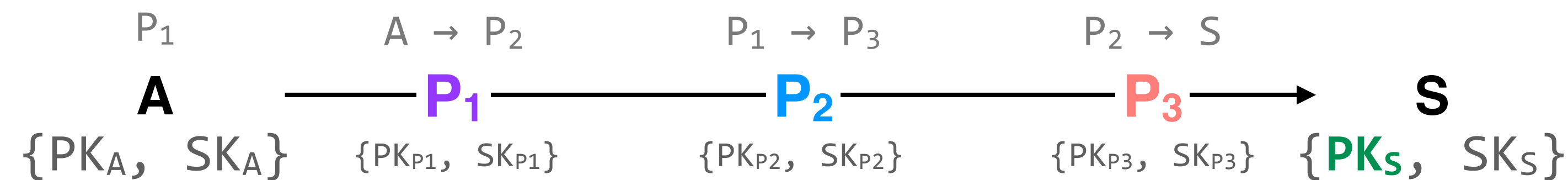
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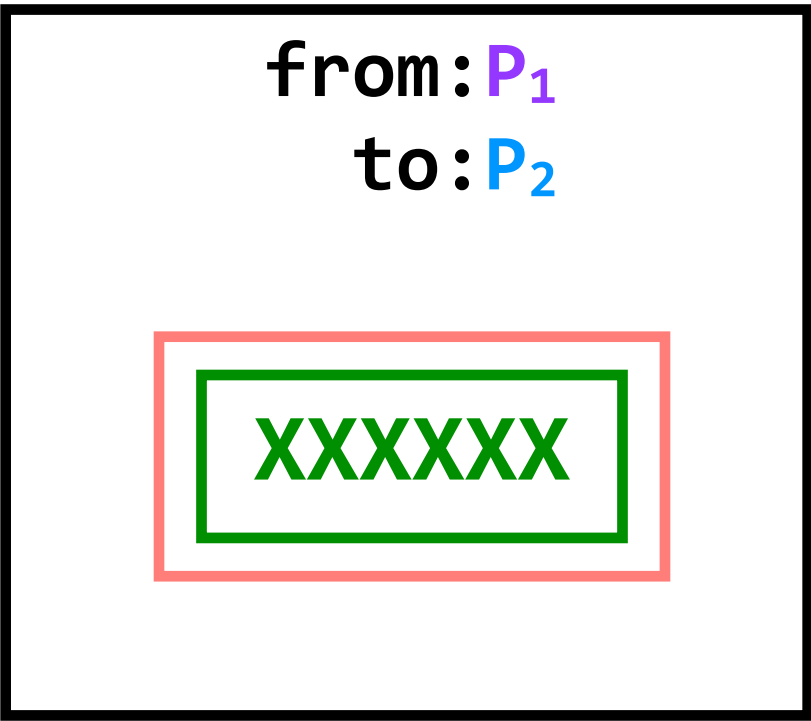
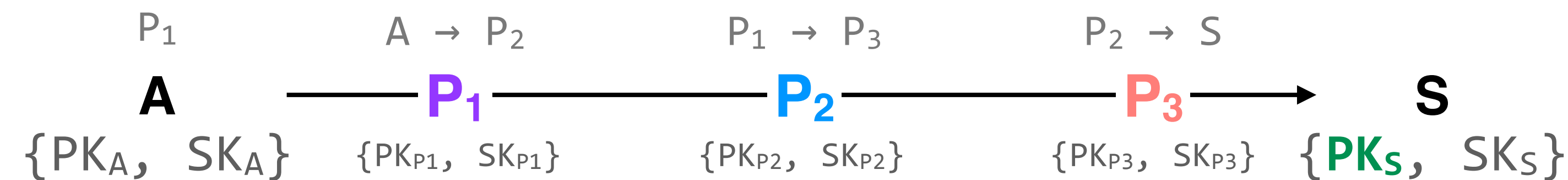
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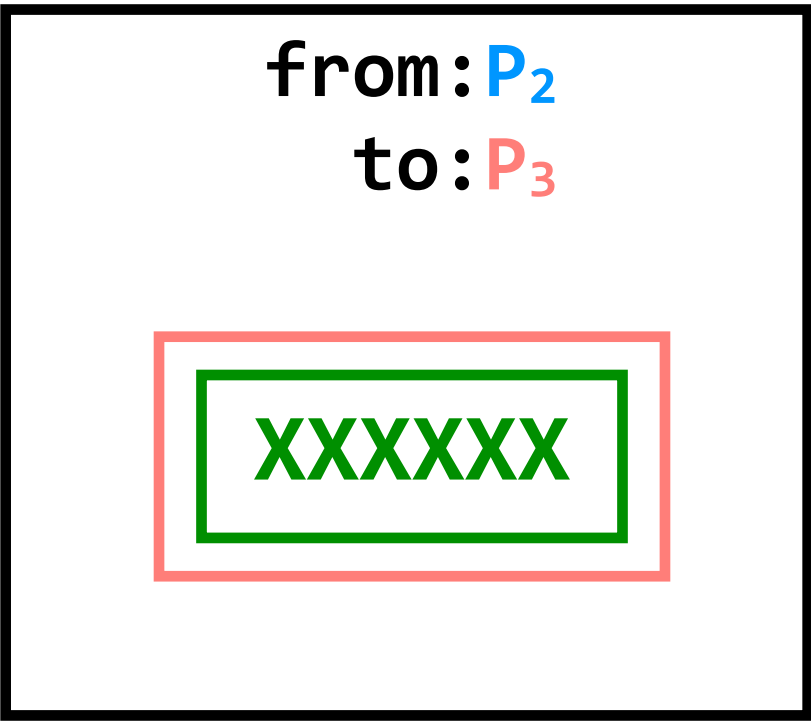
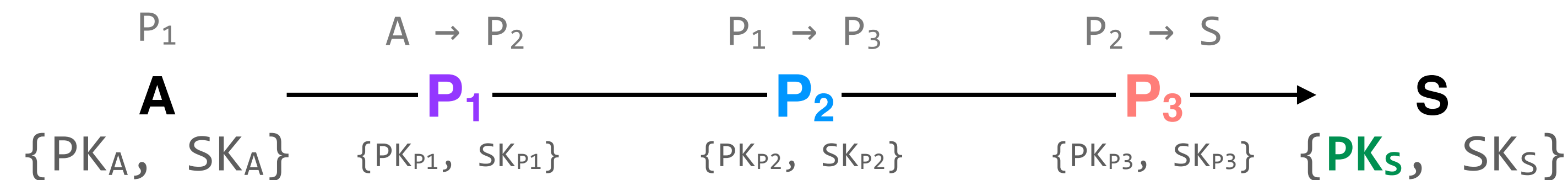
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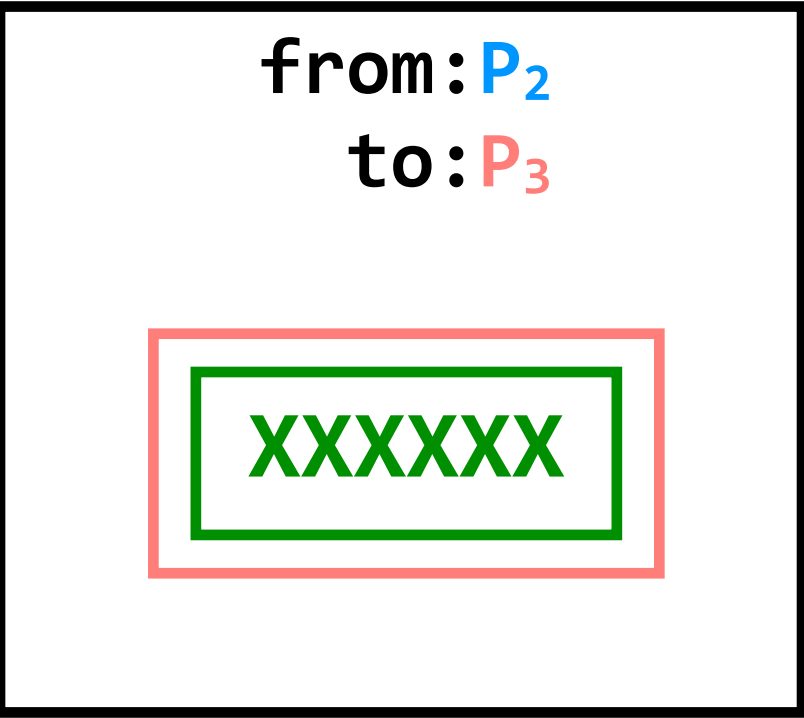
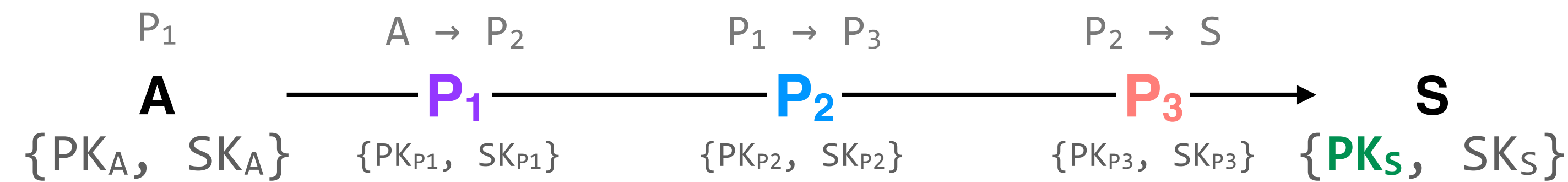
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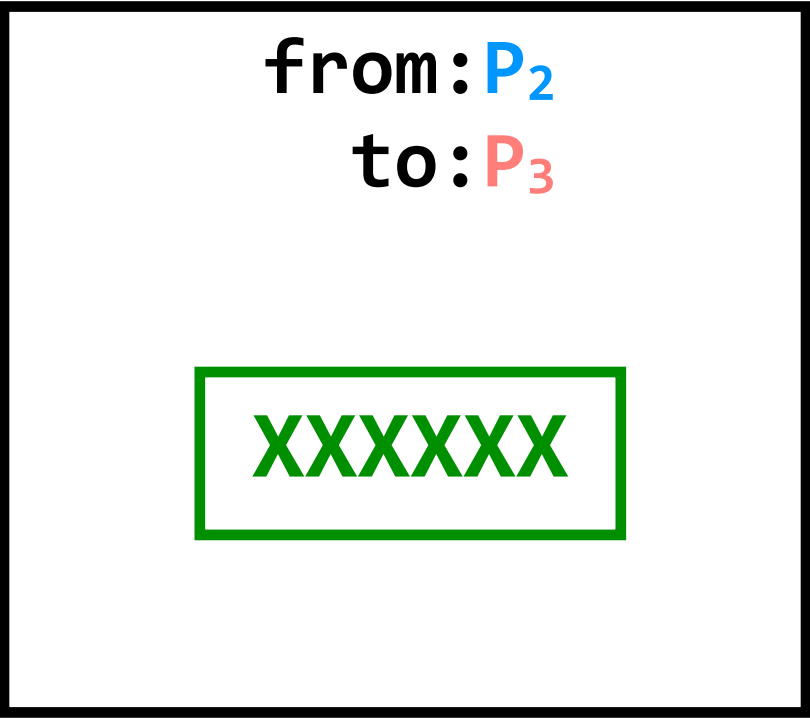
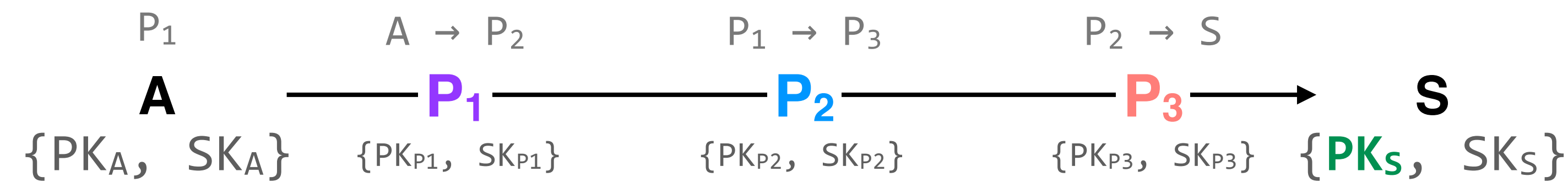
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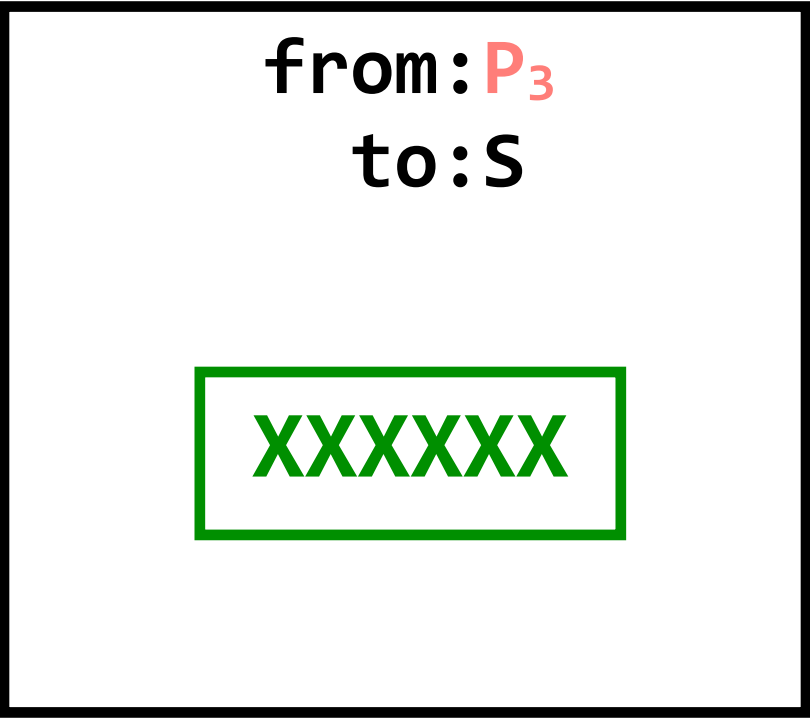
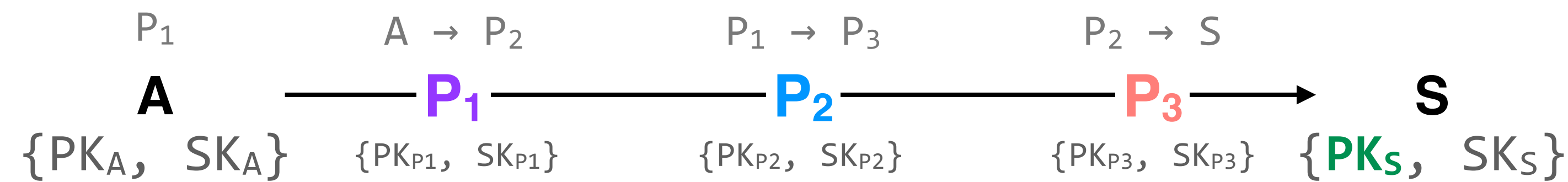


