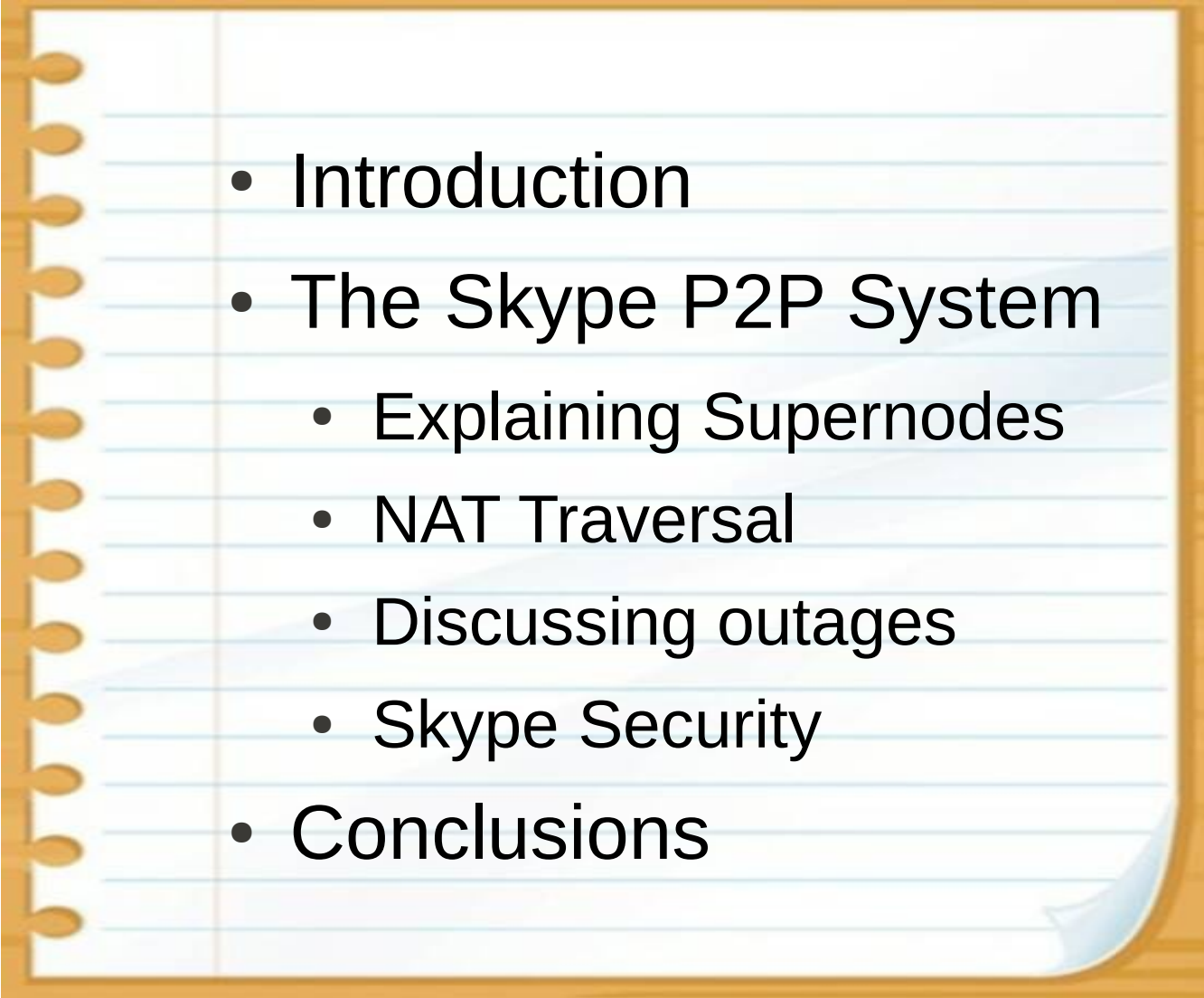


P2P VoIP Applications: “A Skype case-study”



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Outline

- 
- Introduction
 - The Skype P2P System
 - Explaining Supernodes
 - NAT Traversal
 - Discussing outages
 - Skype Security
 - Conclusions

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P2P VoIP Overview

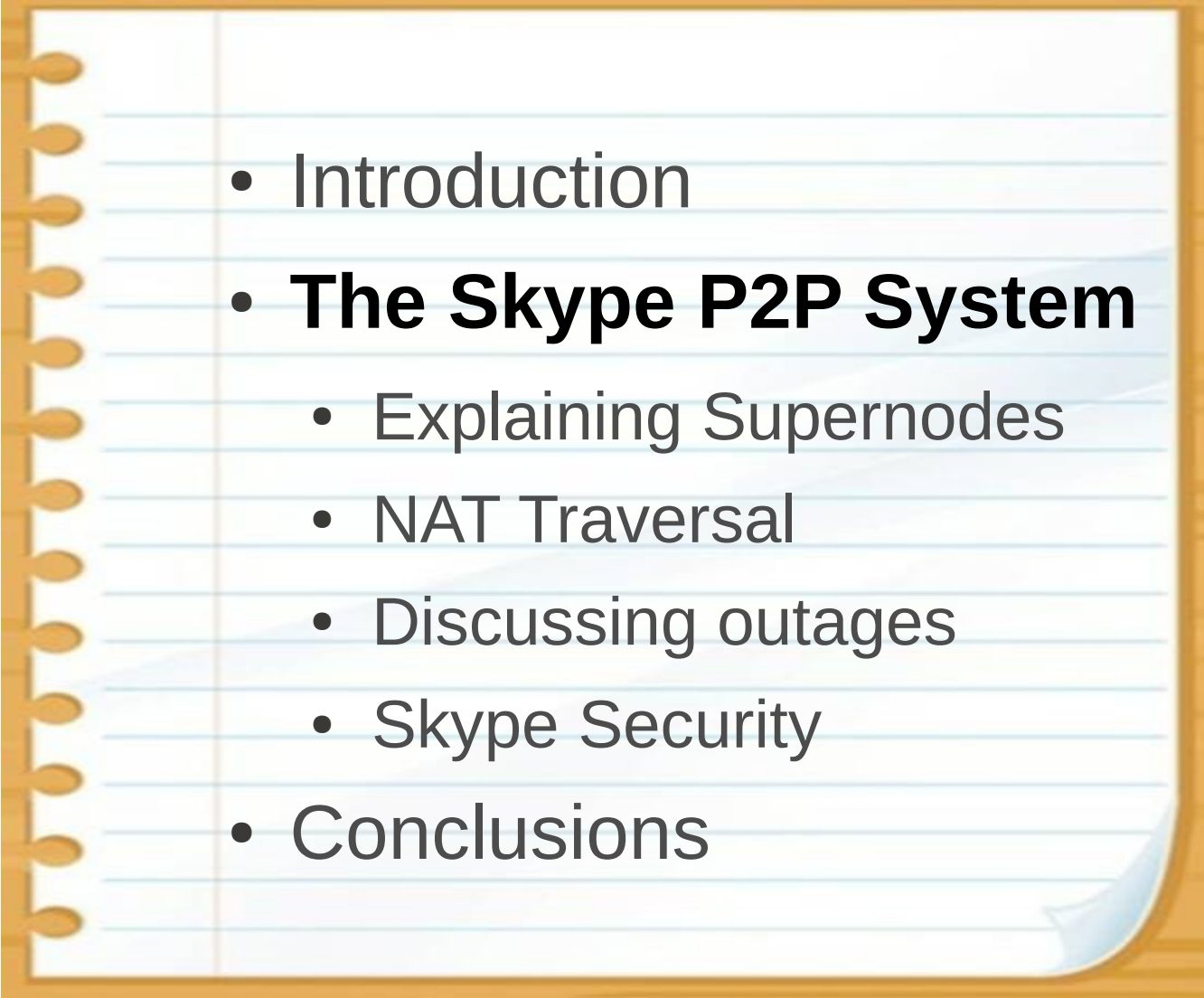
- Communication Over IP Networks
- Free calls among Internet users
- Usually mixed centralized and P2P scheme
- Requirements
 - Resource location
 - Session establishment
 - Session management
 - Presence



P2P VoIP Challenges

- Best-effort Internet
 - Transmission delays
 - Delay variations
 - Packet loss
- Network failures
- NATs and Firewalls

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Skype: why so popular?

