

VoIP Networking Fundamentals



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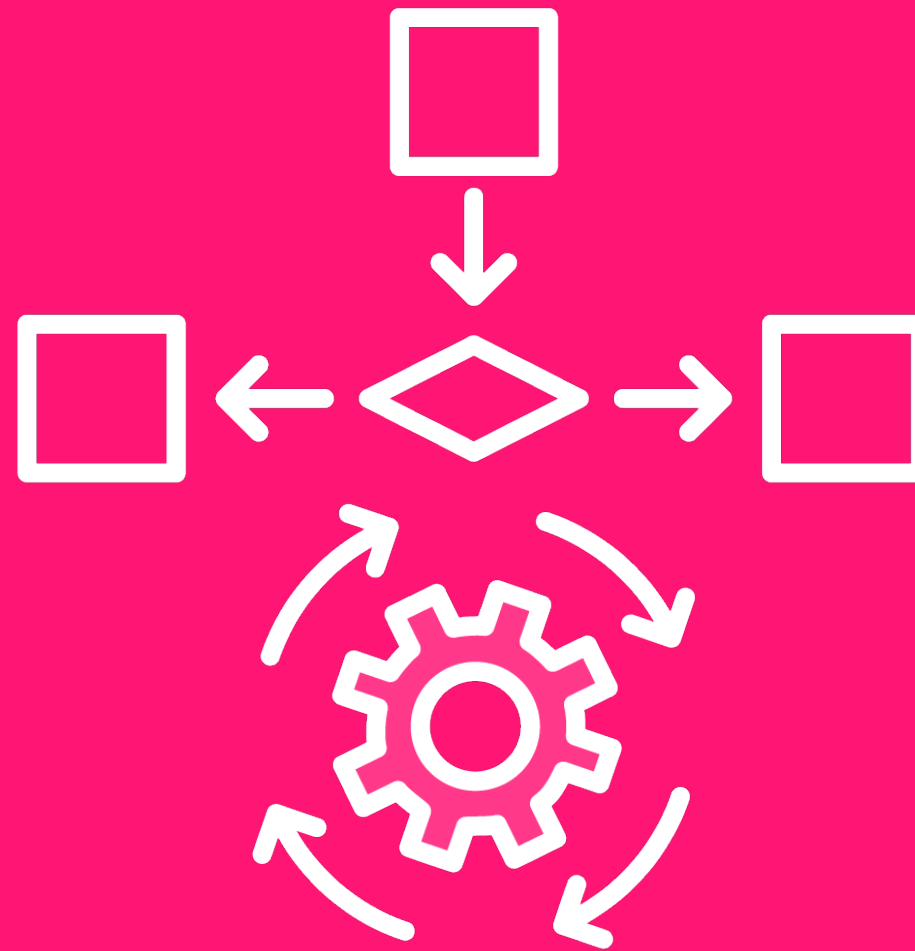


Overview

VoIP protocols and standards

- What are different VoIP protocols?
- What is Codec?
- What is QoS?