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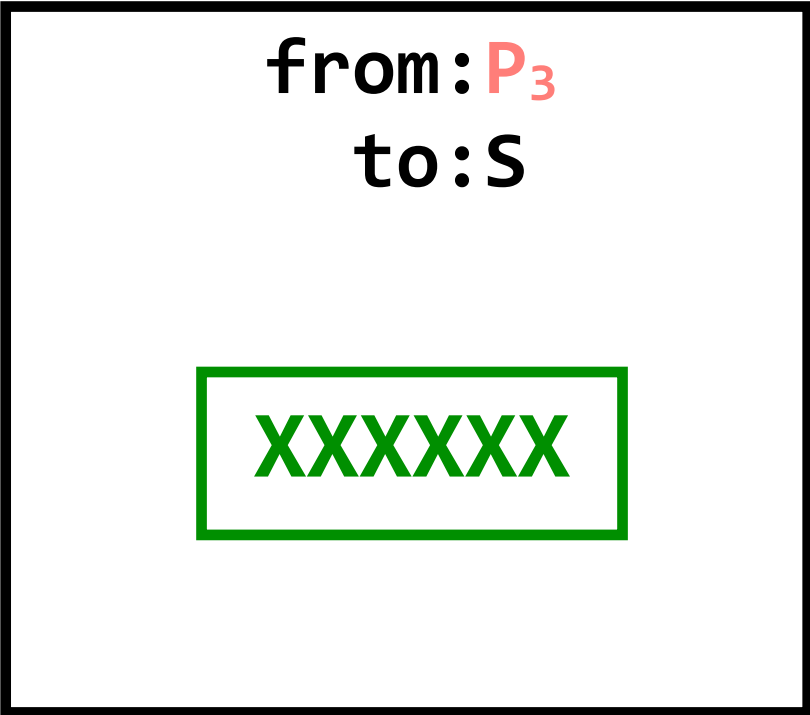
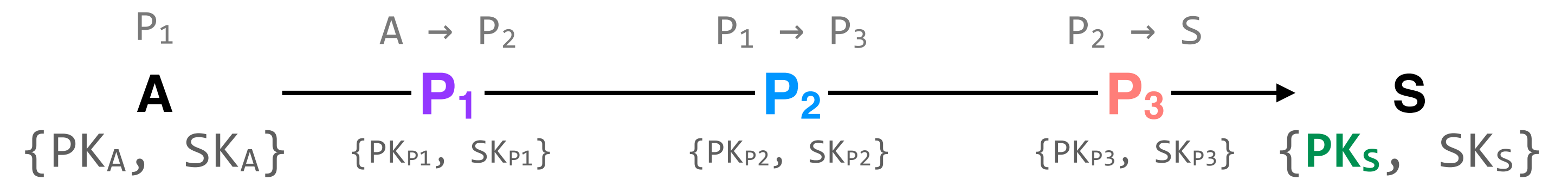
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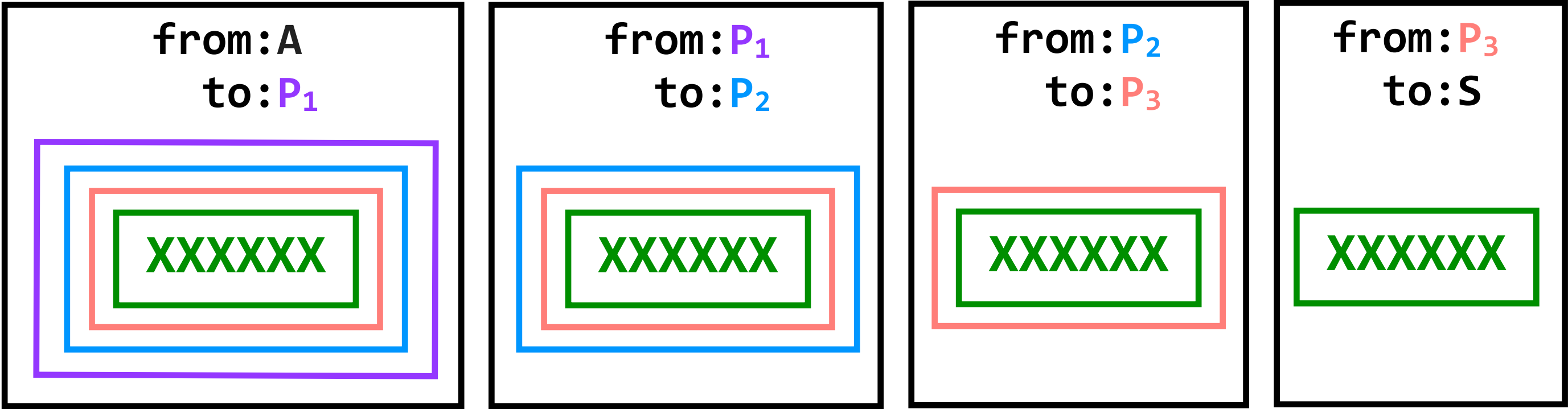
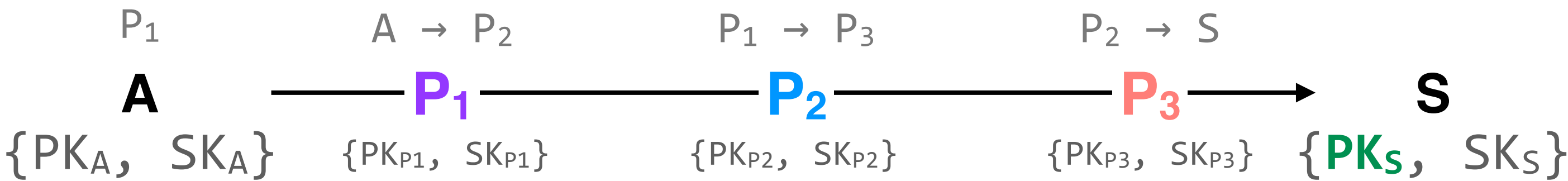
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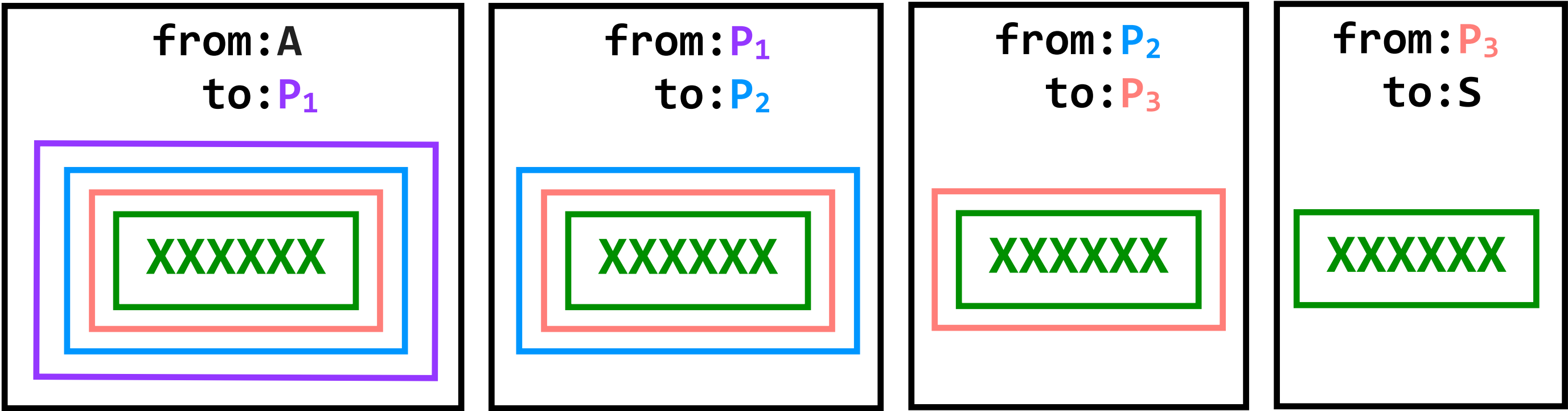
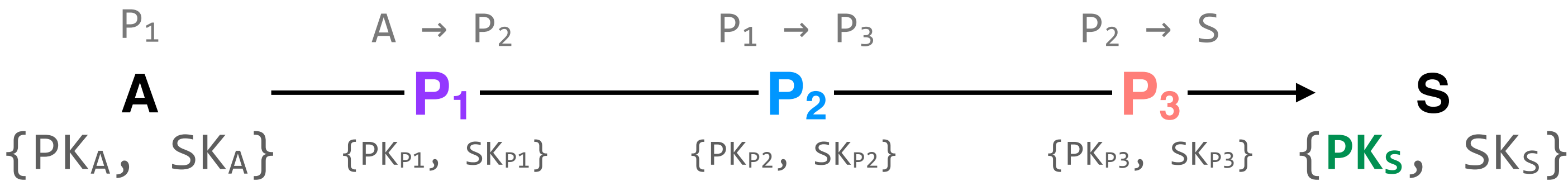
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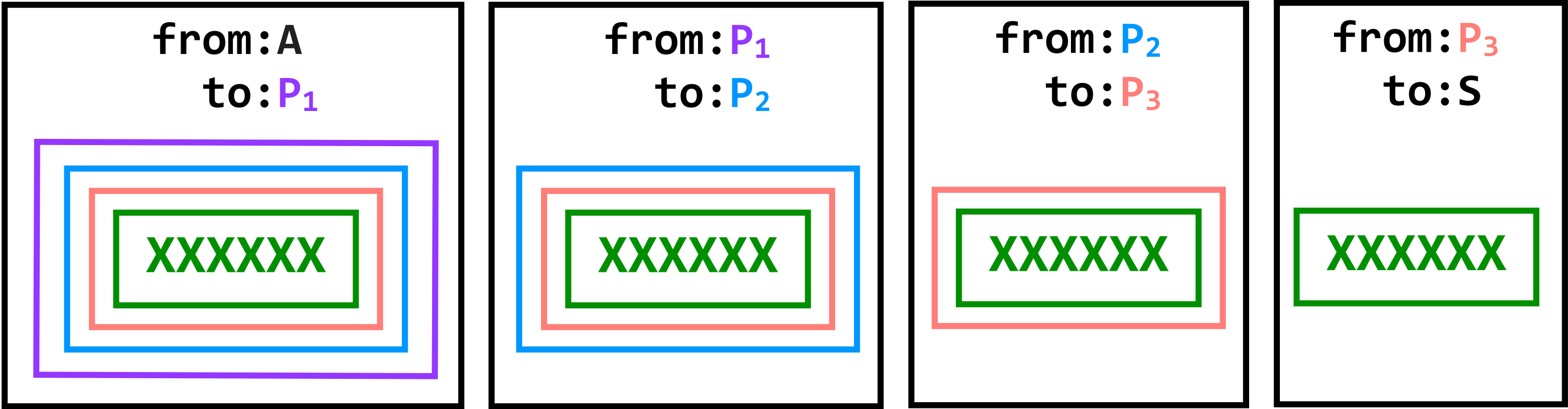
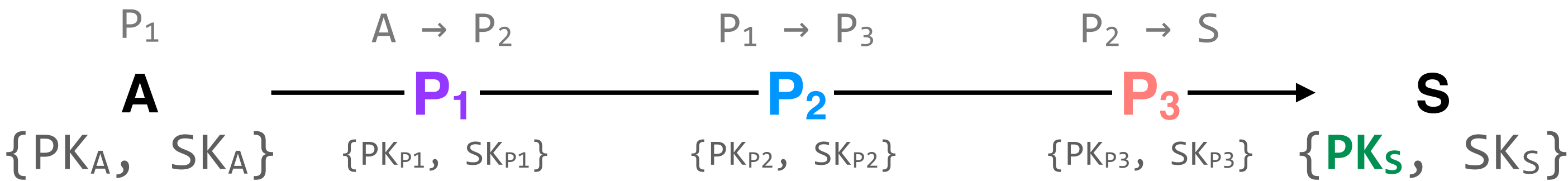
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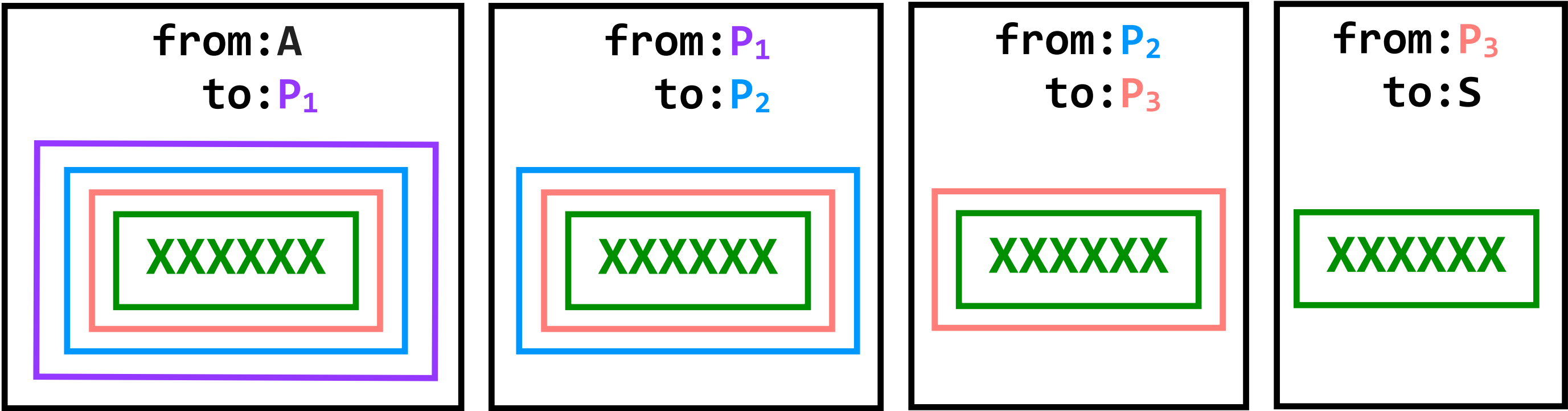
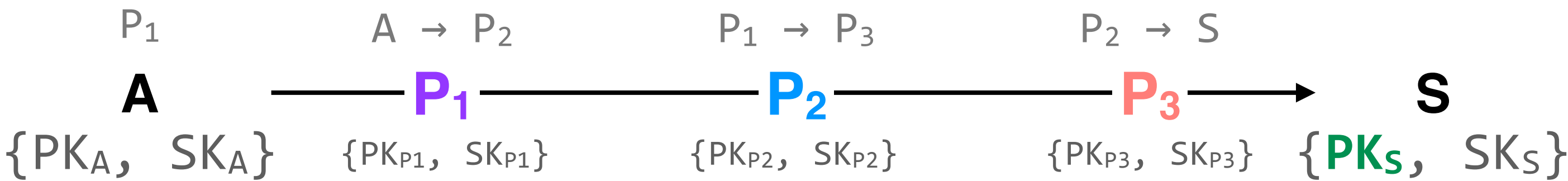
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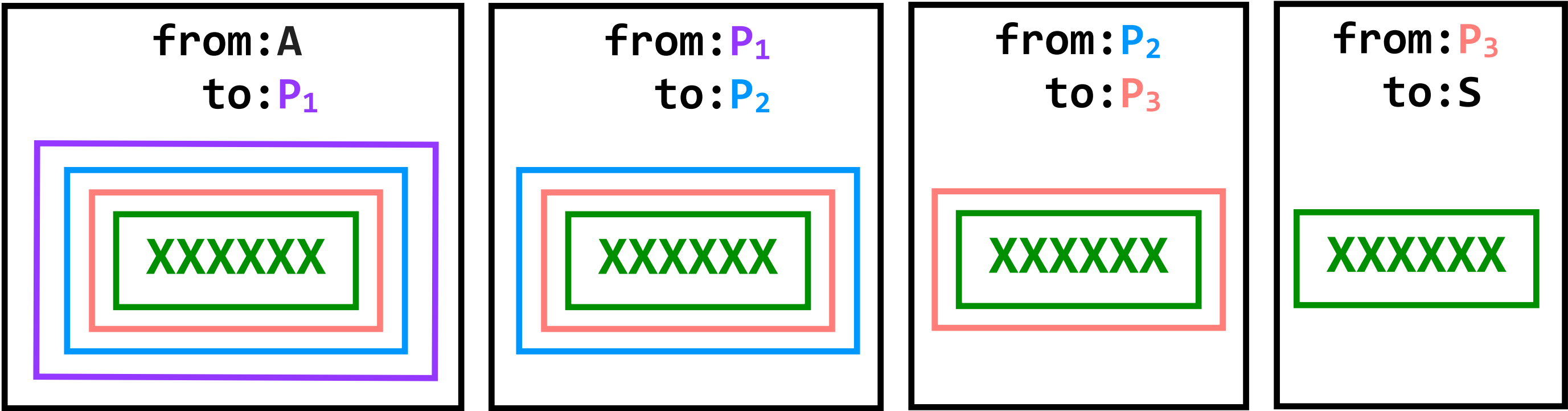
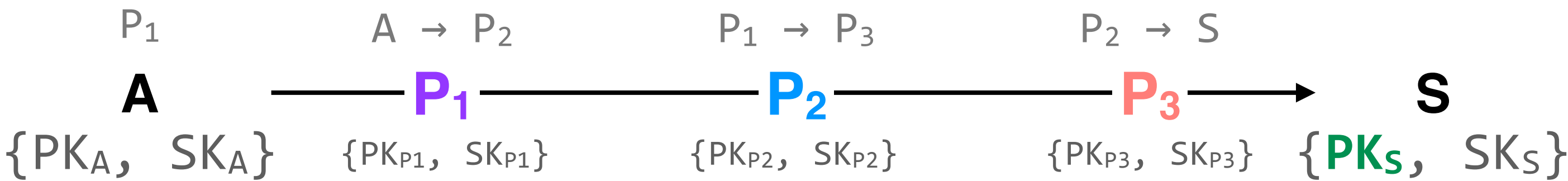
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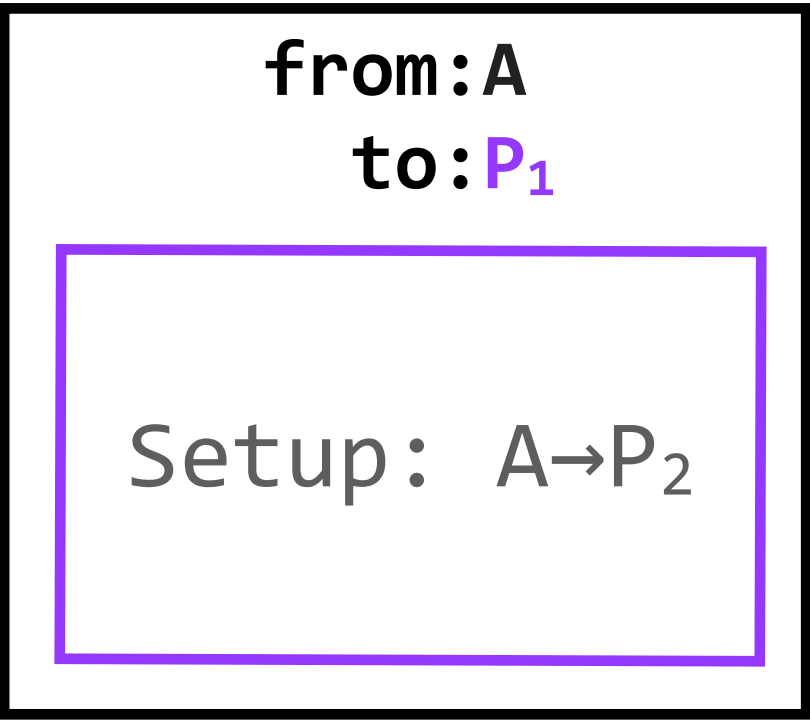
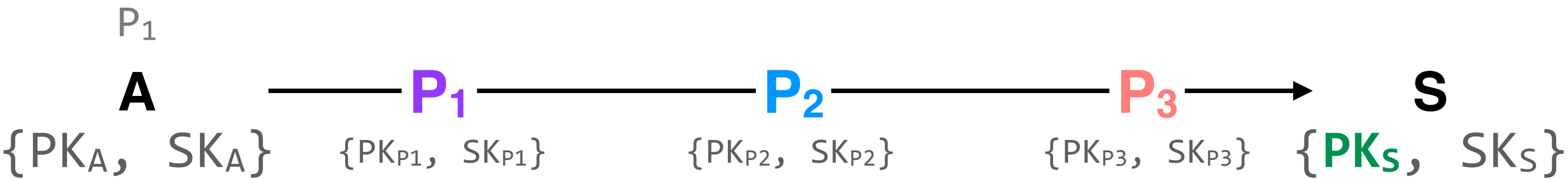
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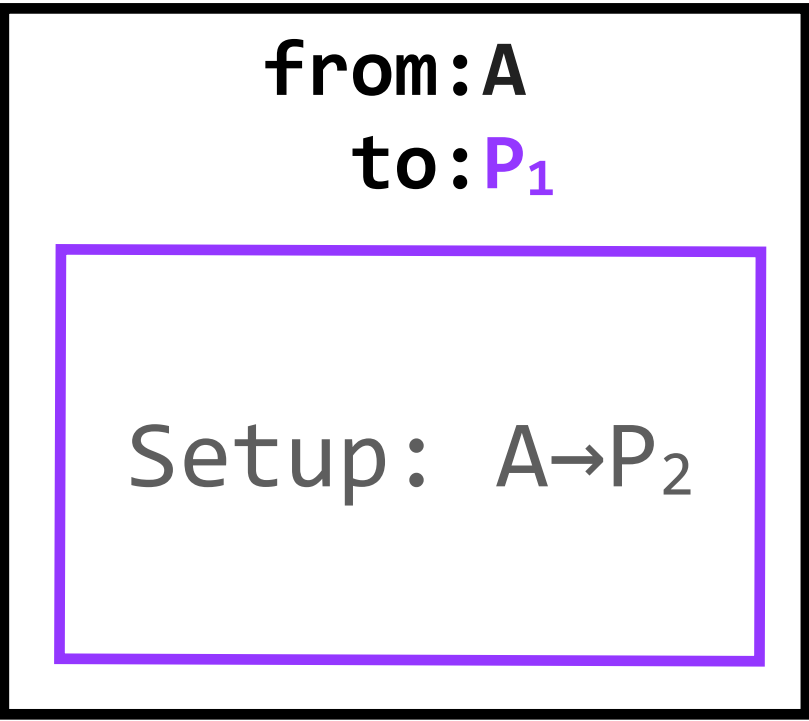
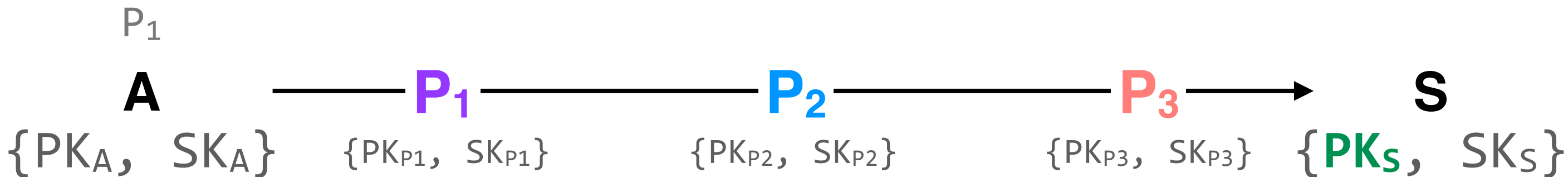
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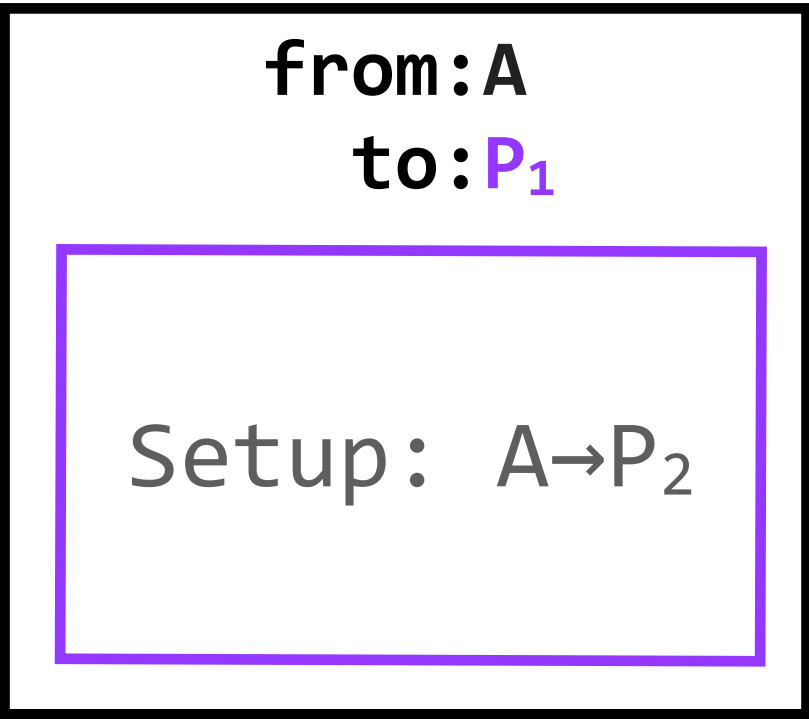
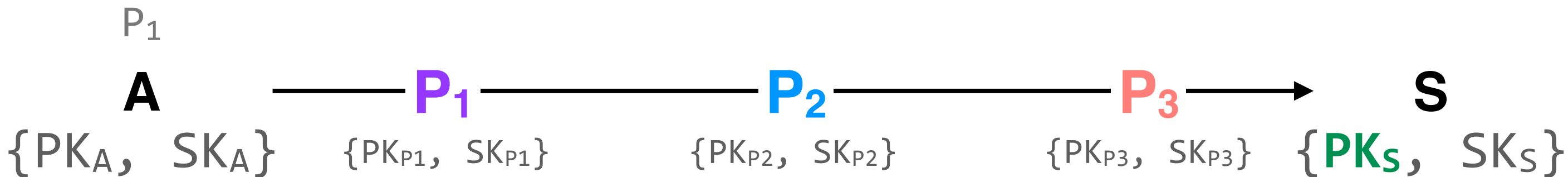
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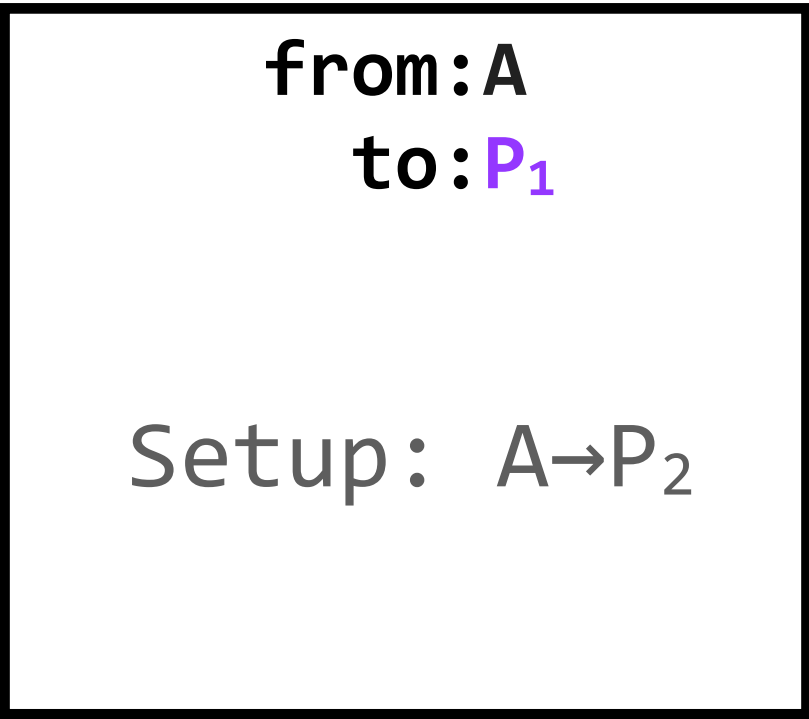
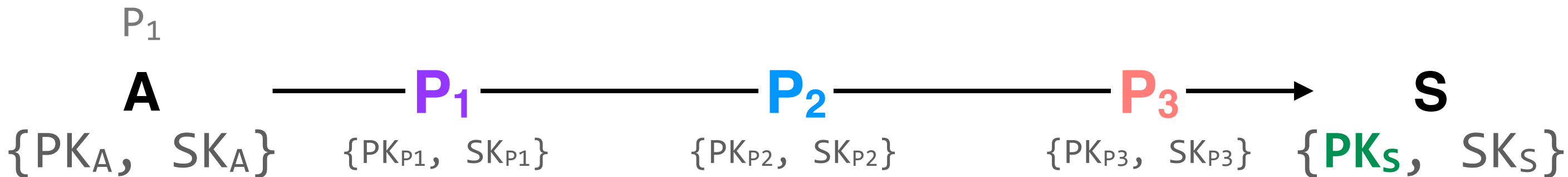
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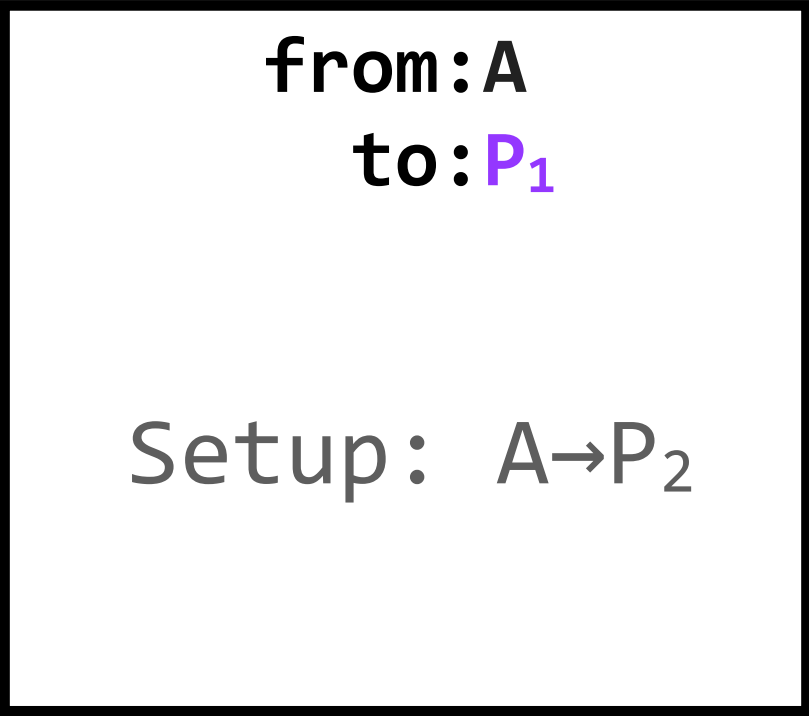
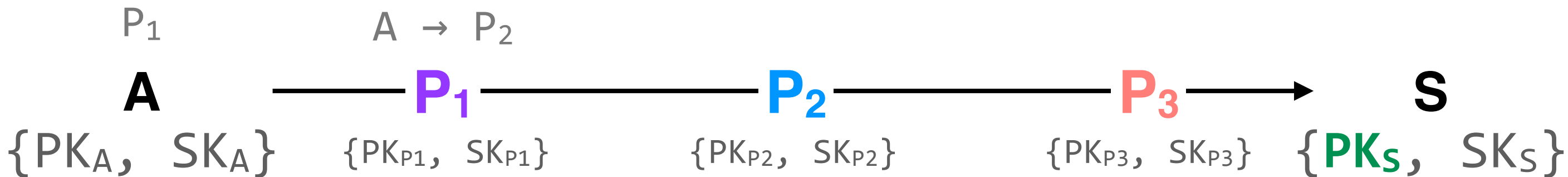