- Easy-to-use
- Works behind NATs and Firewalls (always?)
- More than 50 million users!
- Offers three services
 - VoIP
 - IM
 - File transfer

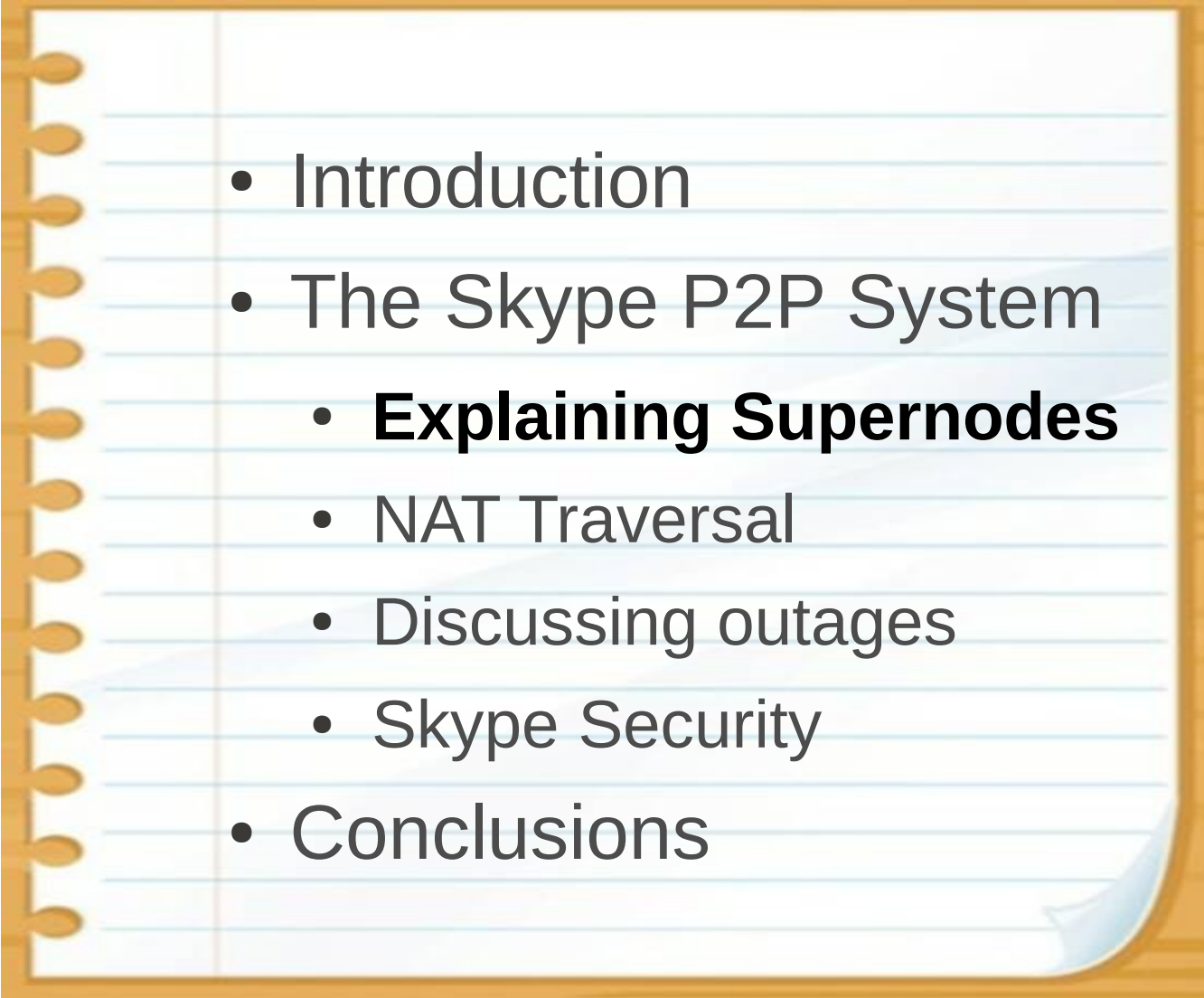
System Design: A KaZaA extension?

- Several studies conclude that Skype is related to Kazaa
- Founded by the same individuals
- Overlap of technical staff
- Use of the “supernode” hierarchical P2P network scheme
- KaZaA V 3.0 included a Skype client

Skype Peer-to-Peer Network

- Supernodes
 - Must be publicly reachable
 - Run the regular Skype software
 - Form an overlay among themselves
 - Also act as ordinary nodes
- Ordinary Nodes
 - Connect to one or more supernodes
 - Issue queries through supernodes