SIP – Session Initiation Protocol

**Initiate, establish and manage
communication sessions for voice and video
calls**



SIP – Session Initiation Protocol

Setting up, modifying,
maintaining, or terminating the
calls

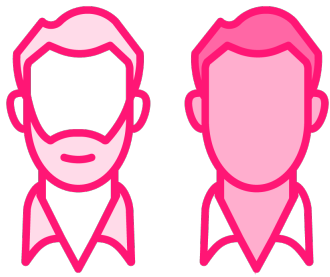
Call hold

Conference call

End call



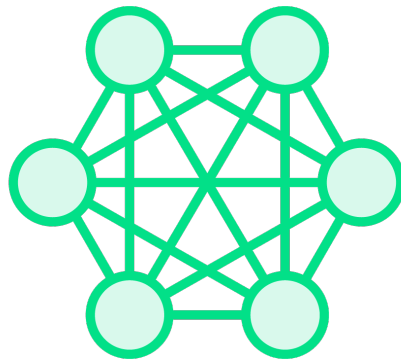
SIP – Session Initiation Protocol



Call your best friend using the internet



Traffic cop



Route call



SIP – Session Initiation Protocol

Find a friend at a party

Ask the host about him

Host helps finding

SIP on internet finds your friend's phone

Remember SIP on next VoIP call



H.323 Protocol

**Communication
standard for calls**

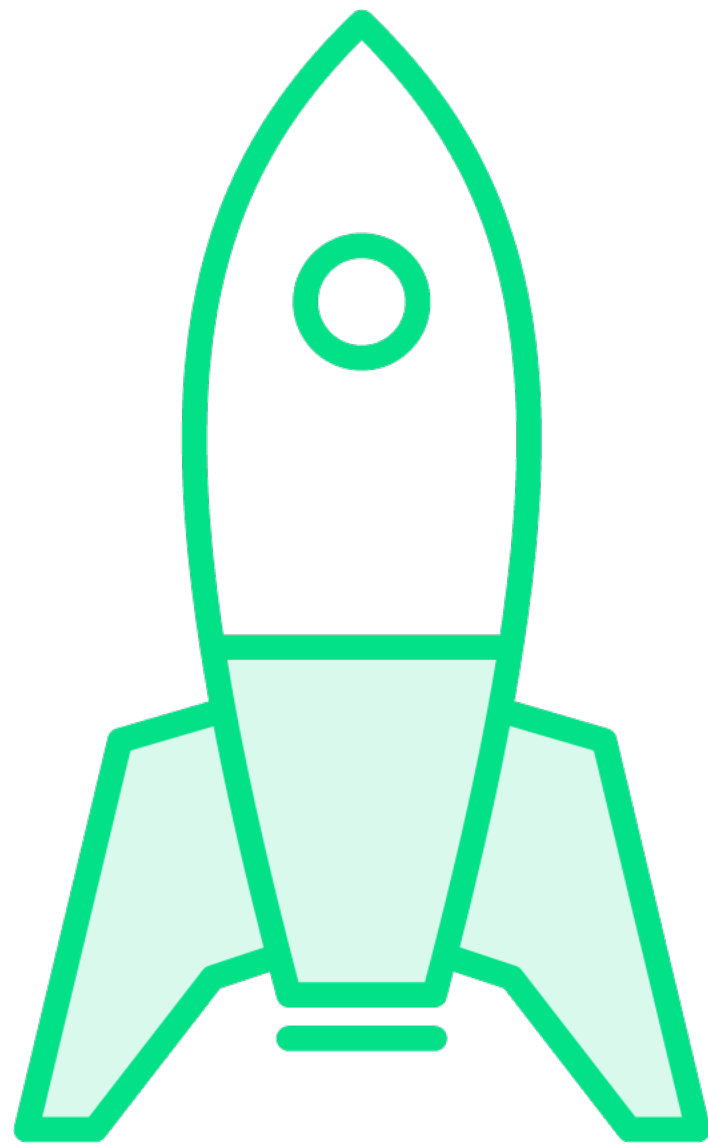
**Set of rules to
communicate**