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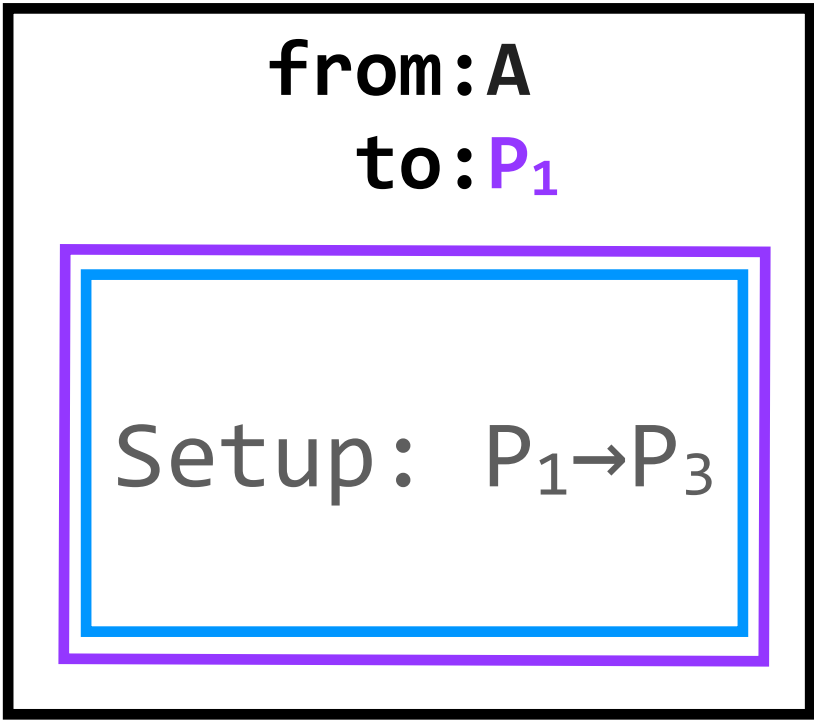
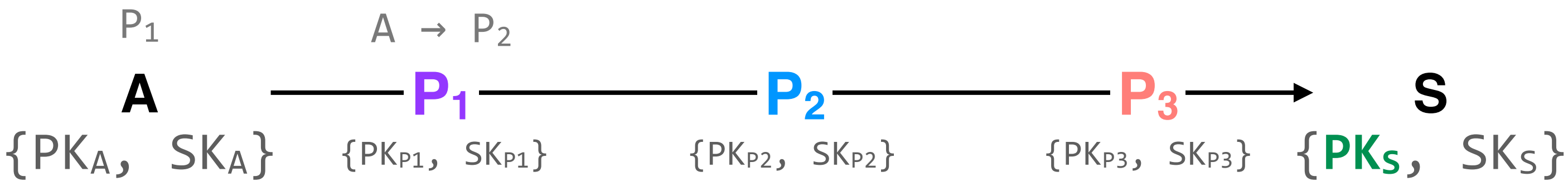
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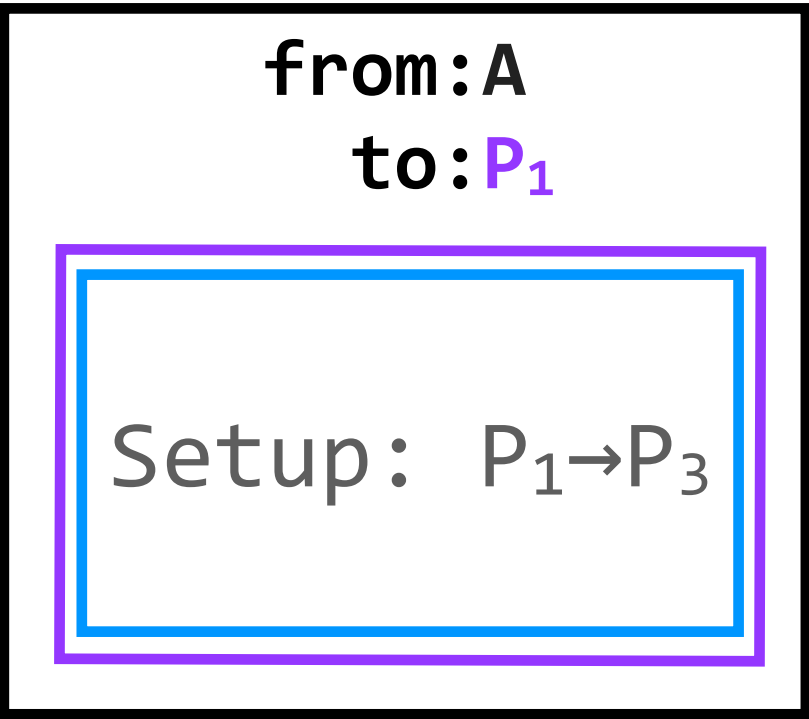
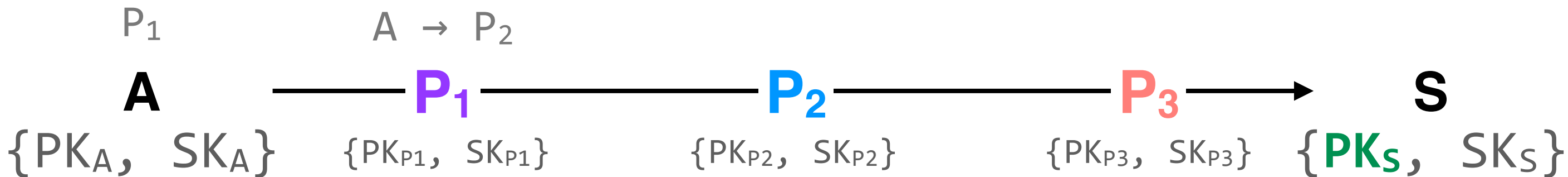
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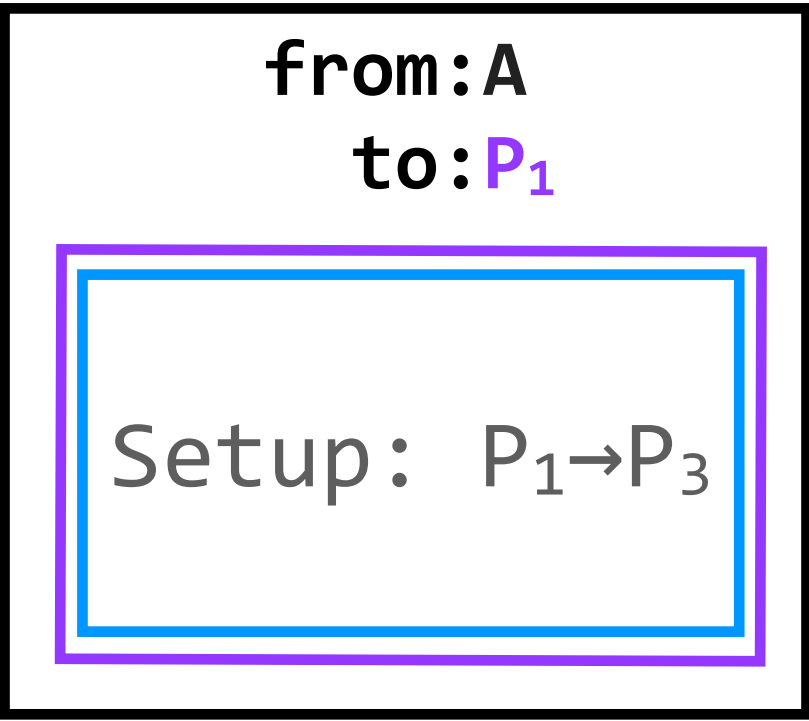
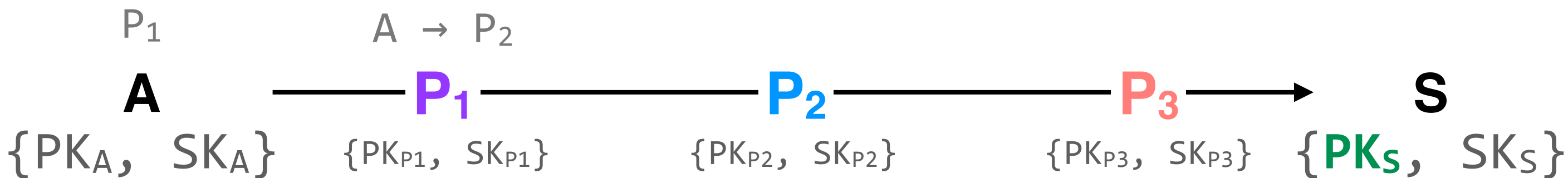
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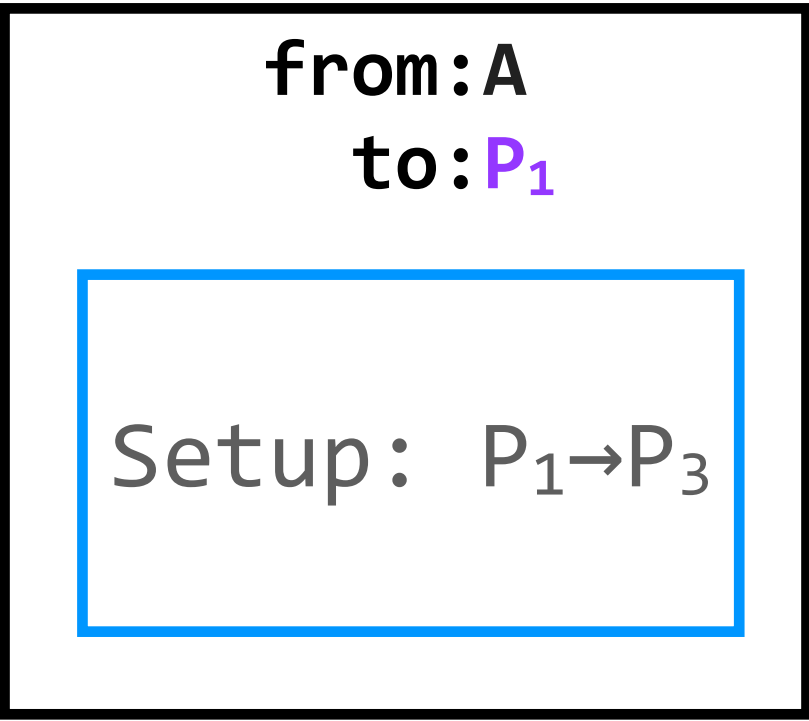
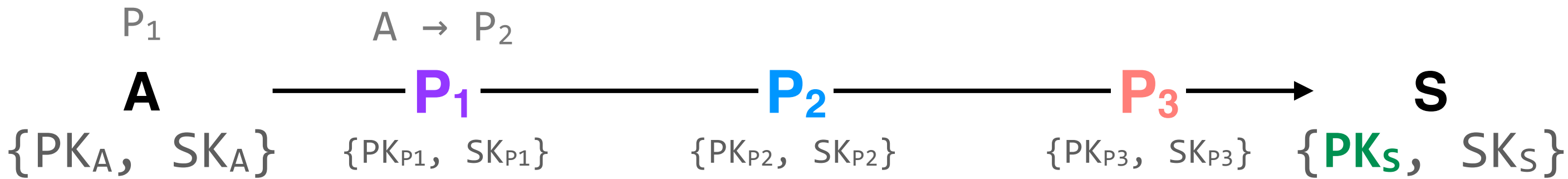
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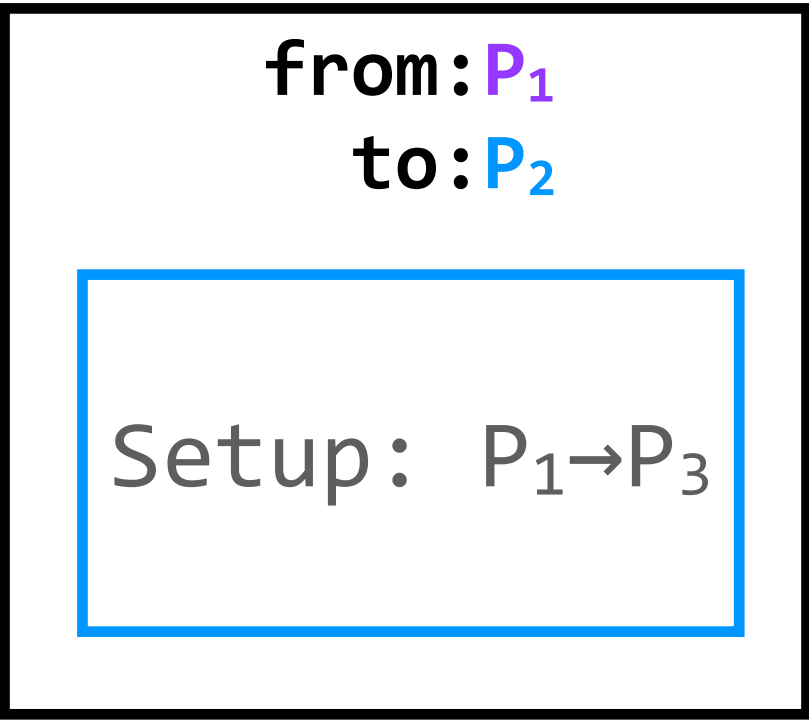
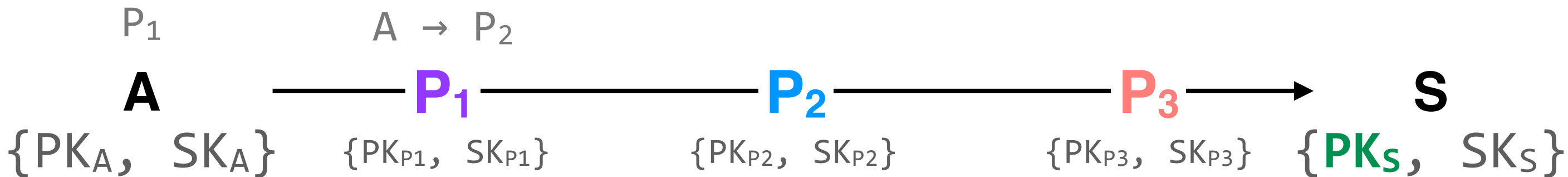
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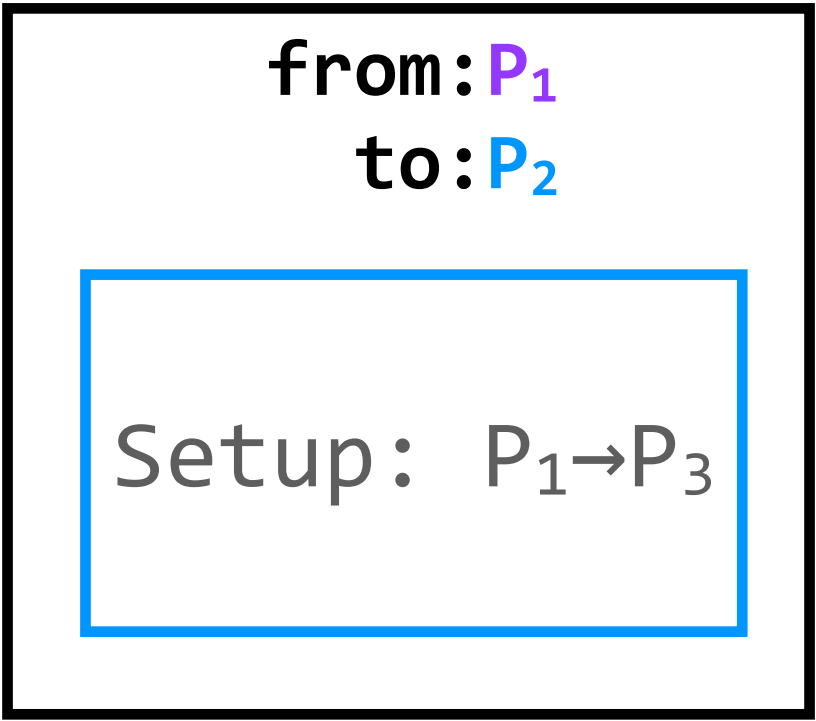
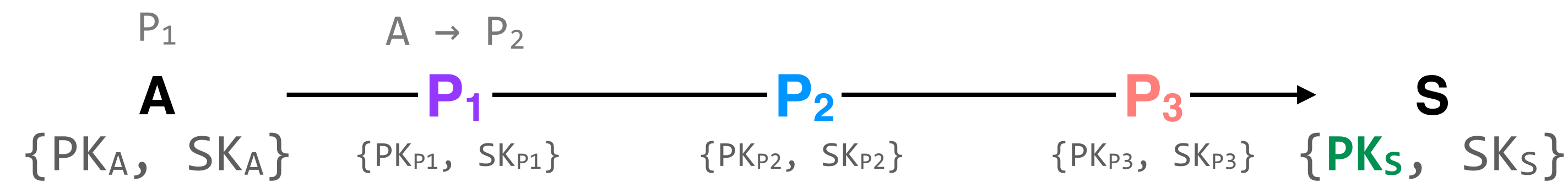