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Explaining Supernodes

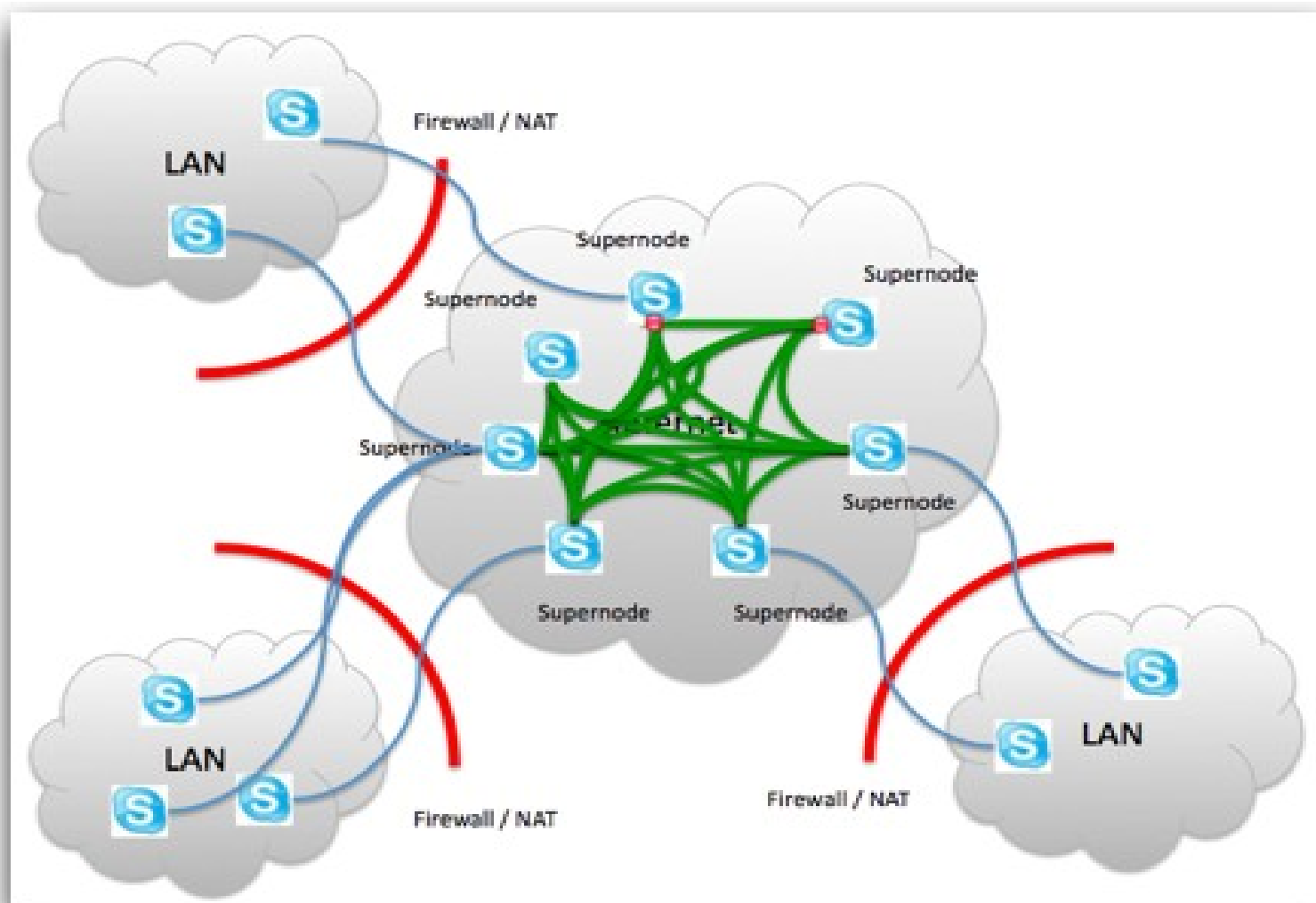


Image Source: <http://www.disruptivetelephony.com/2010/12/understanding-todays-skype-outage-explaining-supernodes.html>

The complete image

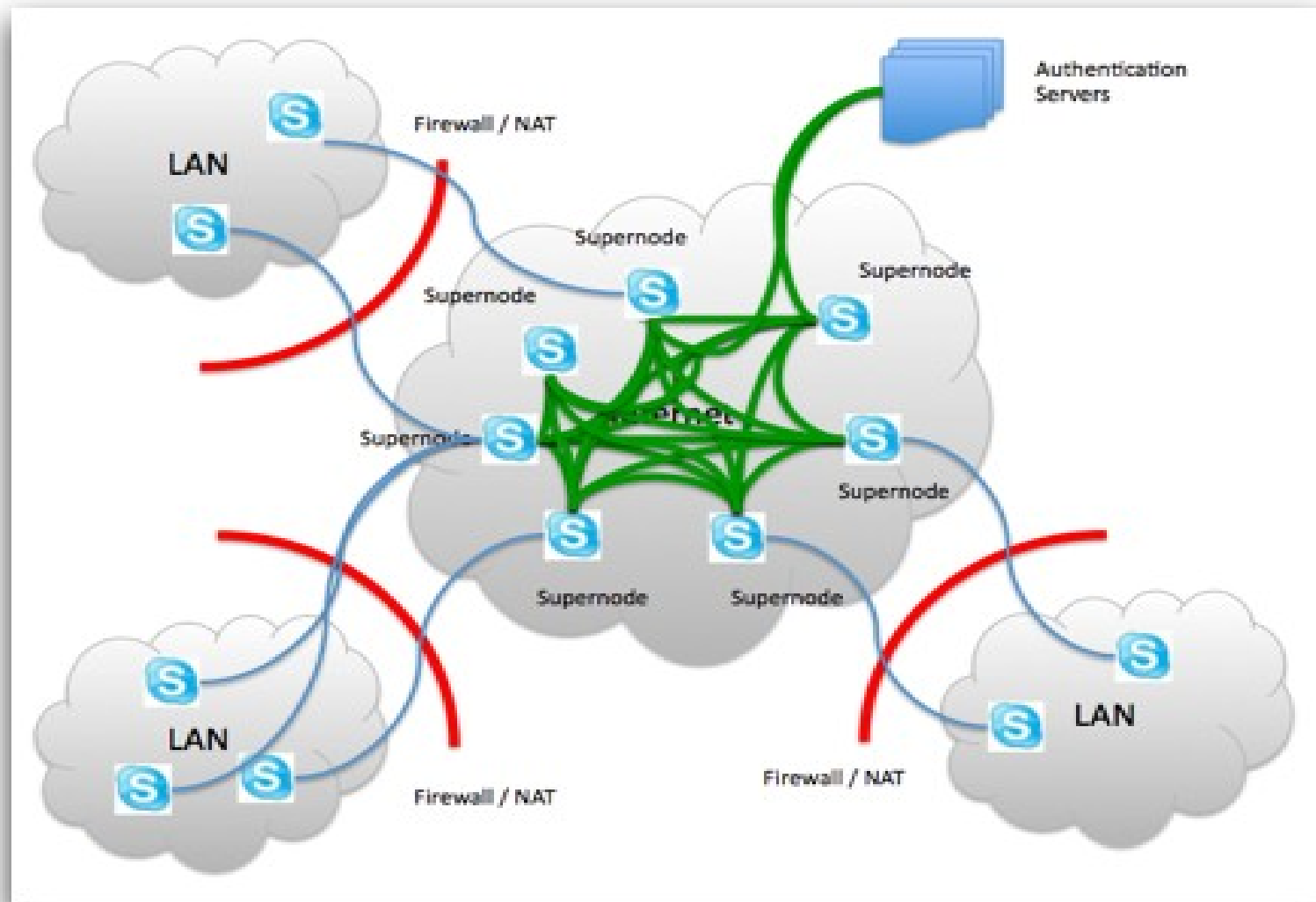


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System Design Advantages

- High scalability
- Use of processing and networking power of the end-users
- Reduce costs
- Reliability by self-healing