**Coordinate for call
signaling**

Game rules

**Easier and smoother
to communicate**

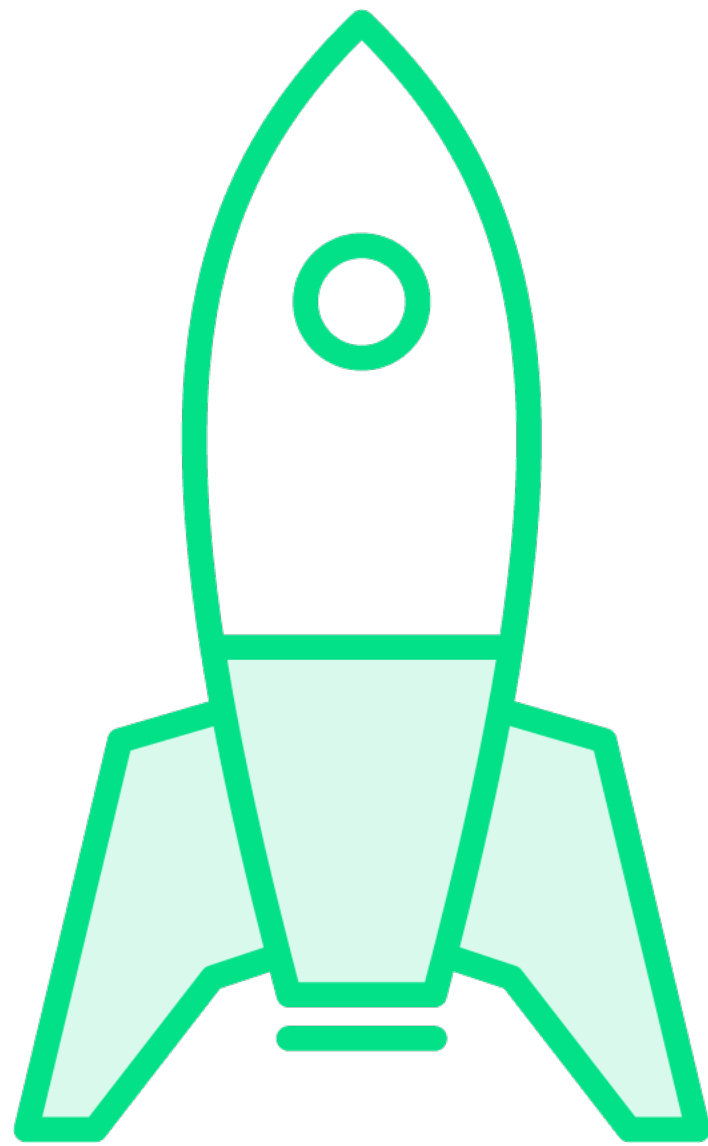




RTP – Real-time transport protocol

- Different purpose
- To send and receive audio and video traffic
- In real-time
- Dividing into small packets
- Transmit over
- Add packets together
- Form original audio or video





RTP – Real-time transport protocol

- High-quality audio and video
- Extra information to each packet
- Sending time and order
- Responsible for delivering packets
- Over UDP
- Focuses on speed
- Optimized for low latency and jitter
- Works with SIP and H.323

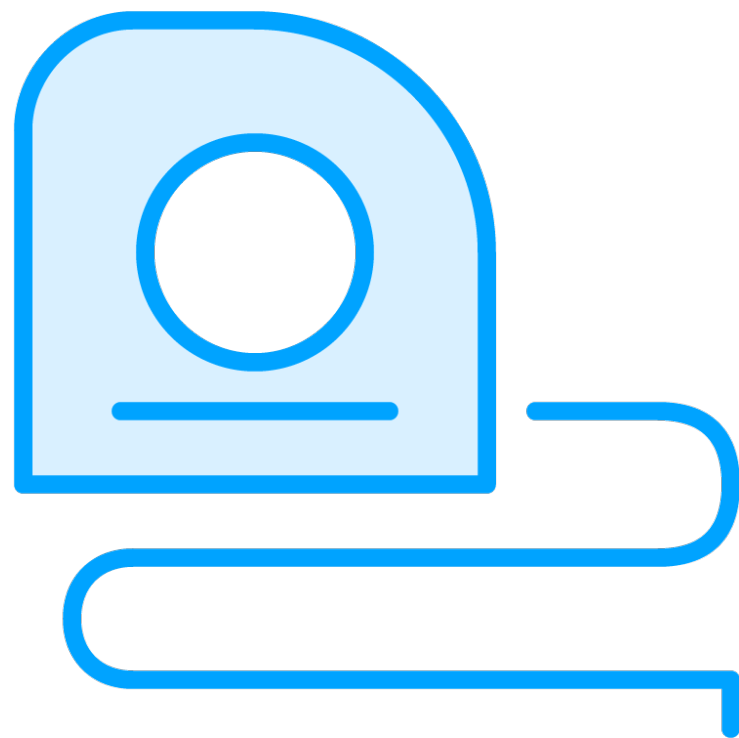




Other VoIP Protocols and Standards



RTCP - Real-time Transport Control Protocol



What is RTCP?