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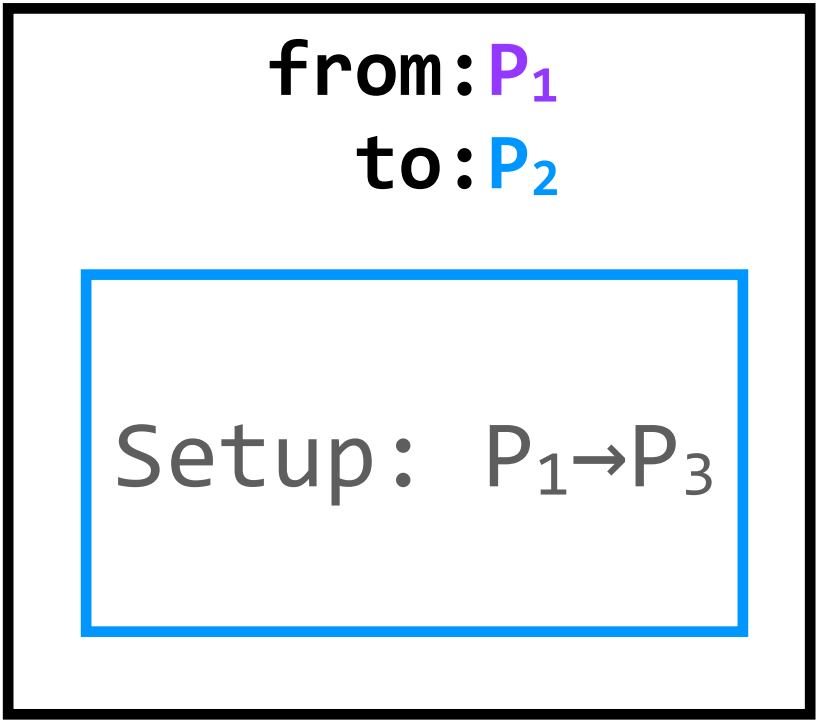
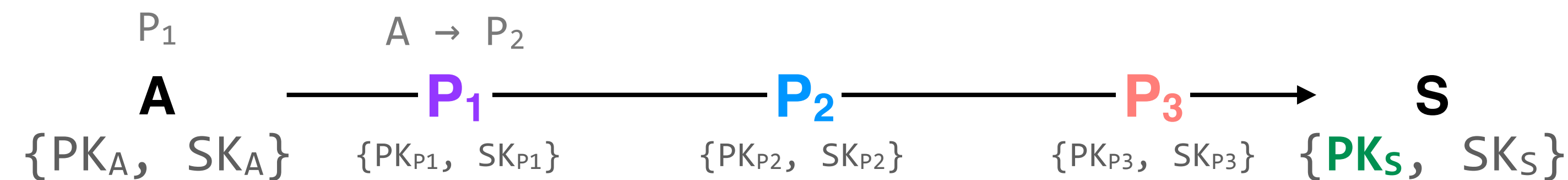