Self-healing

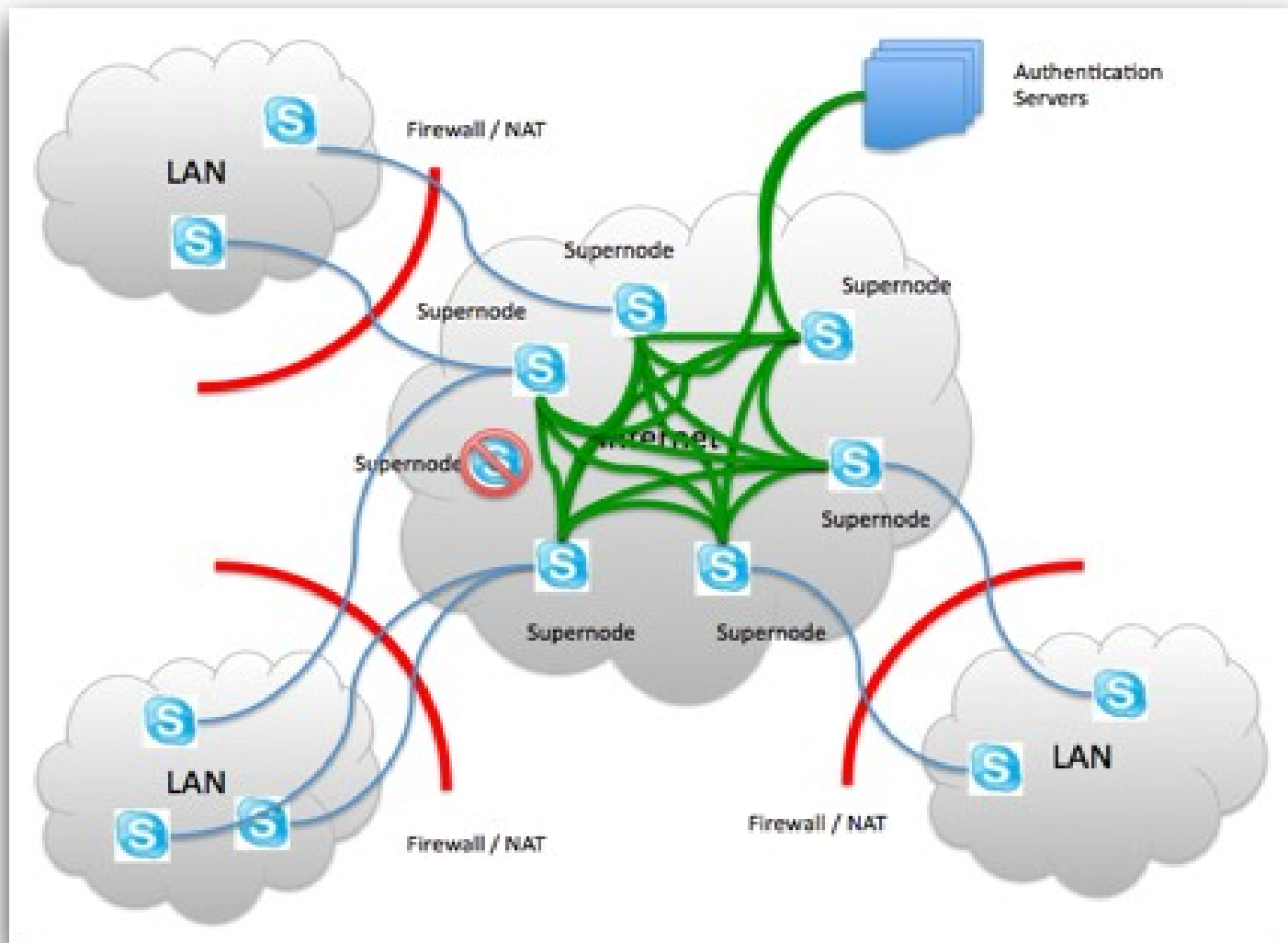
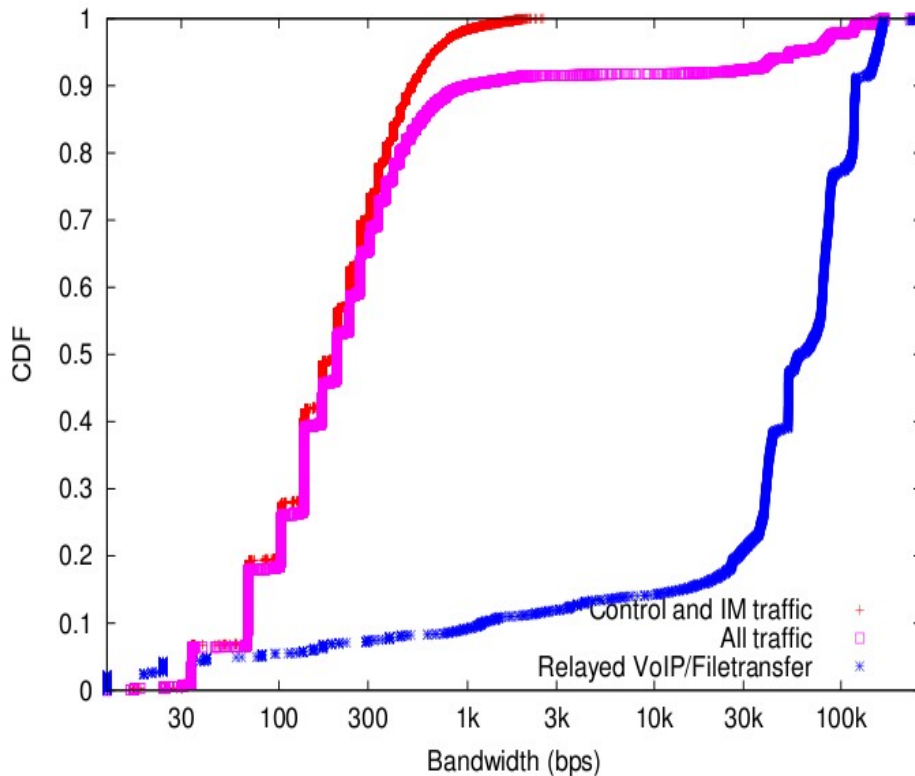


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Becoming a Supernode: How will it affect my connection?



- Negligible additional processing power, memory and storage compared to an ordinary node