- Scorekeeper for VoIP calls
- Track call quality
- Number of packets sent and received
- Used with RTP
- Monitor call quality



Multimedia Gateway

PSTN calls

Different protocols in
PSTN

VoIP to PSTN

Translate between
two different
protocols

Router

Cloud-based
gateways



MGCP - Media Gateway Control Protocol

Control and manage
media gateways

Conversion of analog
voice signals into
digital ones

Call routing and call
quality

Client/server
protocol

Call agent (CA)
controls specific
gateway port

Large enterprise,
service provider



Flexible and scalable
Multiple media gateways
Communication
Media gateway
Media gateway controller
Setting up
Maintaining
Tearing down
Control media streams

H.248 (Megaco)

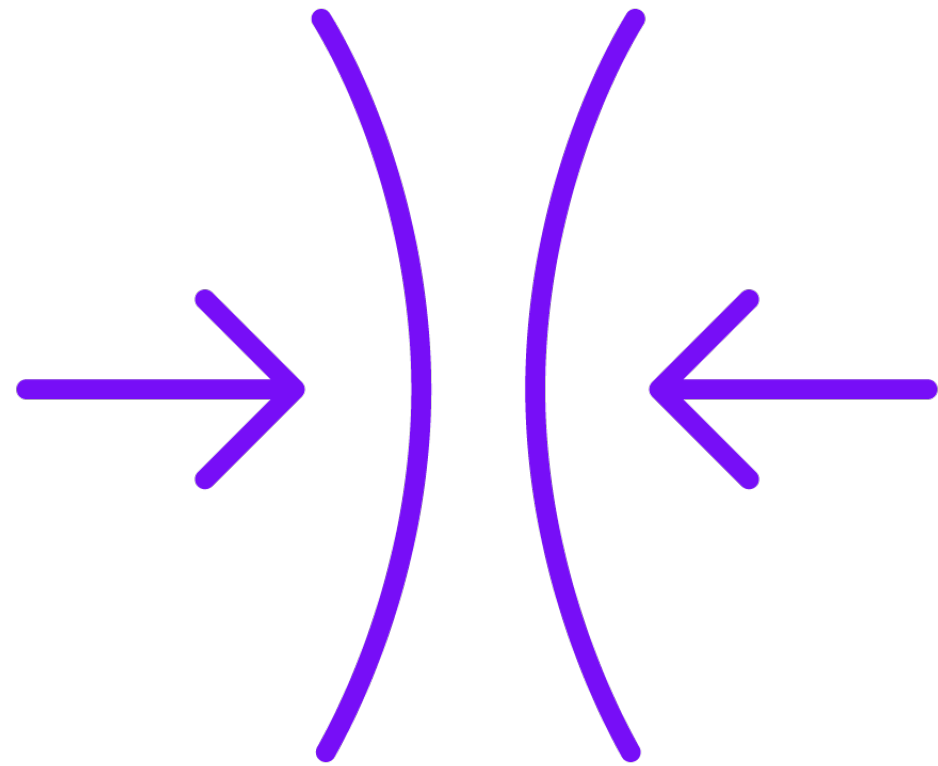




Codecs in VoIP



Codecs



Coder-decoder

- Software or hardware
- Encodes and decodes
- Digital data stream or signal
- Compress and decompress audio data
- Travels over the internet
- Reduce required bandwidth