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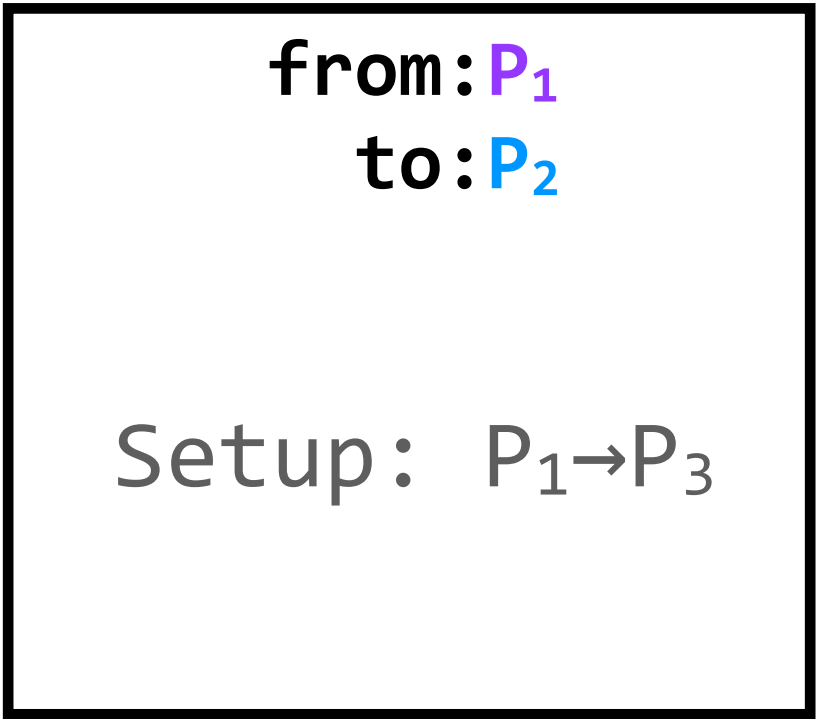
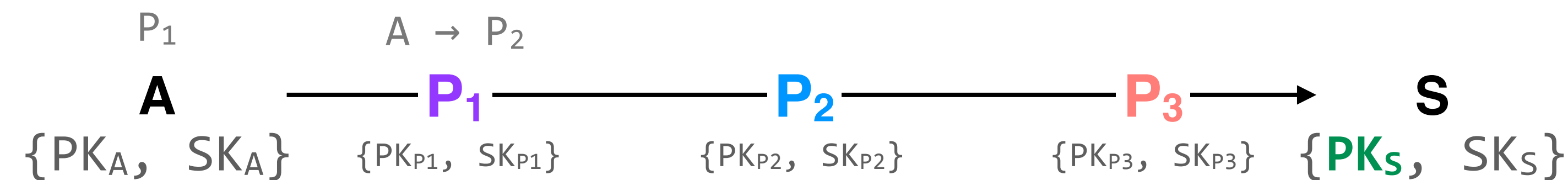
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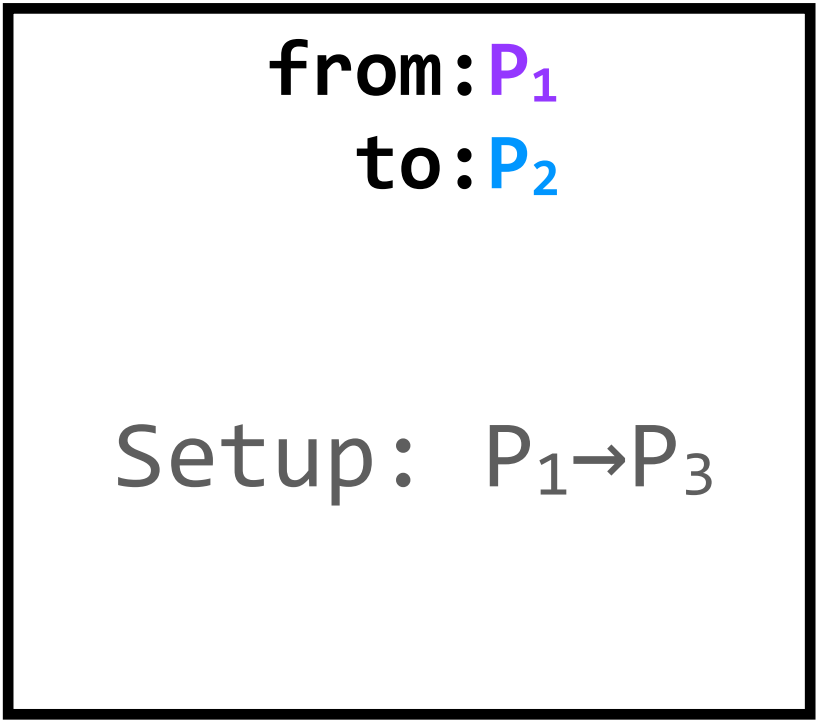
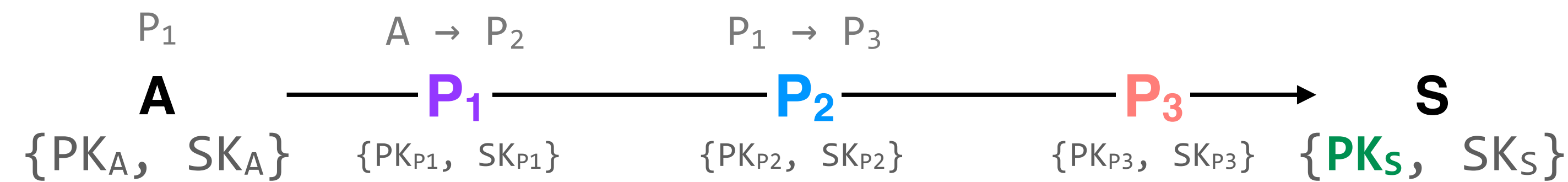
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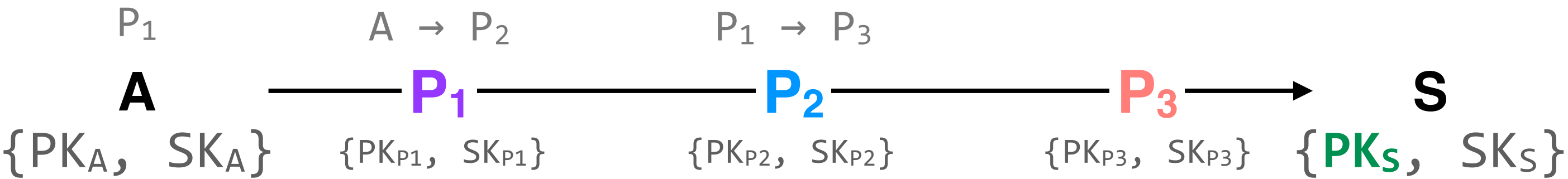
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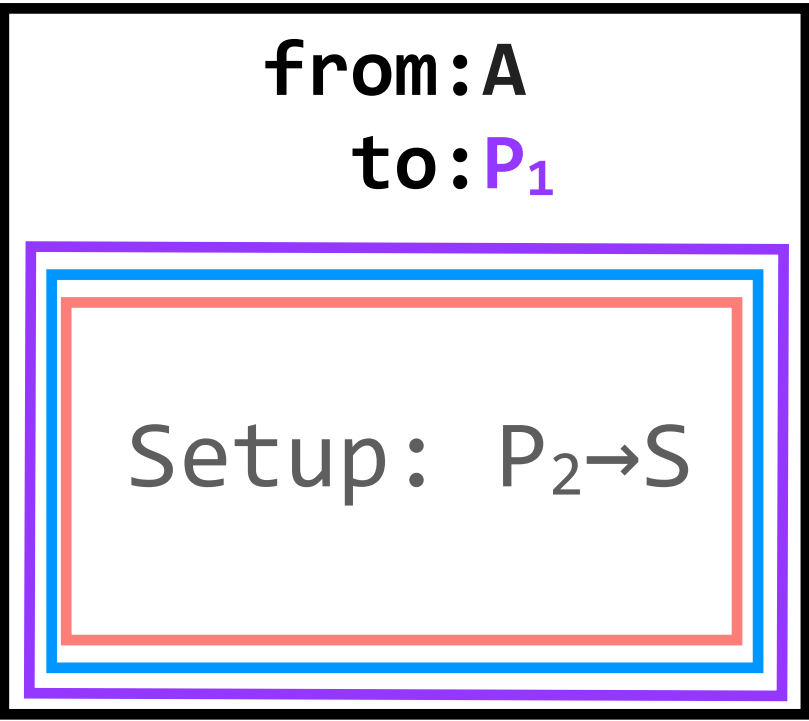
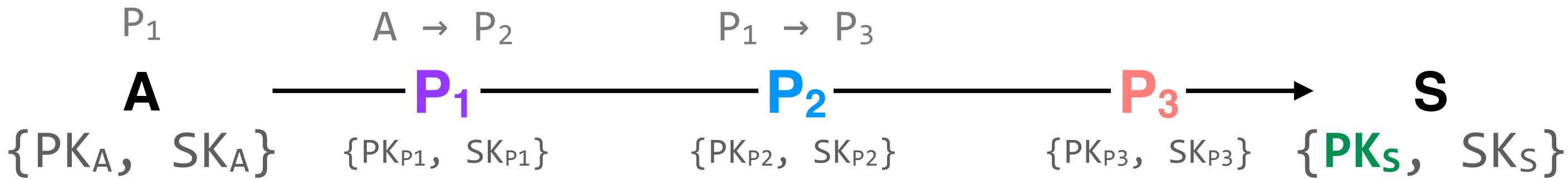
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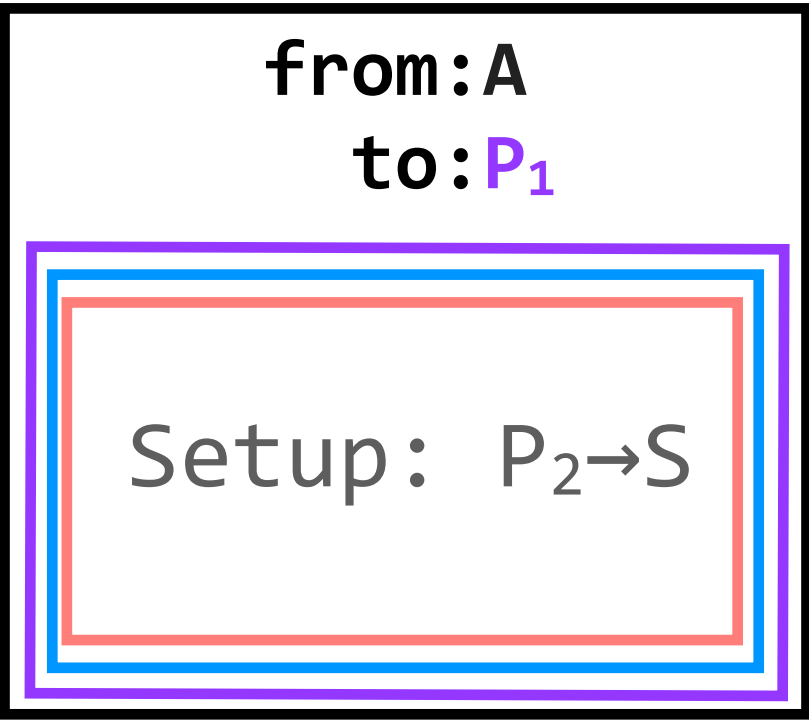
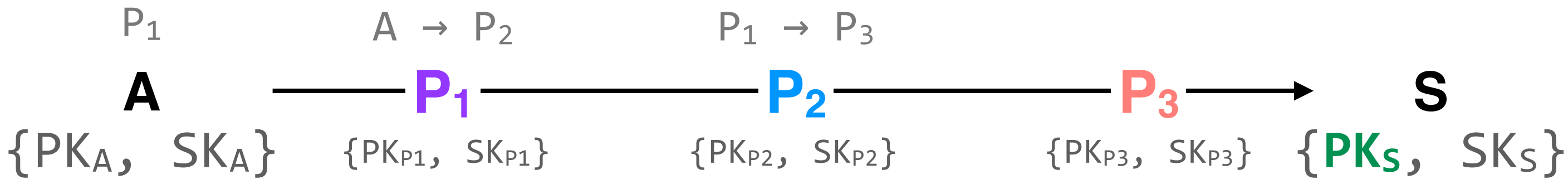


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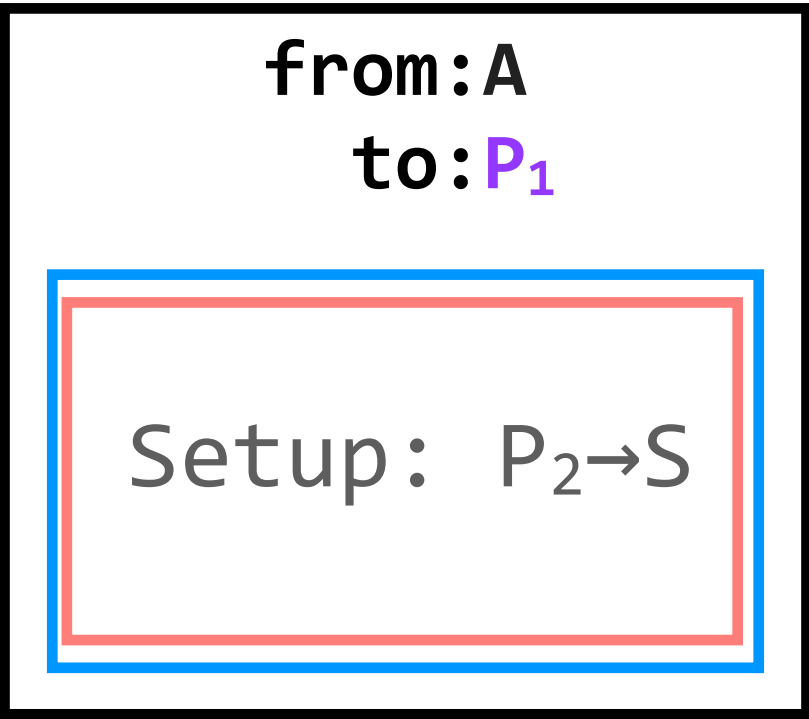
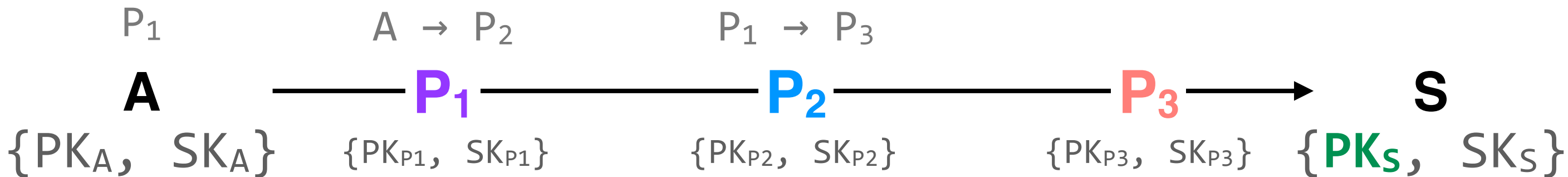


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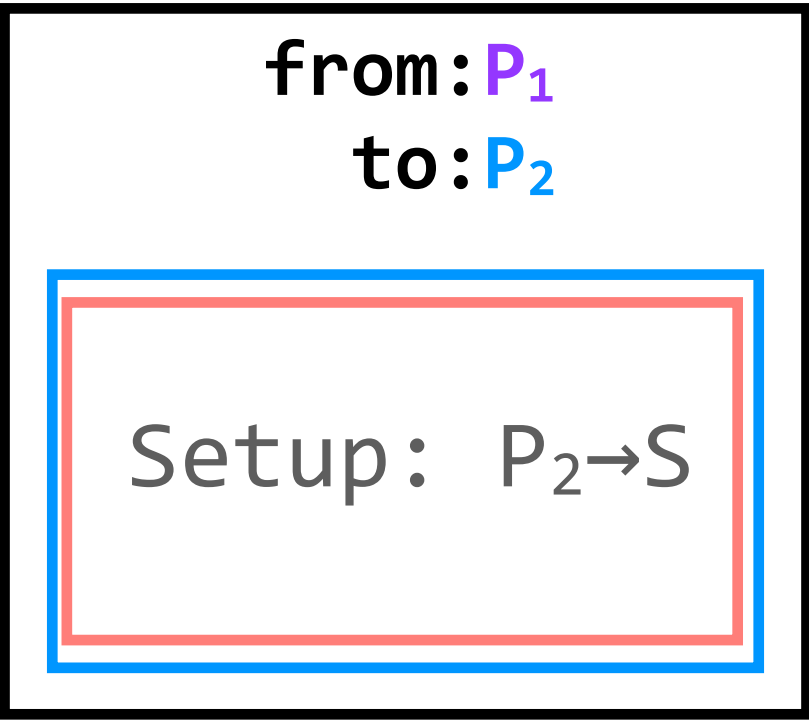
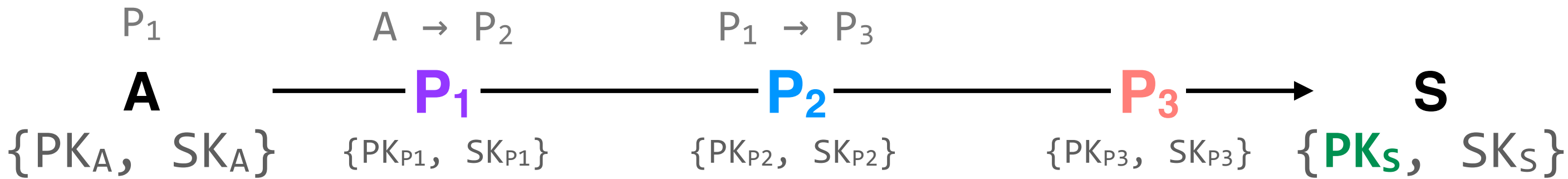
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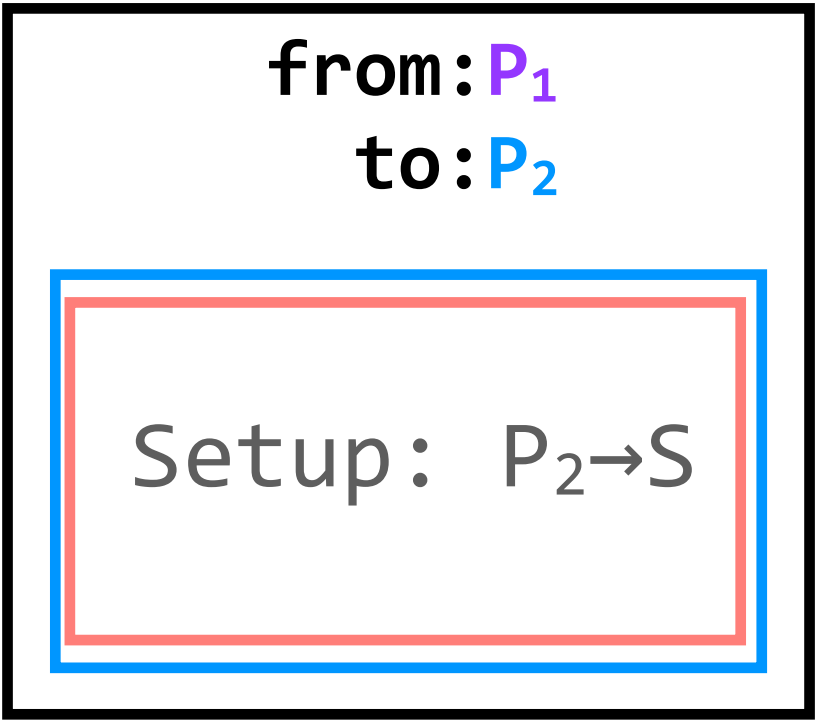
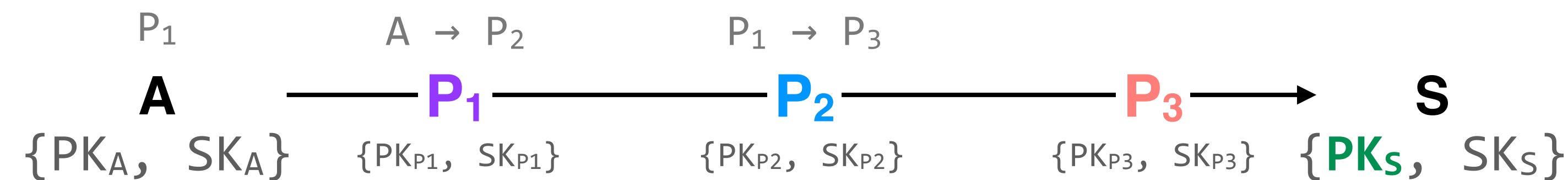
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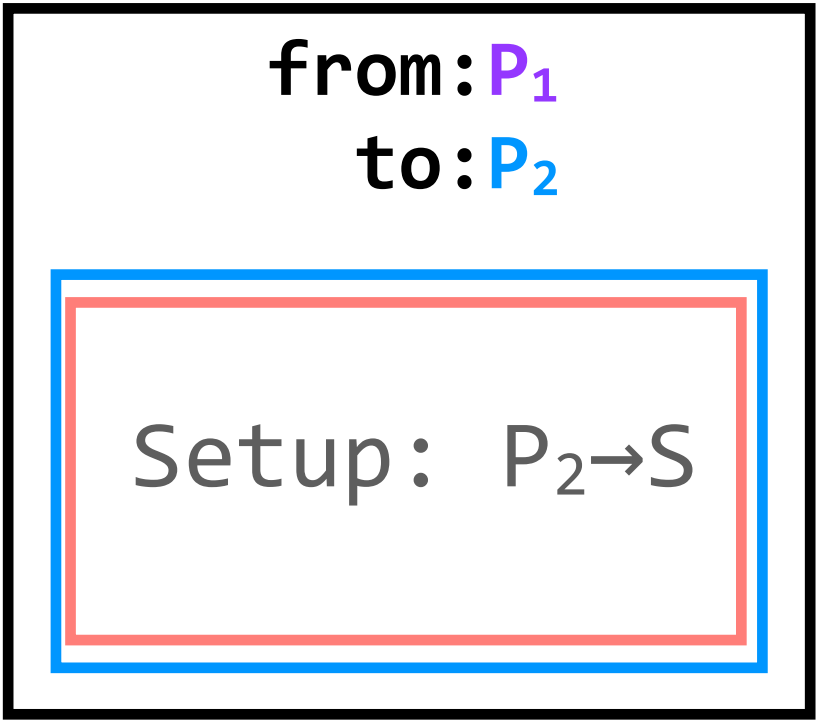
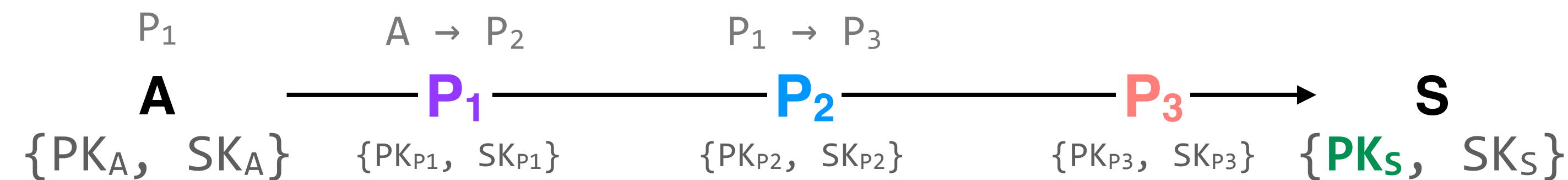
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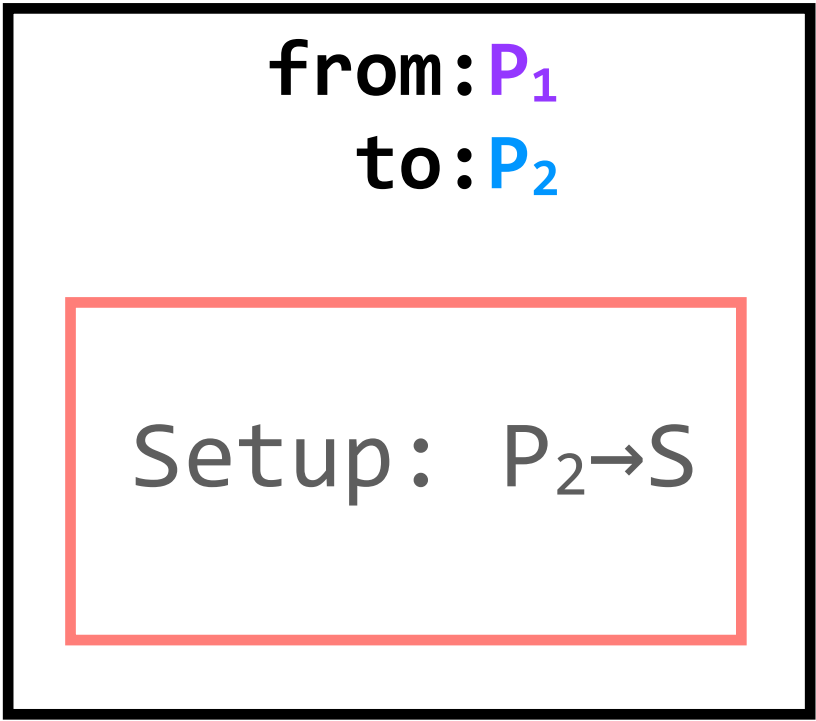
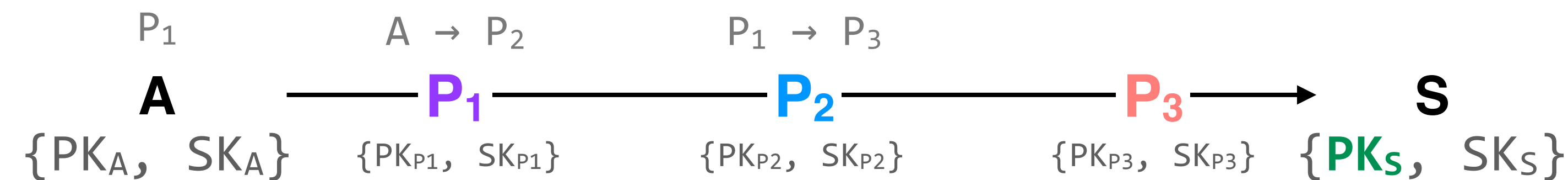
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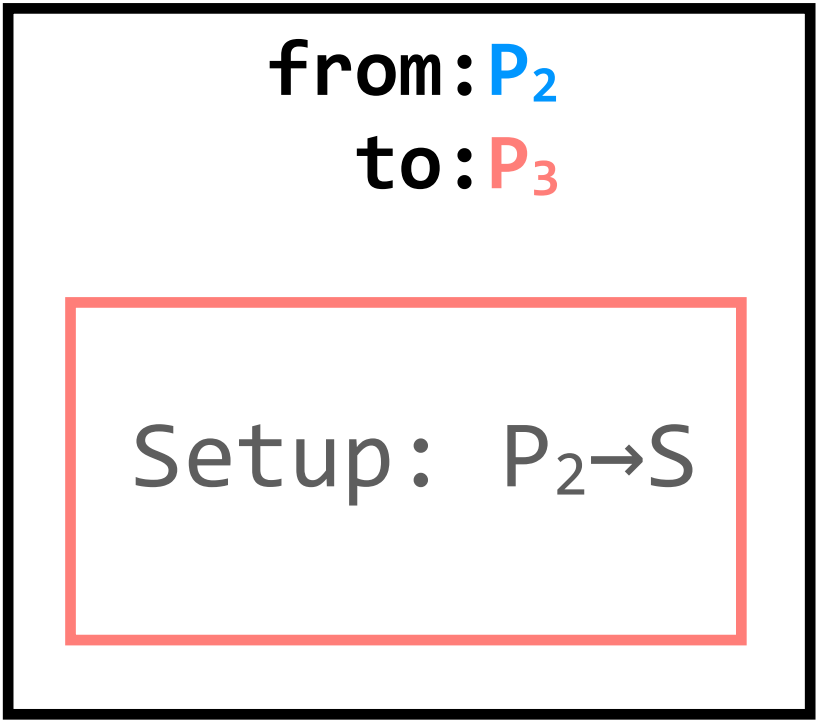
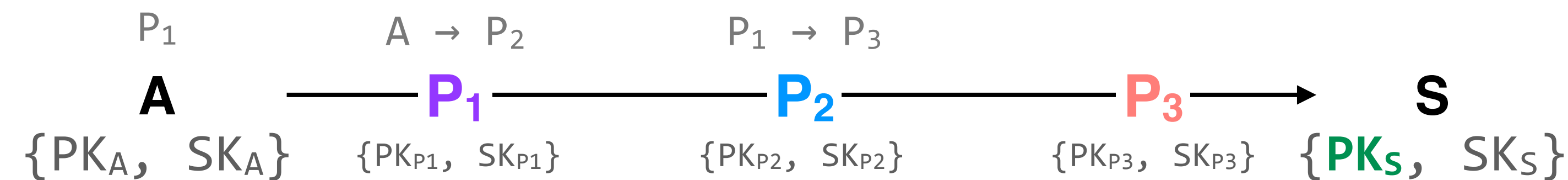