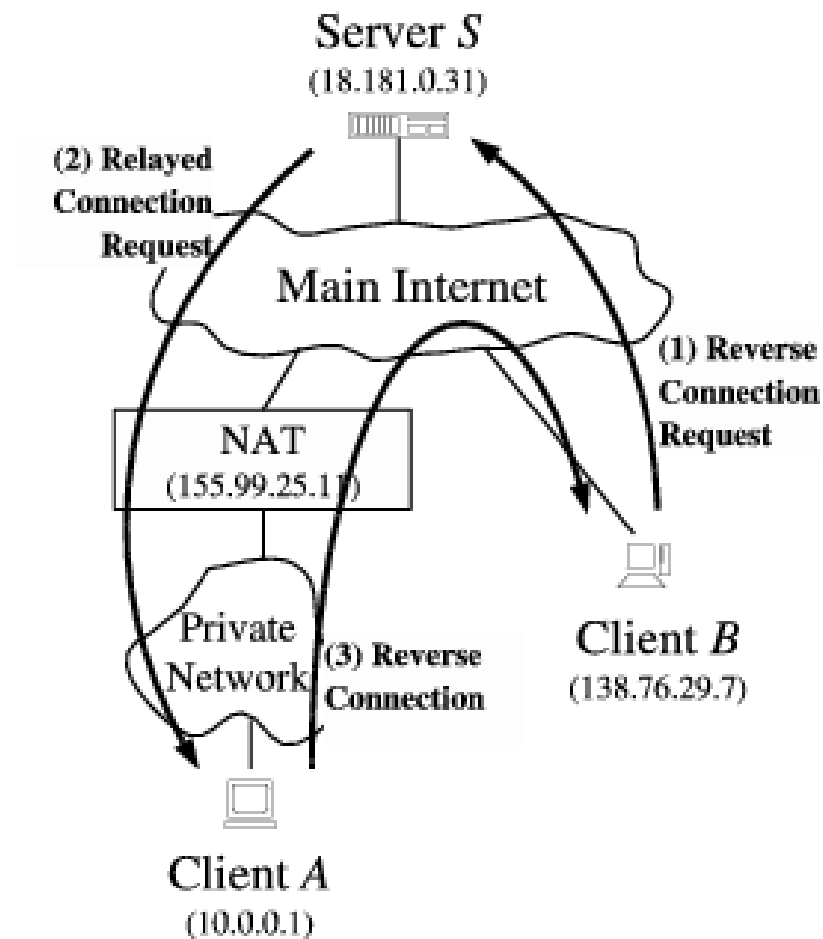
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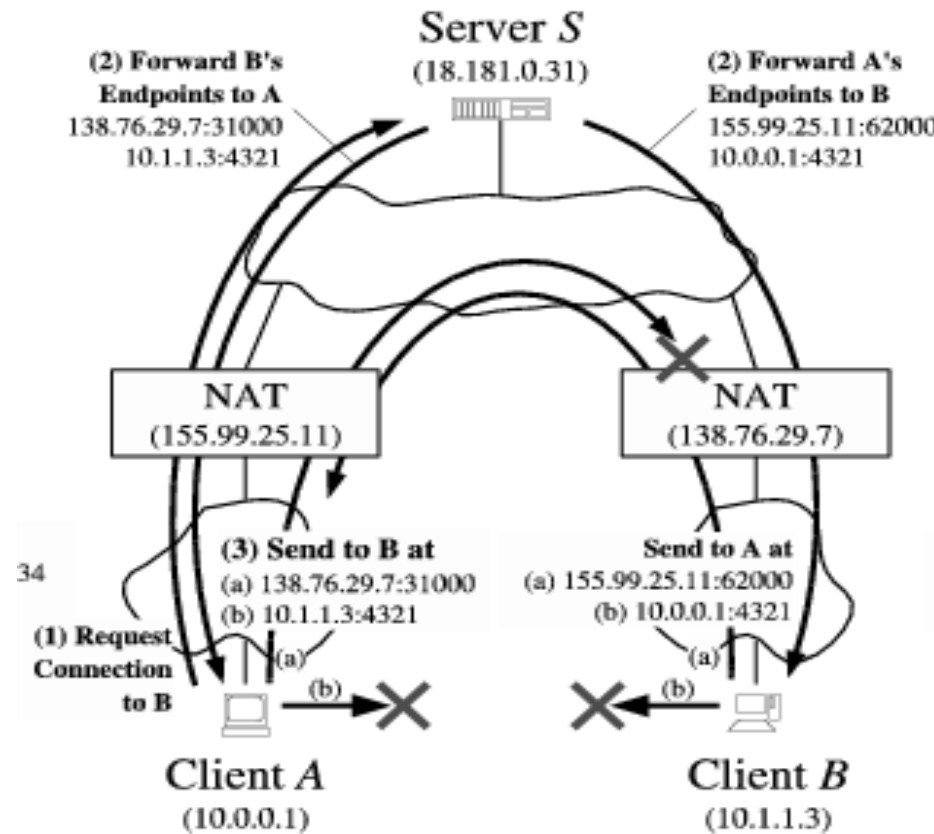
NAT Traversal

- If one client is behind NAT
 - Connection Reversal
 - Hole Punching
- If both clients are behind NATs
 - STUN
- If STUN fails
 - TURN