Secret code

- Computers to talk and understand each other



Size vs. Quality

Different Algorithm

Quality-compression

High compression
Low latency
Lower audio quality



Size vs. Quality

High audio quality
lower compression
ratio and higher
latency

Codec - specific
requirements

Quality, bandwidth,
and latency



Popular Codecs

G.711

high-quality voice
compression

G.729

low-bandwidth
communication

G.722

high-fidelity voice
communication

Opus

adapt to conditions

SILK

low-bandwidth
good quality



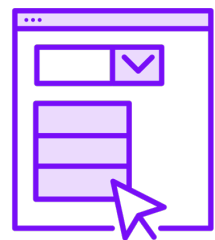
Selecting Right Codec



Strengths and weaknesses



Quality of voice communication



Right codec for a right application



Best possible voice quality





Call Signaling and Media Flow



Call Signaling

Process

establish, modify, and terminate
calls

Handled

signaling protocol such as SIP



Media Flow

Signaling completes

Audio and video data flows

Handled by a transport protocol such as RTP



Media Servers

More features and functionality

Voicemail, conference, recording

Hardware or software

Use SIP and RTP

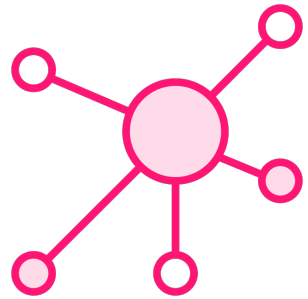




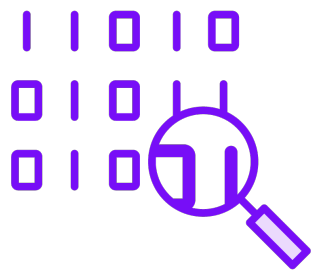
Quality of Service (QoS) Considerations for VoIP



QoS – Quality of Service



Quality of service by a communication network



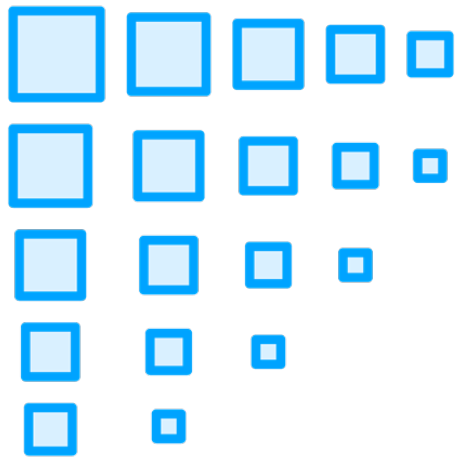
Measured in delay, jitter, and packet loss



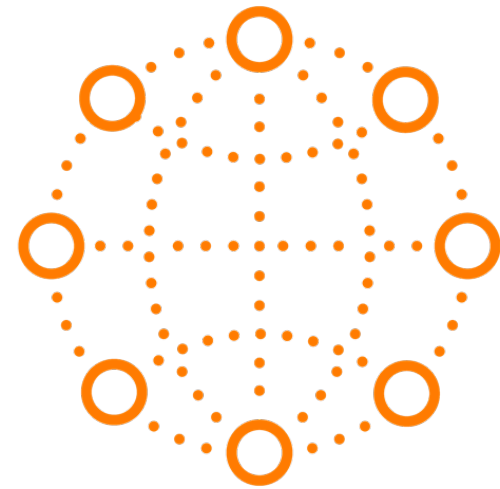
User experience of call quality



Importance of QoS



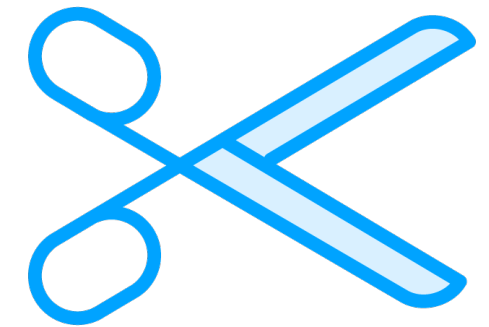
**VoIP
sensitive to
changes**



**Little delay,
jitter, or packet
loss**



Negative impact



**Choppy audio
poor experience**



Improving QoS



How to improve QoS for VoIP?

Prioritizing VoIP traffic

- Over other traffic
- Reduce delay and jitter

QoS marking

- Marking VoIP packets with QoS tag
- Treated with priority

Bandwidth management

- Sufficient bandwidth for VoIP



Demo

Capturing and analyzing real-time VoIP traffic using a protocol analyzer



Summary

Summary

- VoIP protocols and standards
- Call signaling and media flow
- Quality of service (QoS)