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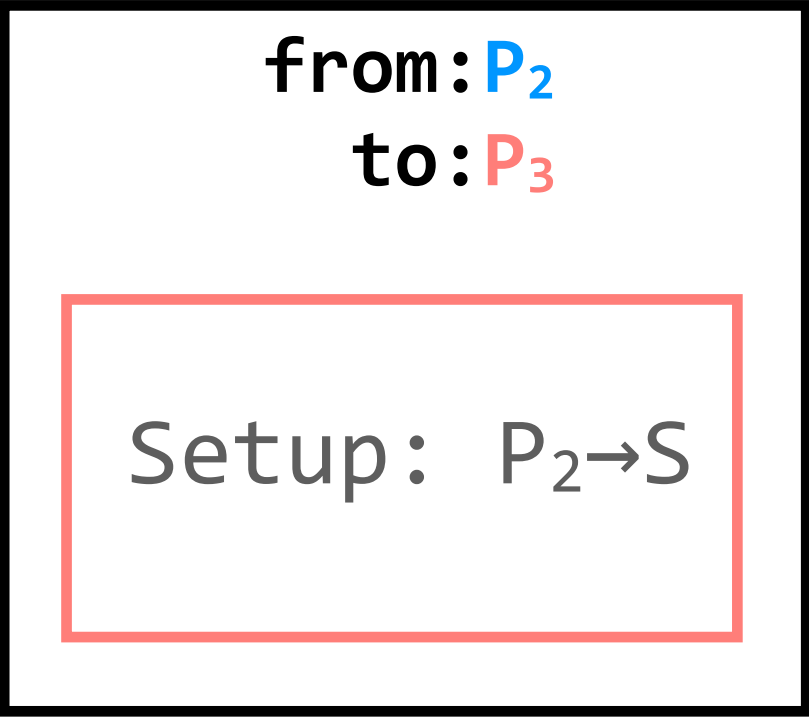
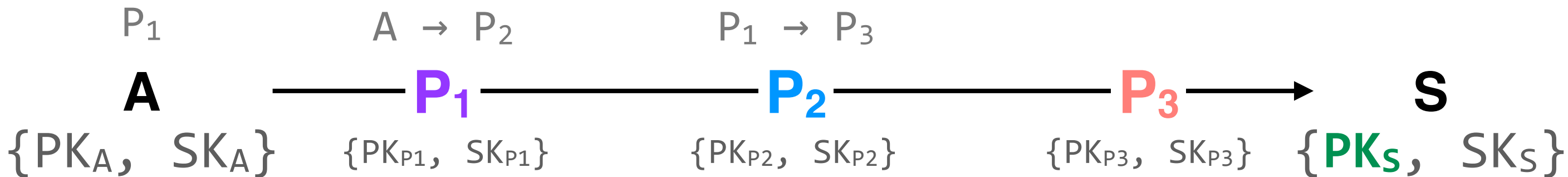


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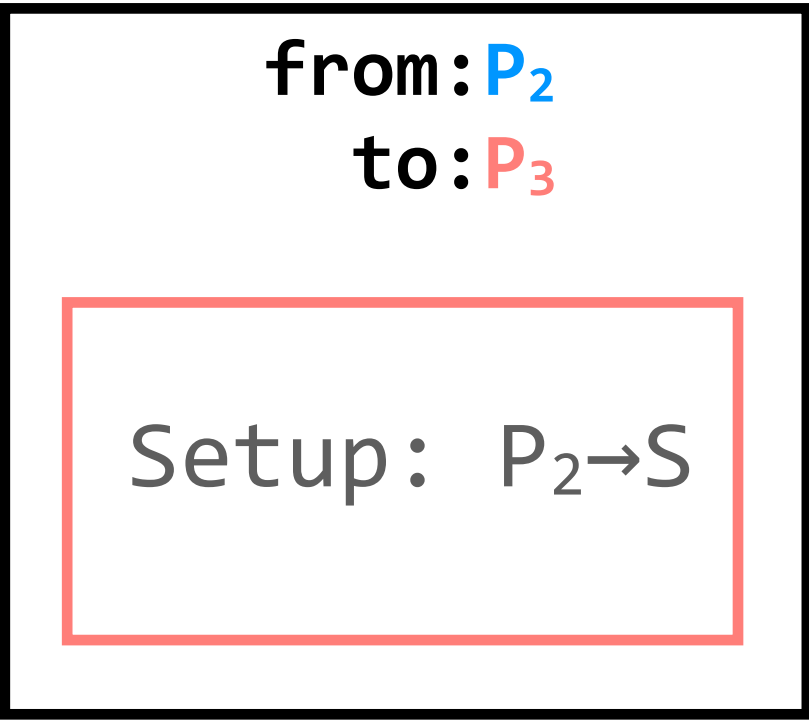
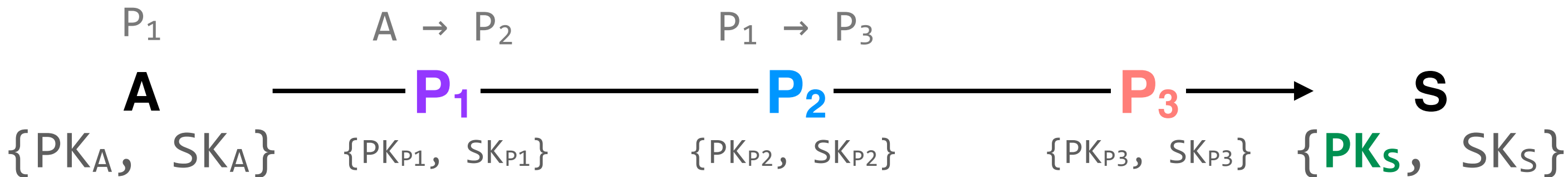
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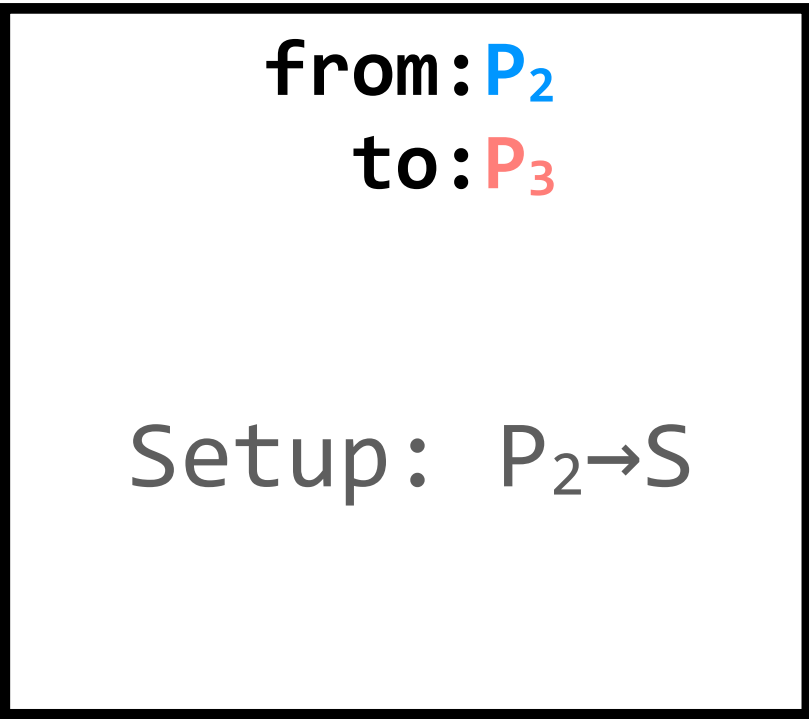
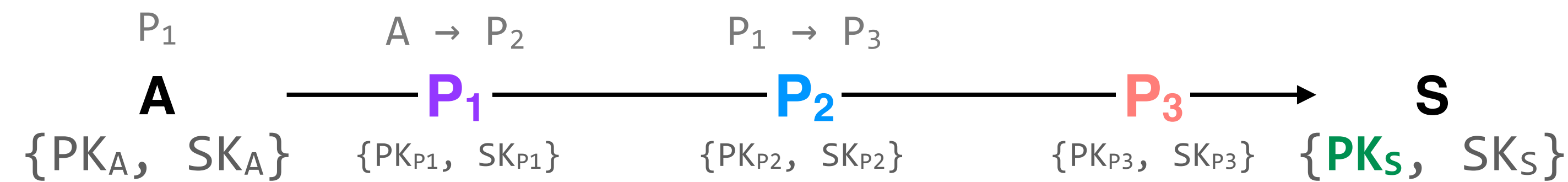
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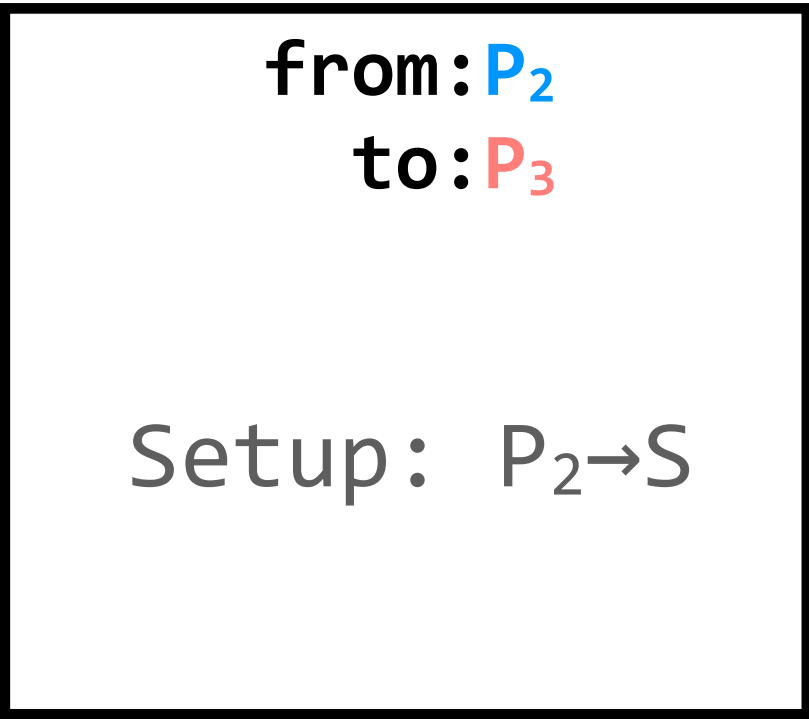
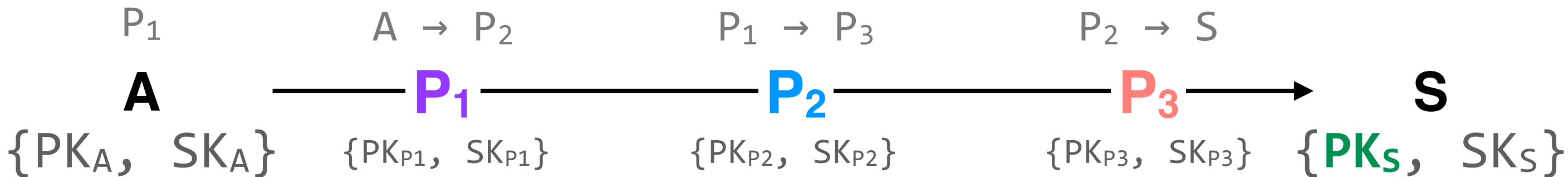
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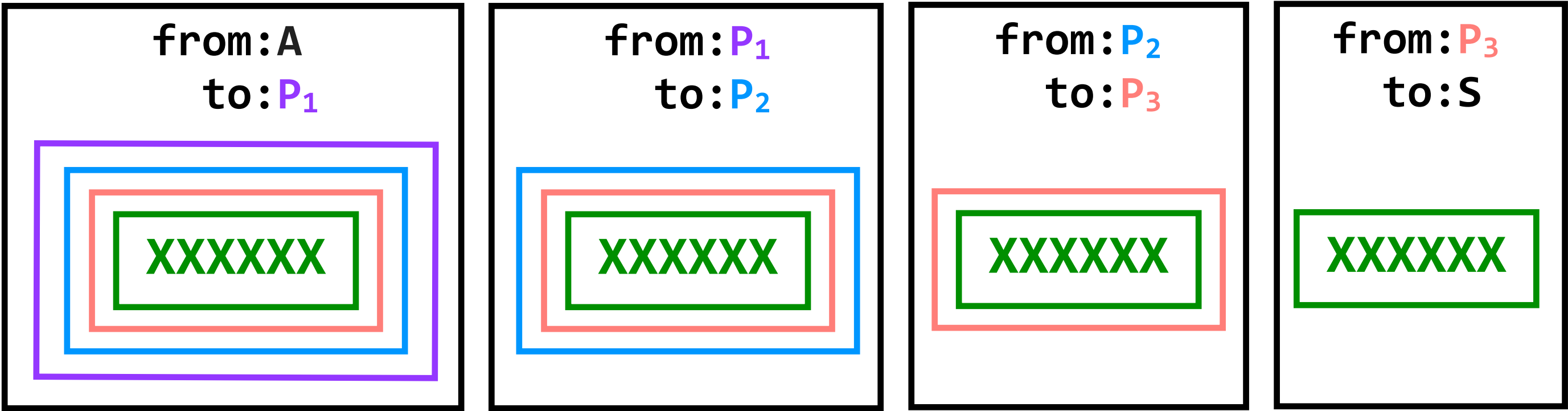
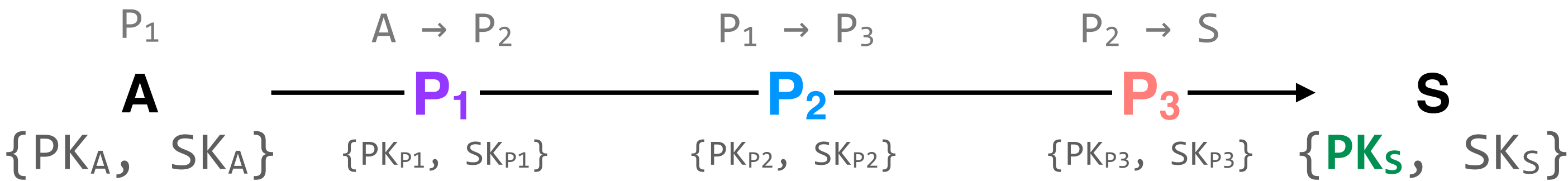
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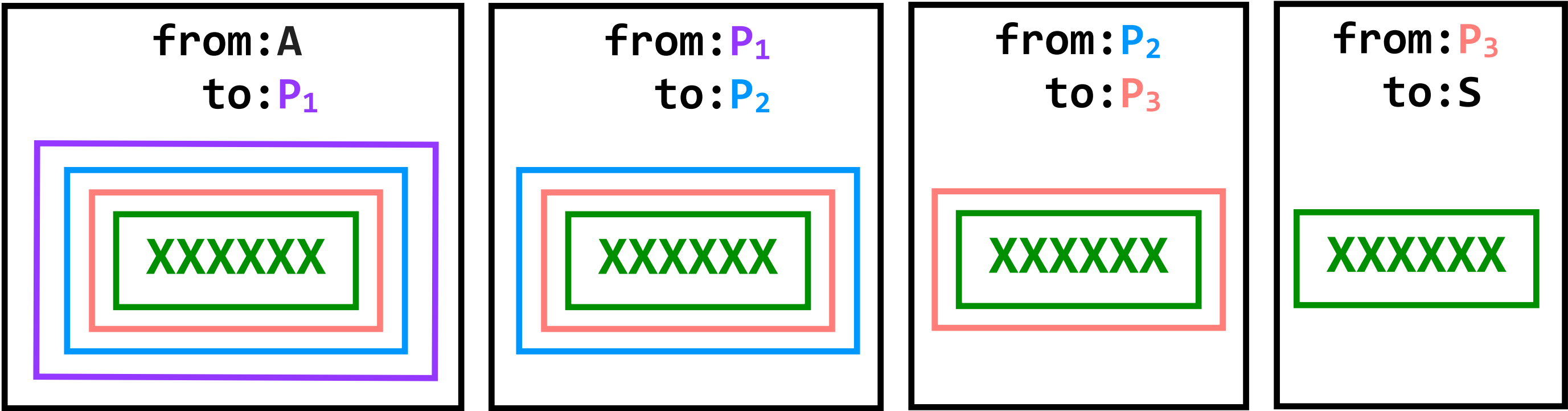
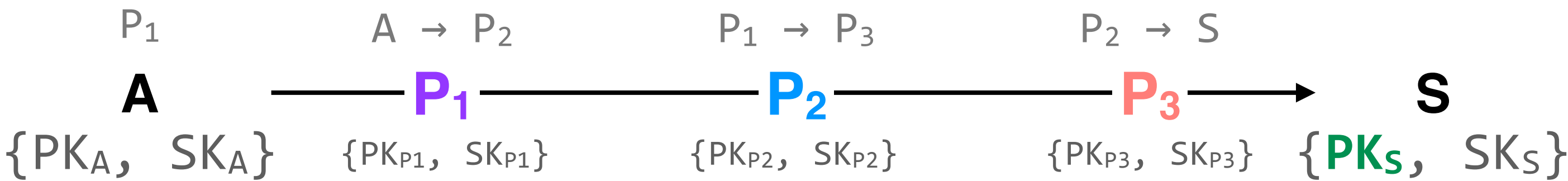
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## Am I totally anonymous if I use Tor?