NAT Traversal: Connection Reversal

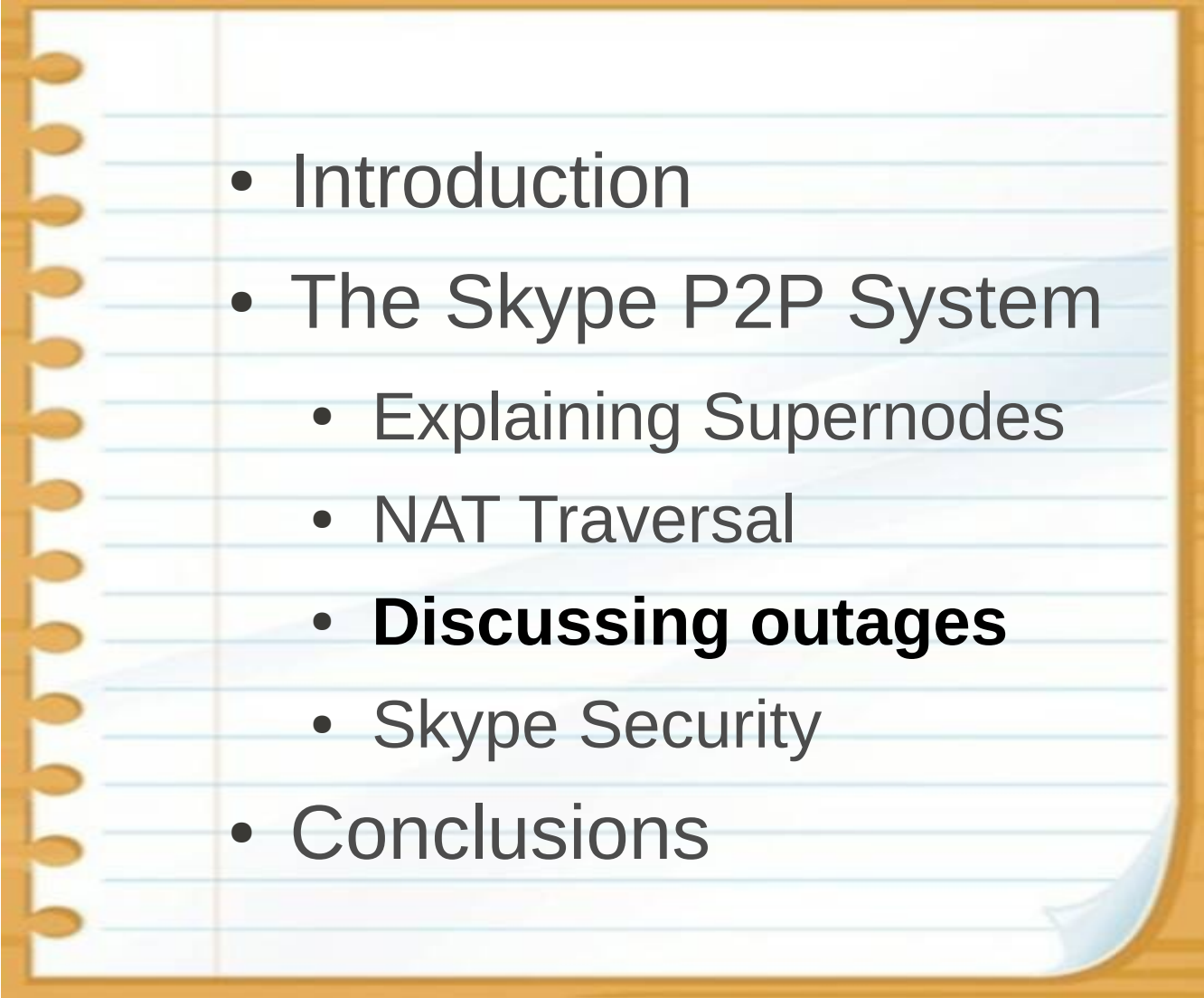


NAT Traversal: Hole Punching



The Hole Punching Process

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Self-healing - revisited

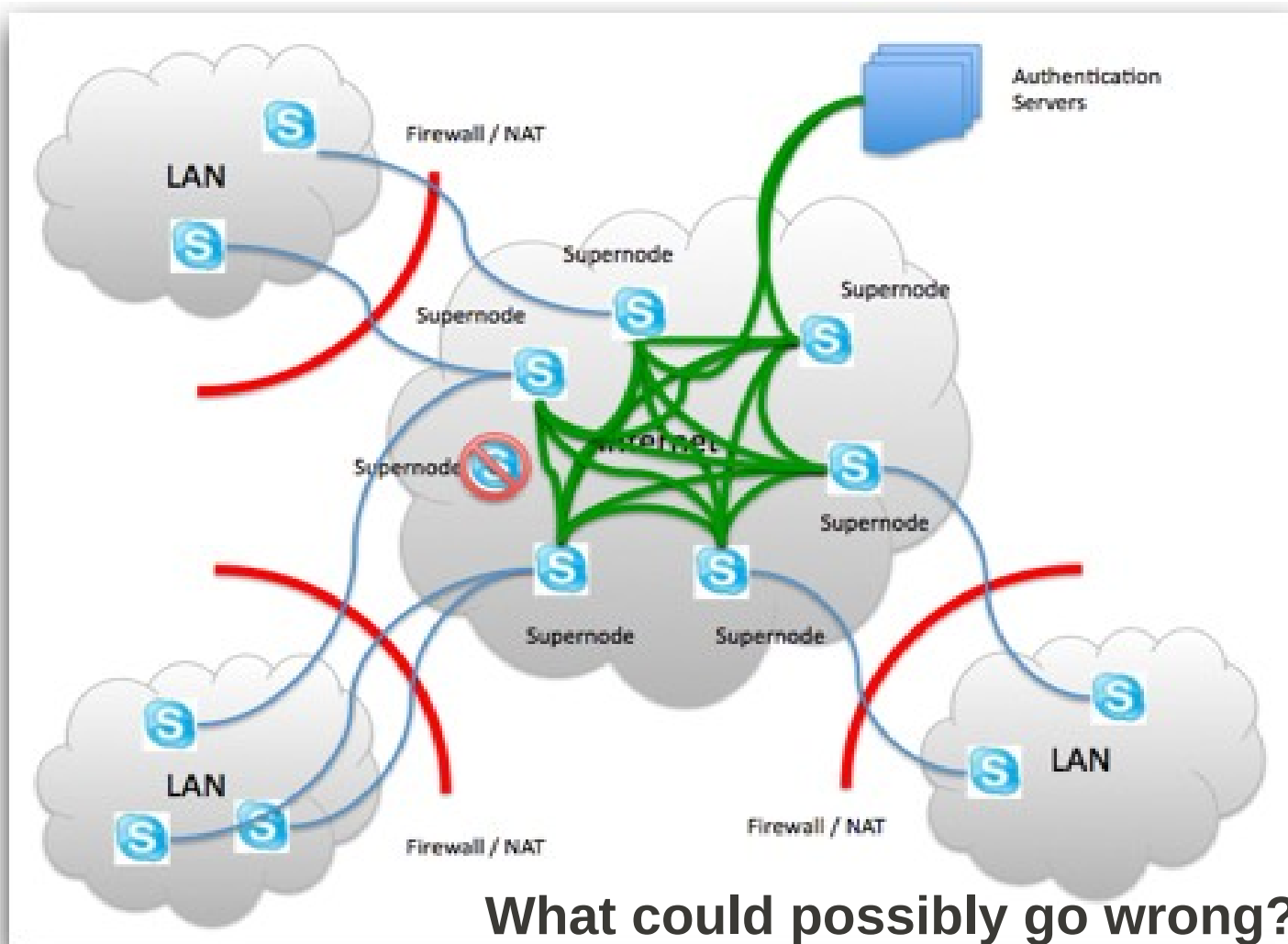


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1st major outage: August 2007

- The number of on-line users started falling unexpectedly
- Users faced login problems or slow services
- Problems lasted for more than 48h

1st major outage: *“Supernodes not so super”*

- Skype's Official Explanation
 - A Microsoft Windows Update caused Supernodes to restart all at once
 - Self-healing failed because too many users were chasing too few Supernodes
- Skype's Solution
 - The system self-recovered completely after almost 48 hours.

1st major outage

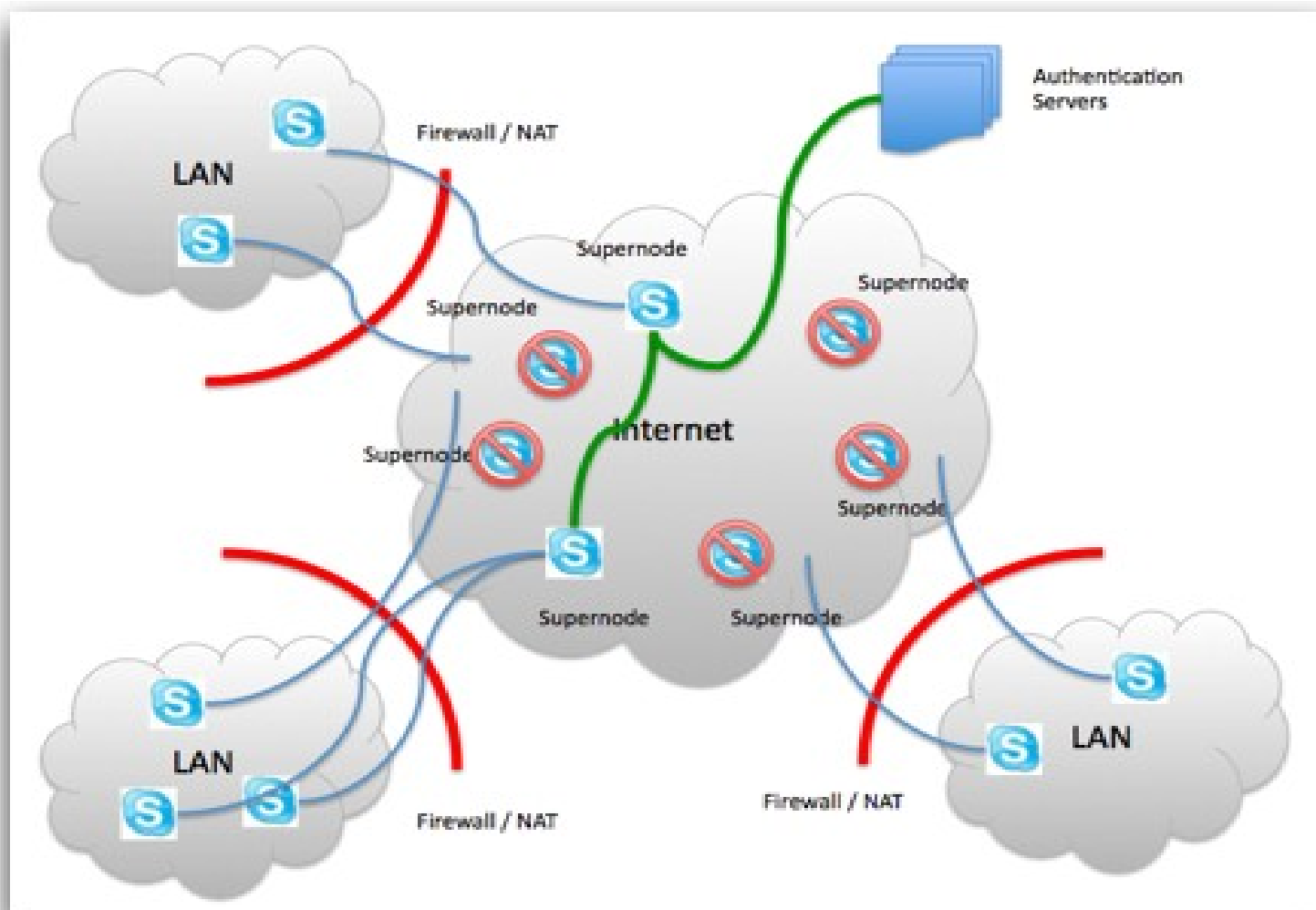


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1st major outage: *“Blame it on Microsoft!”*

- Questions raised
 - Why this particular Tuesday?
 - Microsoft has been releasing security fixes on the 2nd Tuesday of each month since October 2003
 - Why at the same time?
 - Updates are downloaded and installed at 3am in the PC's local time
 - At the very least, systems would have rebooted time zone by time zone!
 - Microsoft: *“The disruption was caused by a bug in their software.”*

2nd major outage: December 2010

- The network became unstable
- Suffered a critical failure
- The outage lasted for 24h approx.

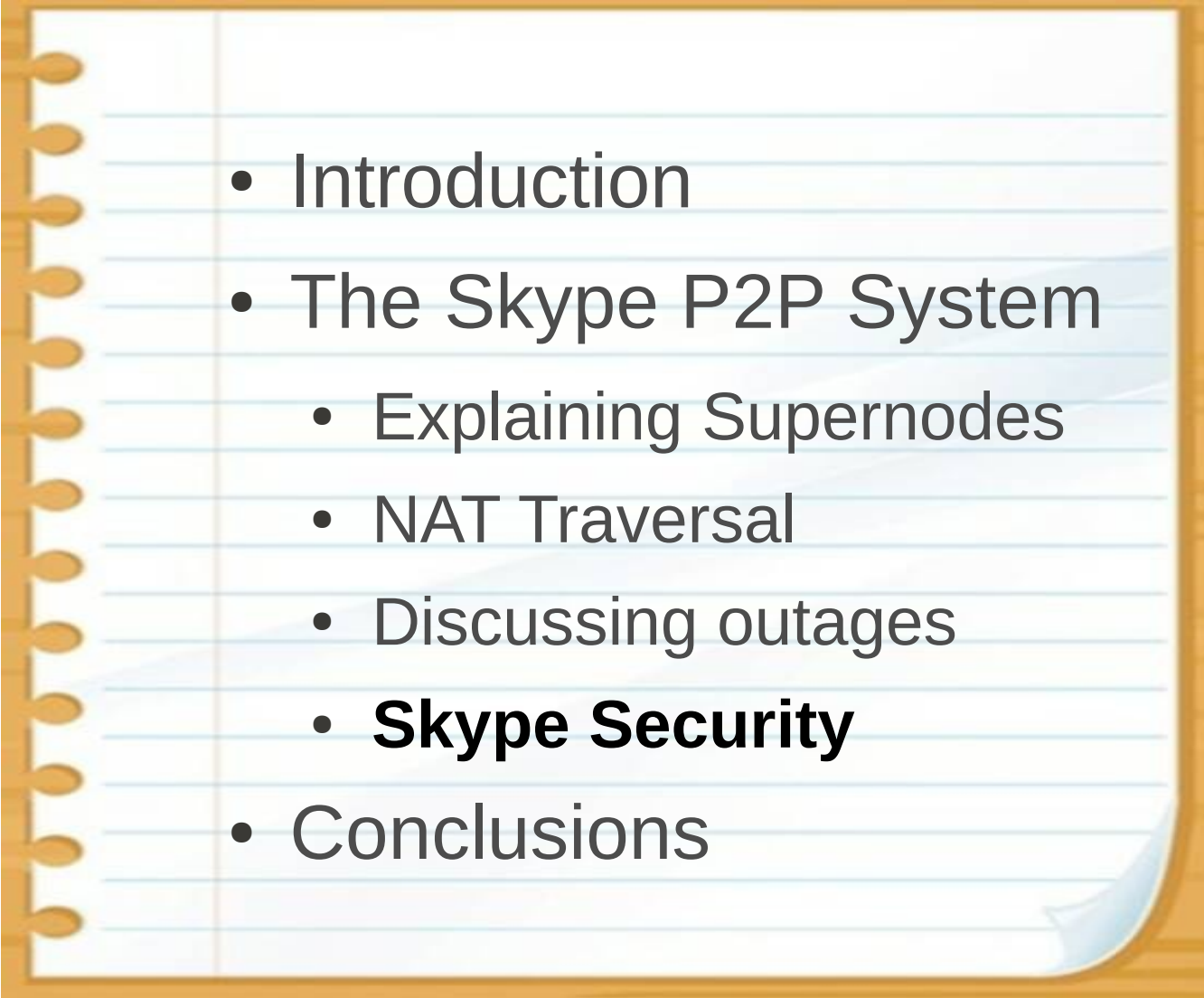
2nd major outage: *“Supernodes fail again”*

- A cluster of servers became overloaded...
 - In version 5.0.0152 of Skype Windows client, the delayed responses caused crashes...
 - 50% of all Skype users globally were running this version...
 - Including 25–30% of the publicly available Supernodes!

2nd major outage: *Permanent Solutions?*

- Fixing software bugs
- Building a more resistant core-system
- Suggestions?
 - Can we rely on user-Supernodes only?
 - How can we recover faster next time?

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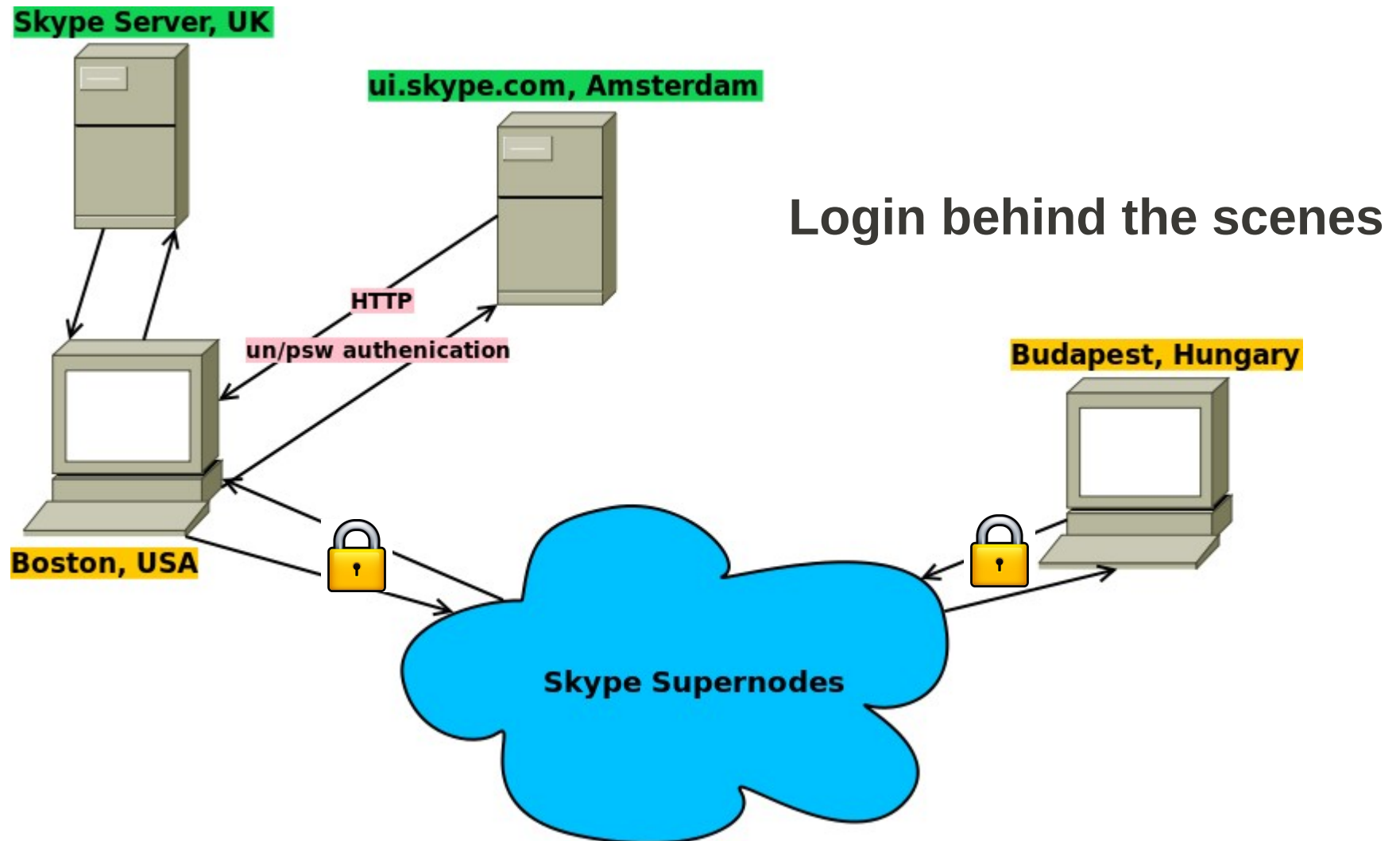
Skype Security