Generally it is impossible to have perfect anonymity, even with Tor. Though there are some things you can practice to improve your anonymity while using Tor and offline.

## Use Tor Browser and software specifically configured for Tor

Tor does not protect all of your computer's Internet traffic when you run it. Tor only protects applications that are properly configured to send their Internet traffic through Tor.

### Web browsing:

- Safe: **Tor Browser**
- Unsafe: **Any other browser configured to use Tor as a proxy**

### File sharing:

- Safe: **OnionShare**
- Unsafe: **BitTorrent over Tor**

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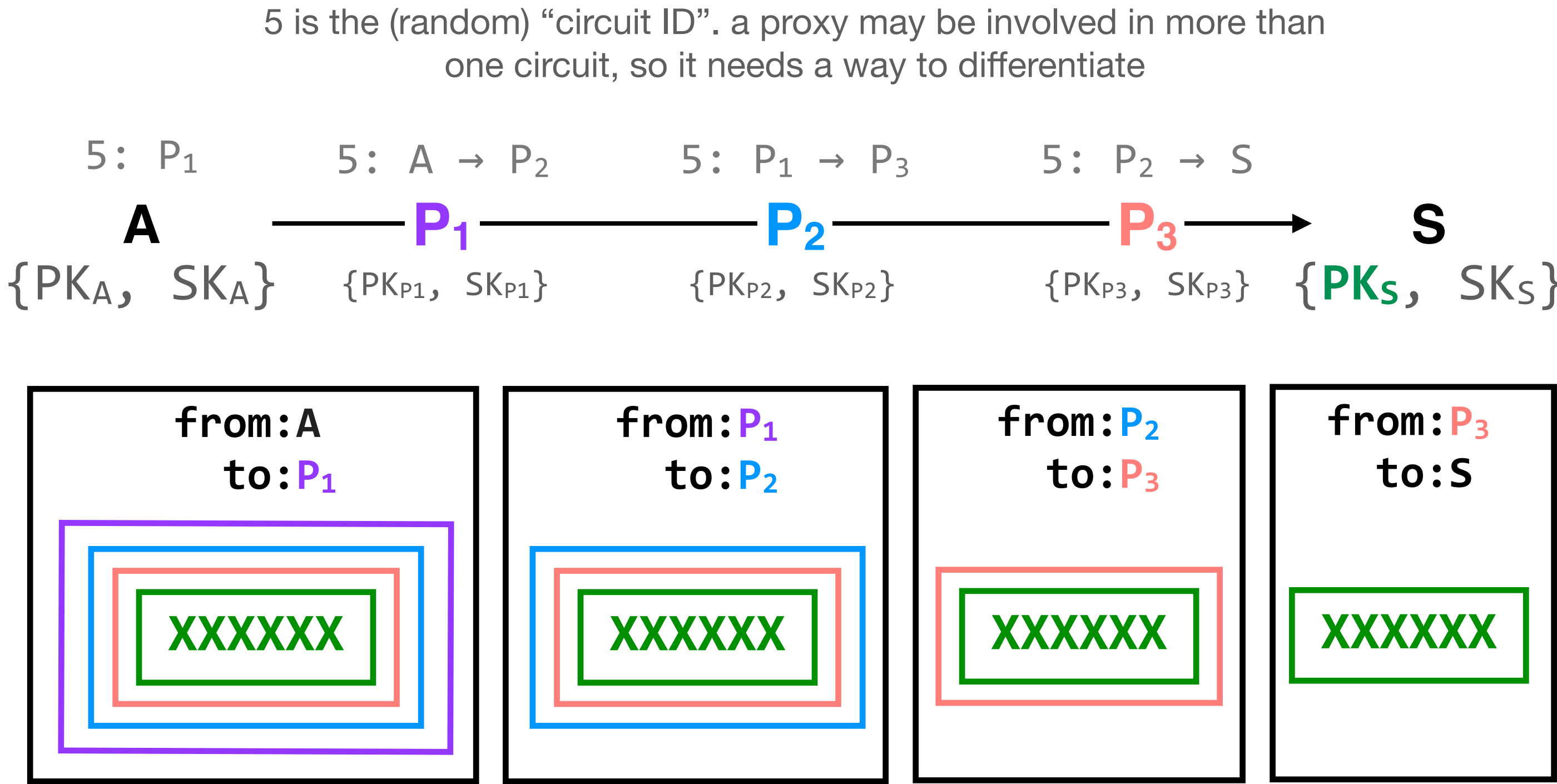
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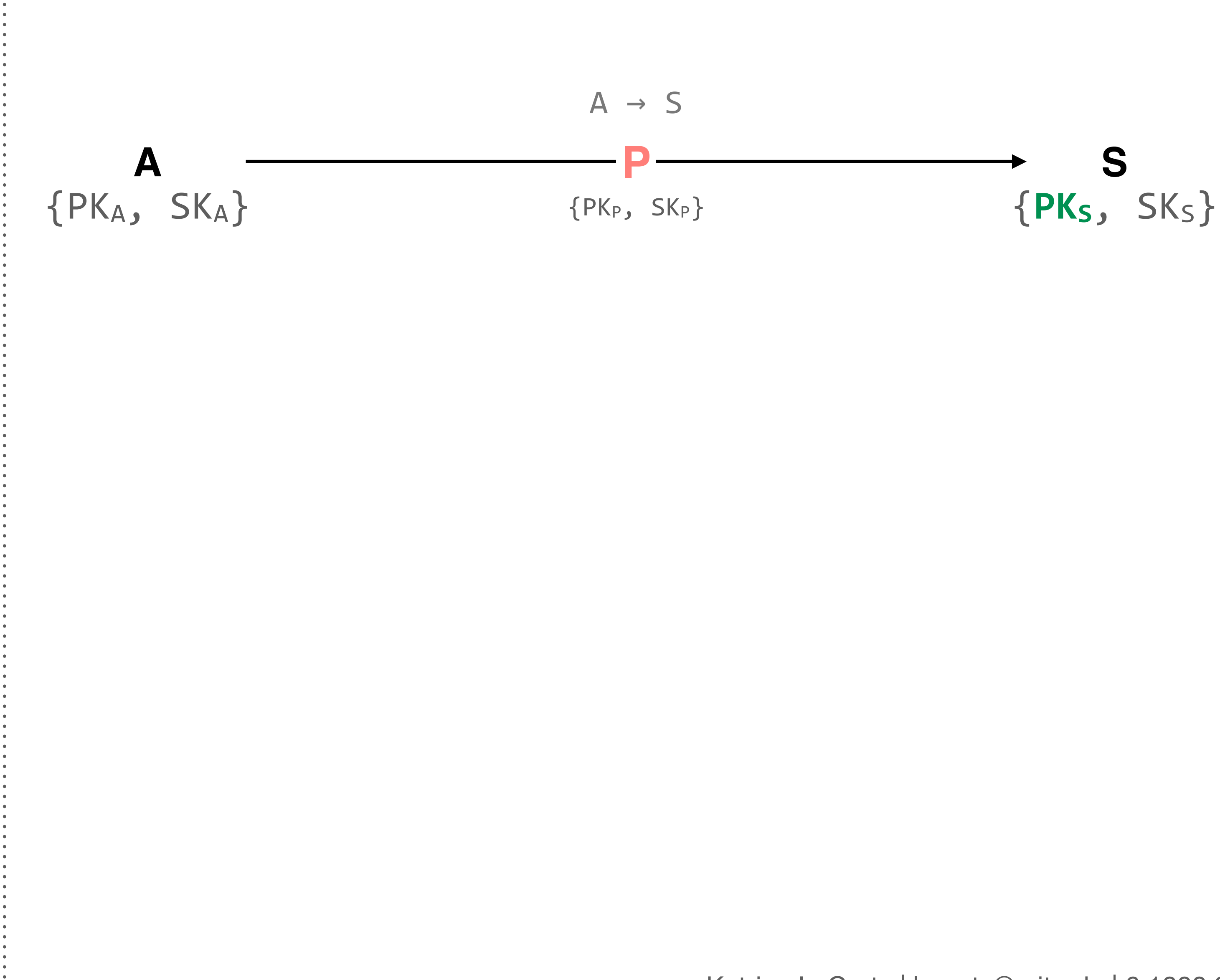
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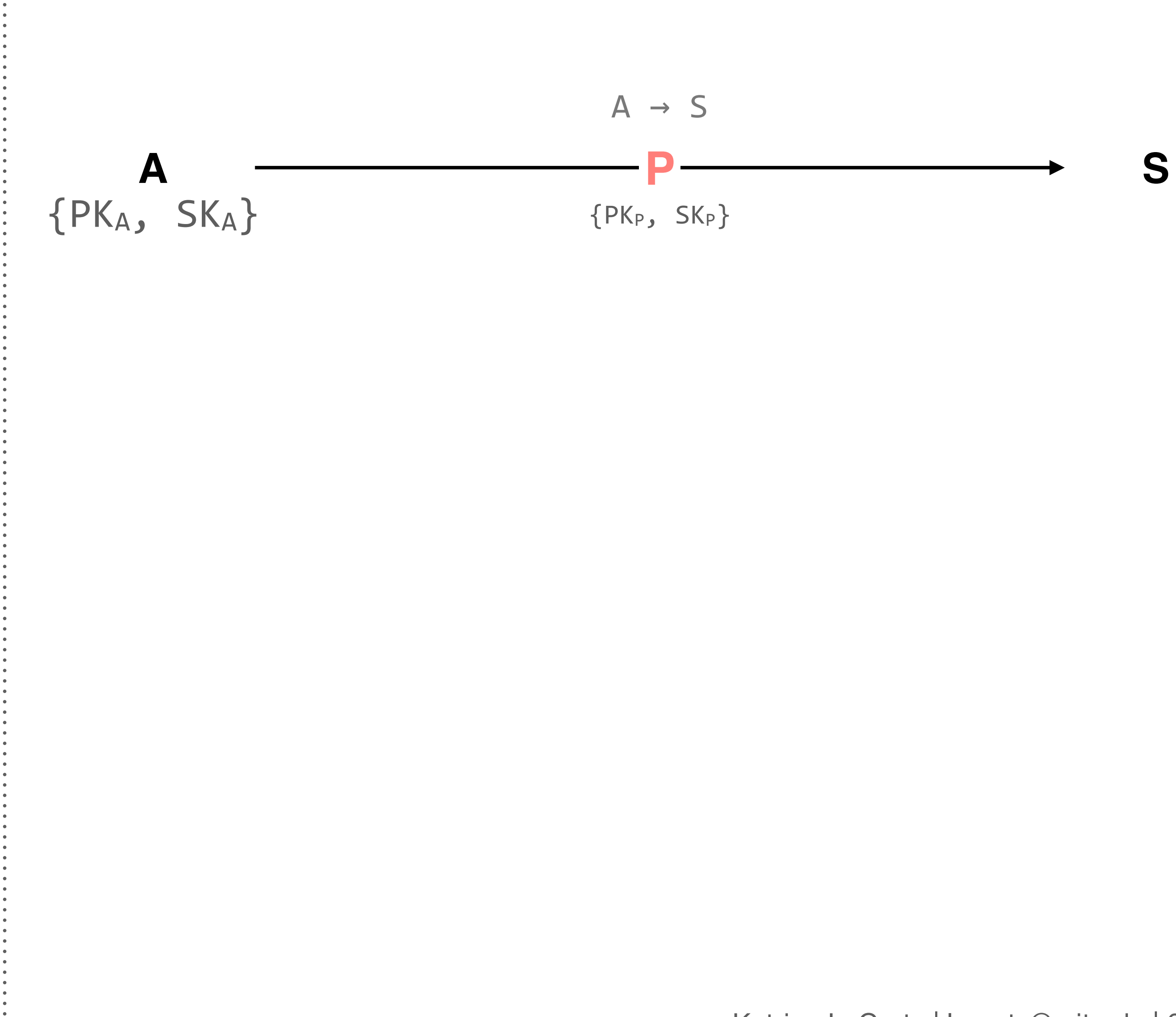


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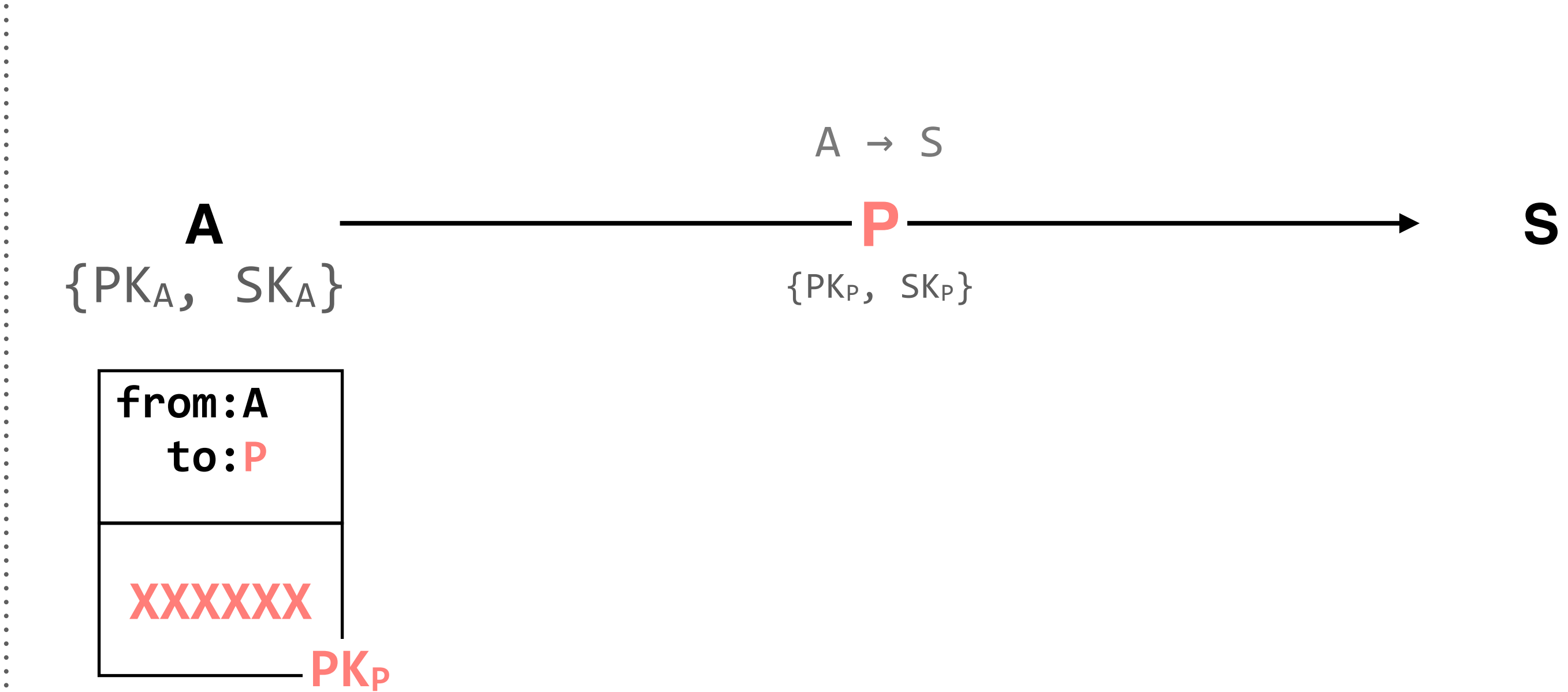


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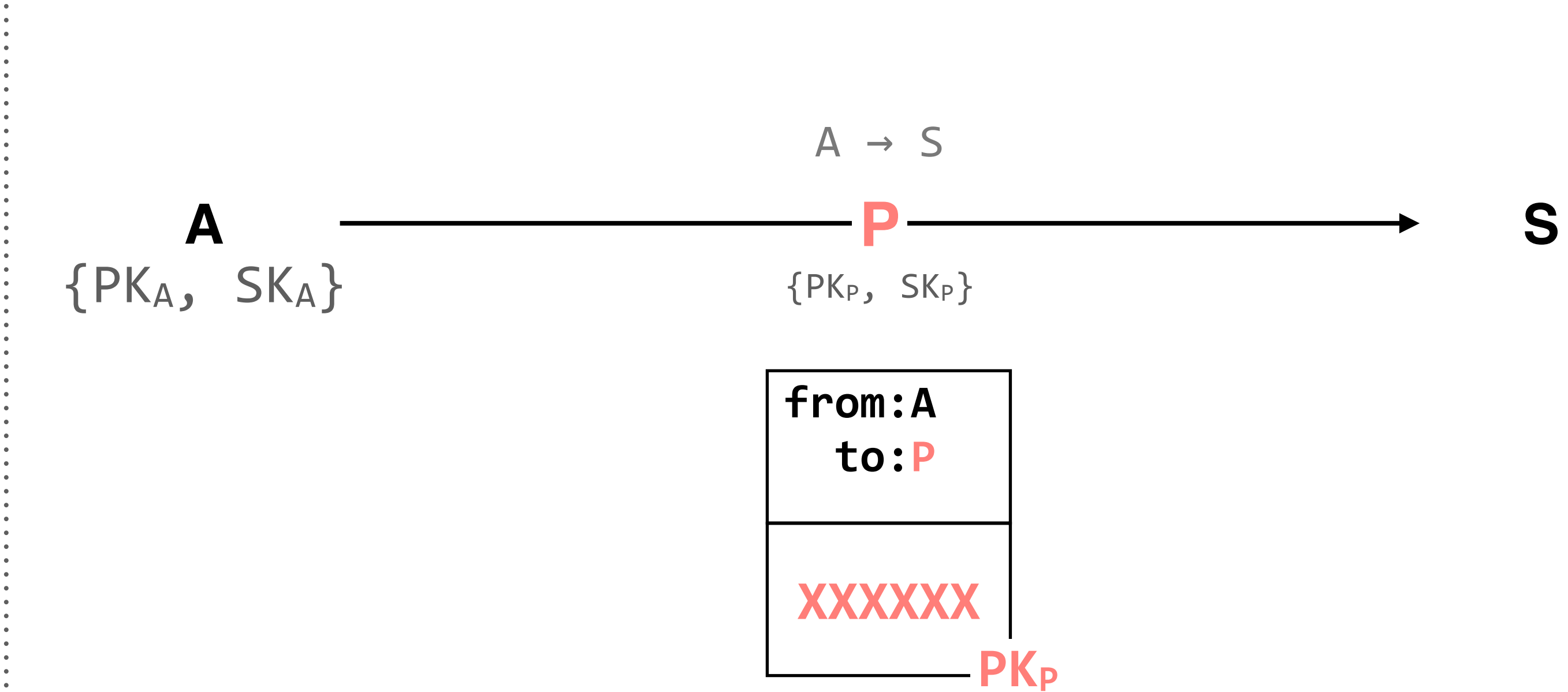


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$\text{encrypt}(\text{PK}_x, m) = c$   
 $\text{decrypt}(\text{SK}_x, c) = m$

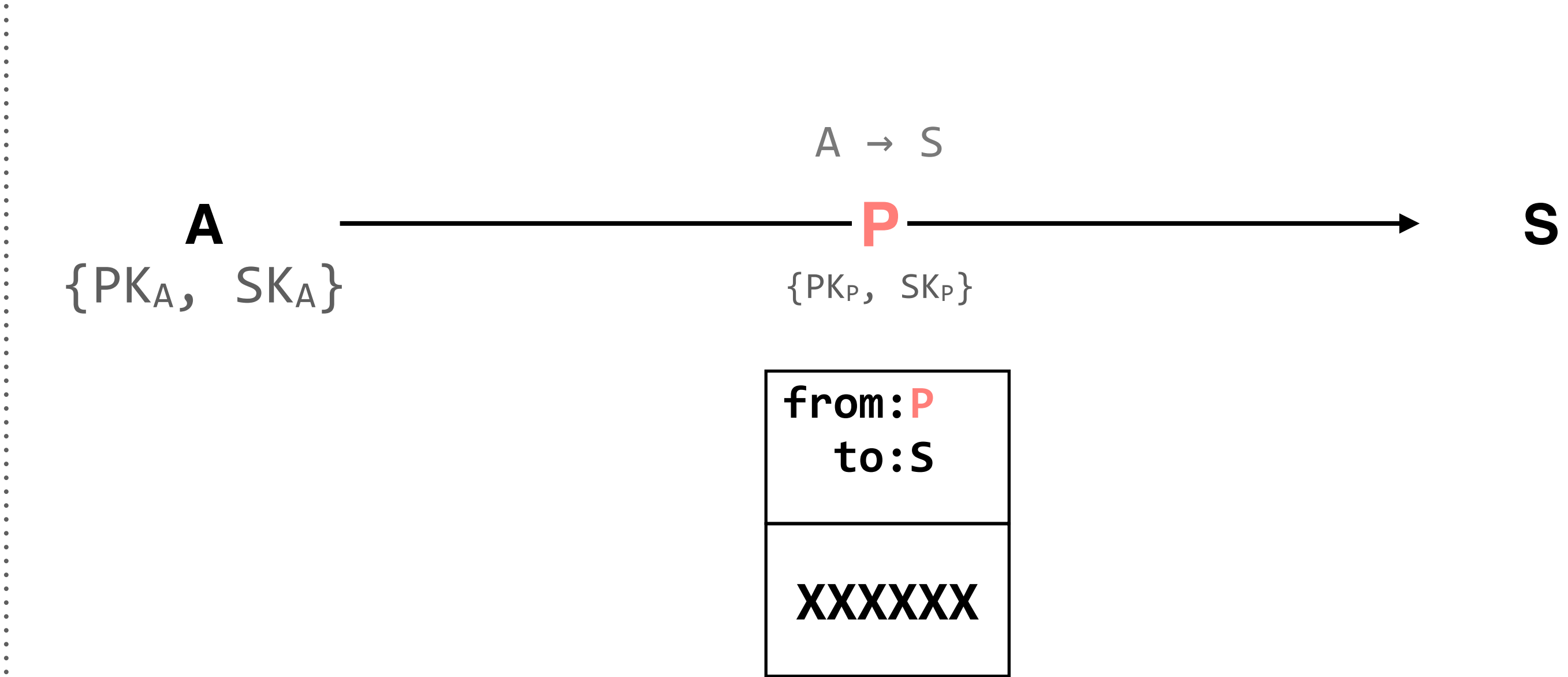


**policy:** provide **anonymity** (only the client should know that they're communicating with the server)

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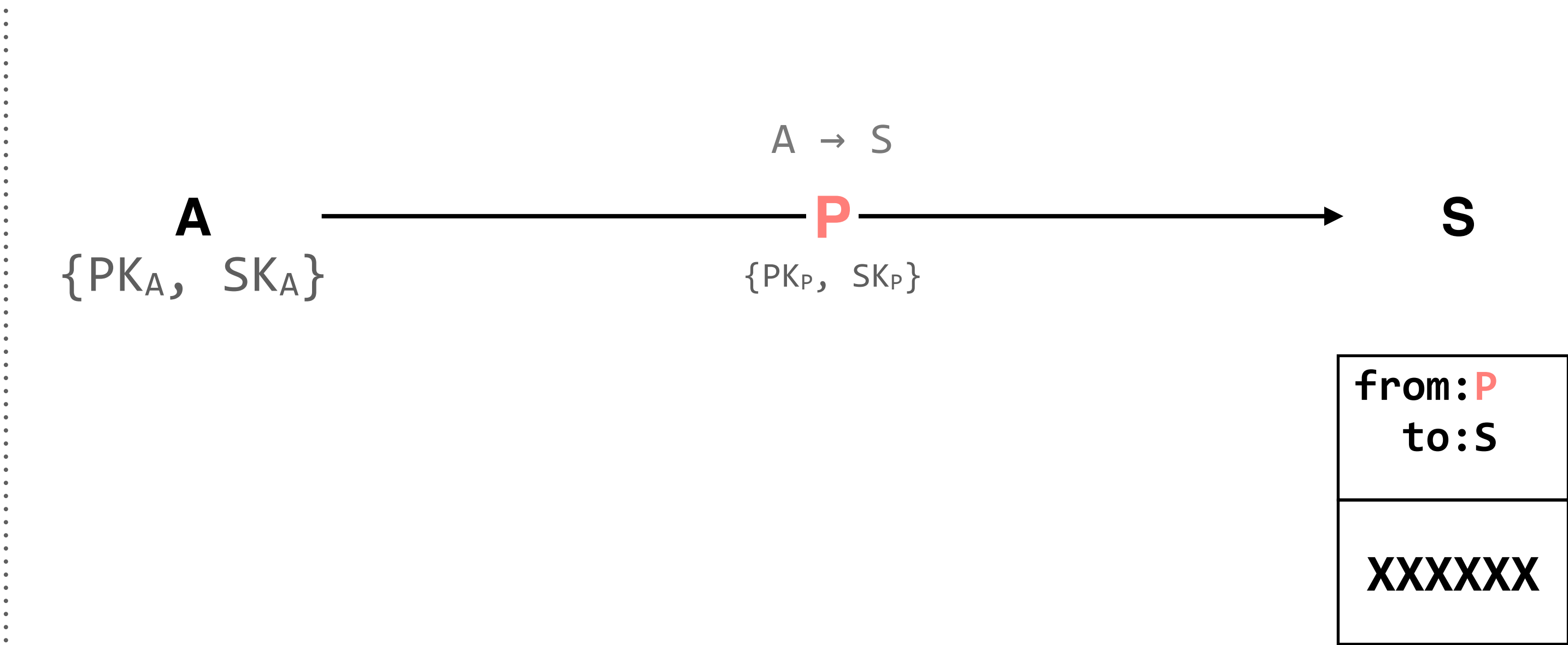


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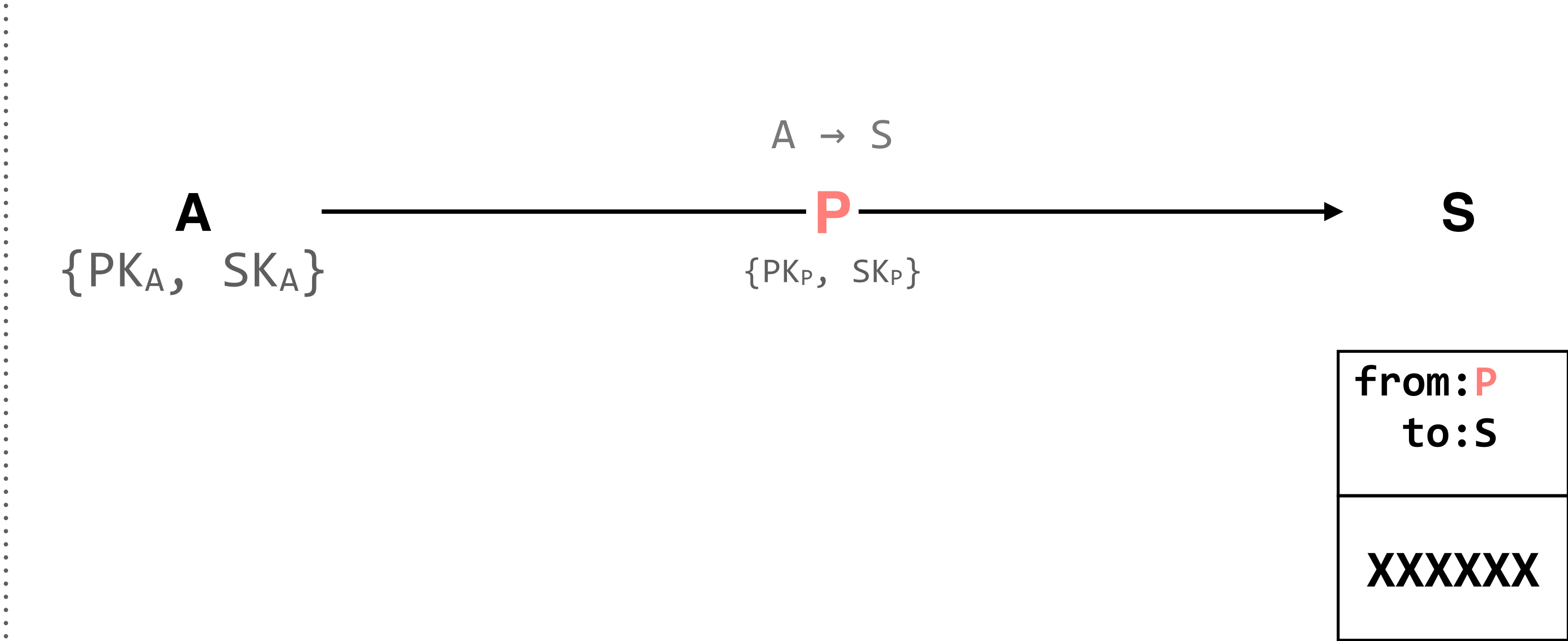


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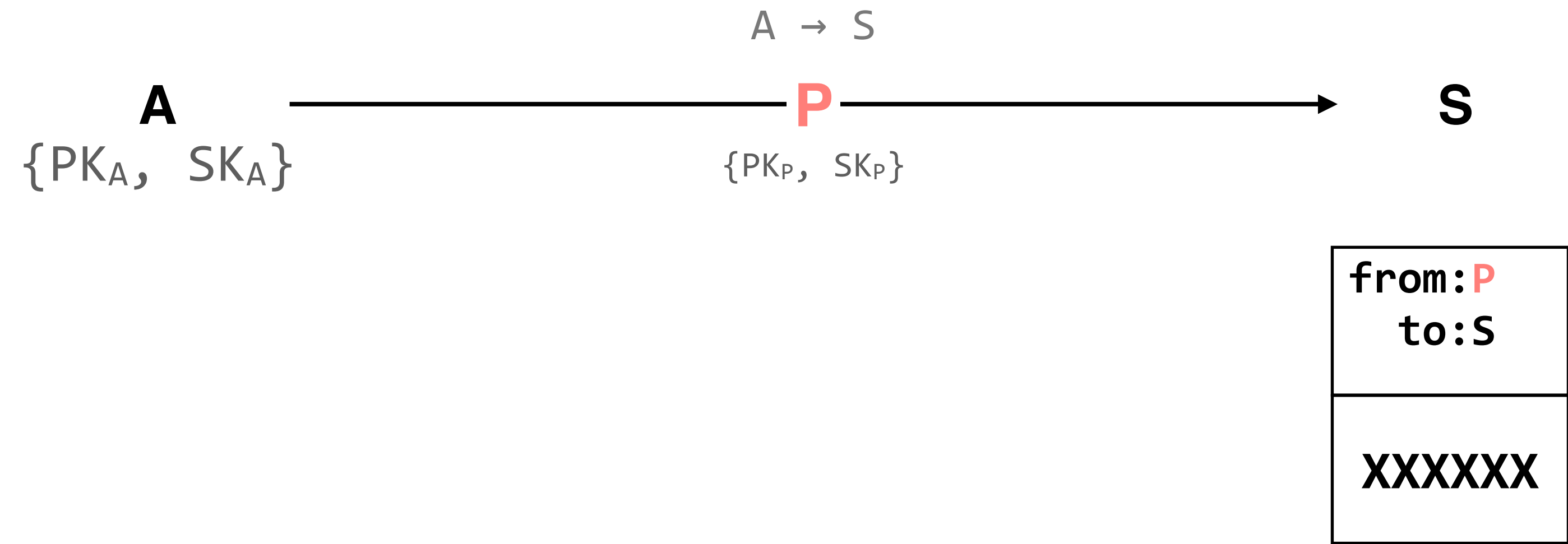
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what we've shown here is a simplified version of some of the functionality you get when you use a VPN



**tor** provides some level of anonymity for users, preventing adversaries from linking a sender to its receiver

there are still ways to attack tor, namely by **correlating traffic** from various points in the network

a larger takeaway here is that a secure channel alone only provides confidentiality and integrity of the message data; **packet headers can reveal information** that may be sensitive in certain contexts

much like when we discussed certificate authorities, there are interesting questions about who should run tor. how do we trust that the relay nodes are behaving as they should?

as system designers, it's important to think about what traffic you're sending over the network to clients, and whether that traffic can be sent in a more secure way (and what the trade-offs would be)