- Privacy: Does the Skype system allow an outsider to eavesdrop on a conversation?



I don't mean a person in the next room!

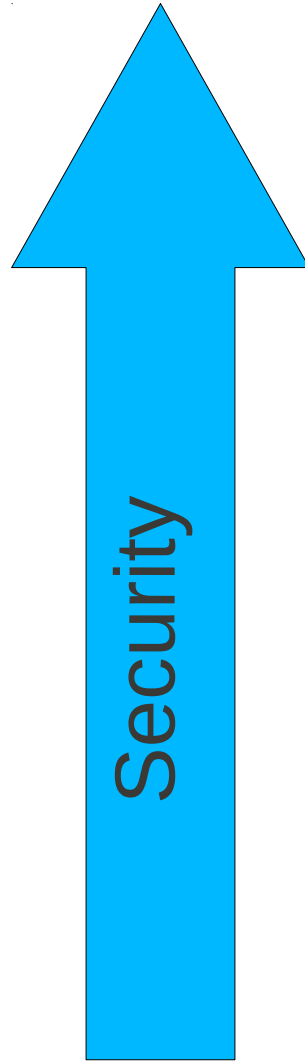
Skype Security: Privacy



Skype Security: Privacy

- Skype uses encryption
 - Specific algorithms not publicly available
 - Key-exchange mechanisms not known
- Secure against casual snooping
 - Packets can be observed but are undecipherable
 - Searches are observable
 - Unknown security level against sophisticated attacks

Skype Security: Privacy



Silence ;)

VoIP over VPN

Skype

VoIP

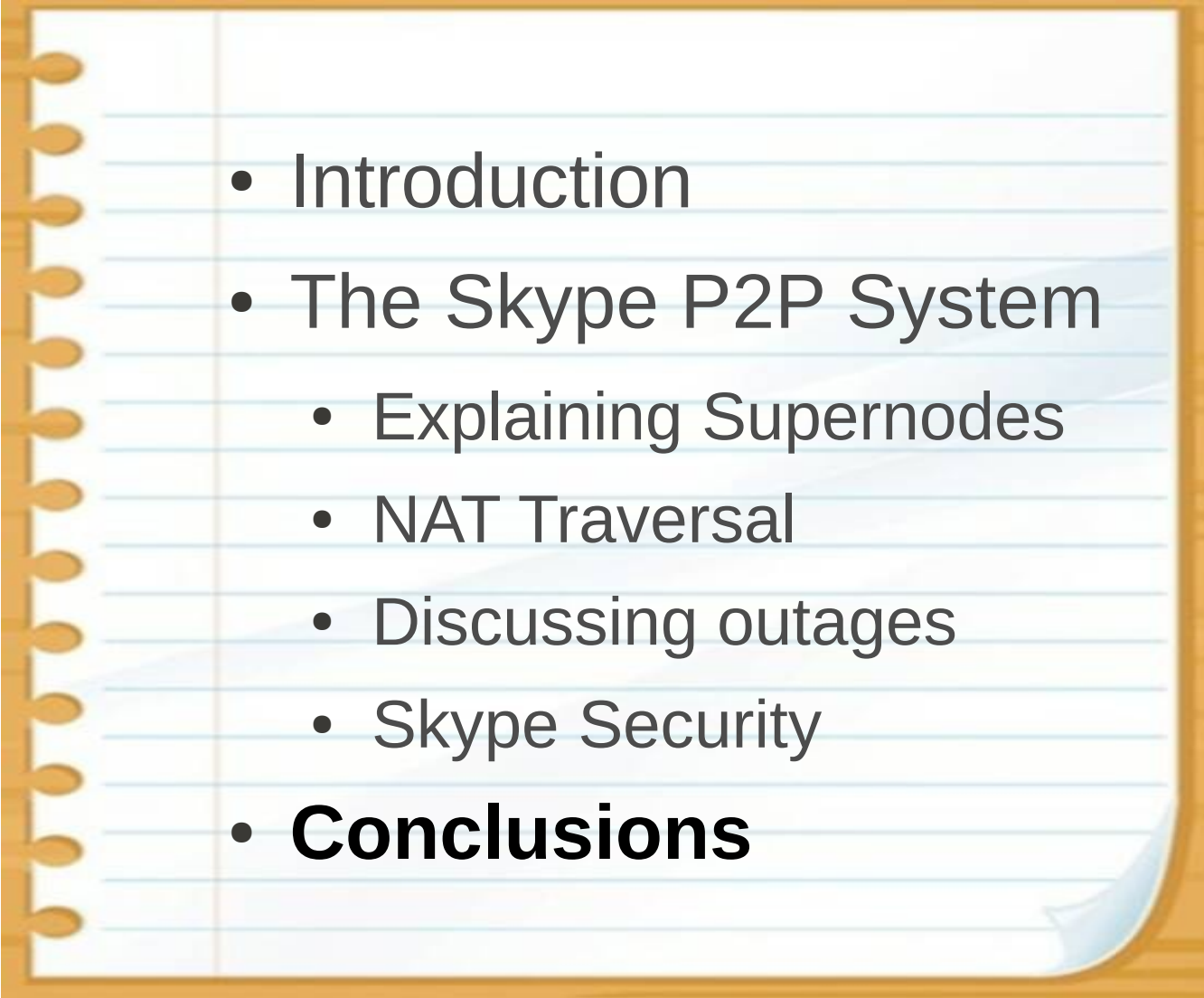
PSTN

Skype Security: Authenticity

- Email-based Identification and Authentication
 - username/password
 - Registered e-mail address
- The network is involved → attacks are possible!

Authentication security level: AOL, Webmail

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Conclusions on Skype

- Gained popularity and offers good quality despite Internet limitations
- Good performance and user satisfaction
- Supernodes increase availability but also fail
- Not clear Security level
 - Encryption, network involvement
 - As secure as webmail

General Conclusions

- VoIP over P2P is challenging but works
- Cost reduction sharing resources
- Fault Tolerance
- Increase call quality over best-effort Internet

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