Interactive Applications

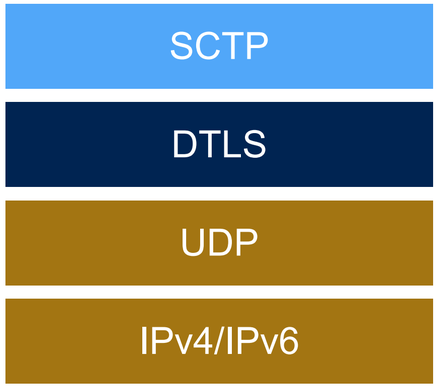
- Data Channel
- Signalling Protocols: SIP → WebRTC

Media: WebRTC Data Channel

- In addition to audio-visual media, WebRTC provides a peer-to-peer **data channel**
  - For peer-to-peer file transfer
  - To support a chat session
  - To support reactions, raise hand, etc.

Media: WebRTC Data Channel

- WebRTC data channel using SCTP in a secure UDP tunnel:
  - Transparent data channel
    - Message-oriented abstraction
    - Multiple sub-streams
    - Congestion controlled
  - Makes it straight-forward to build P2P applications with WebRTC



- Why not use QUIC? Because WebRTC pre-dates the development of QUIC
  - Future versions of WebRTC will likely migrate to using QUIC
  - QUIC is more flexible and more highly optimised

Signalling and Session Descriptions

- Media transport flows peer-to-peer for low latency
- A **signalling protocol** is needed to find the peer and establish the paths
- The control protocol needs to describe the communication session expected:
  - Media transport connections required
  - Media formats and compression algorithms
  - IP addresses and ports to use
  - Originator and purpose of session
  - Options and parameters

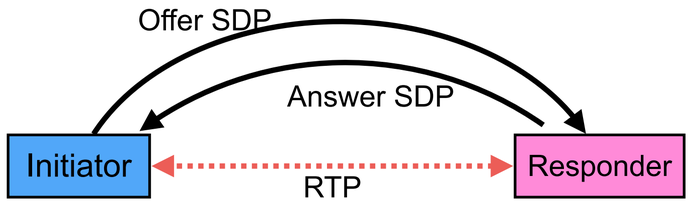
```
v=0
o=jdoe 2890844526 2890842807 IN IP4 10.47.16.5
s=SDP Seminar
i=A Seminar on the session description protocol
u=http://www.example.com/seminars/sdp.pdf
e=j.doe@example.com (Jane Doe)
c=IN IP4 224.2.17.12/127
t=2873397496 2873404696
a=recvonly
m=audio 49170 RTP/AVP 0
m=video 51372 RTP/AVP 99
a=rtpmap:99 h263-1998/90000
```

M. Handley, V. Jacobson, and C. Perkins, “SDP: Session Description Protocol”, IETF, RFC 4566, July 2006. https://datatracker.ietf.org/doc/rfc4566/

- **Session description protocol** (SDP) provides a standard format for such data

Session Descriptions: SDP Offer/Answer

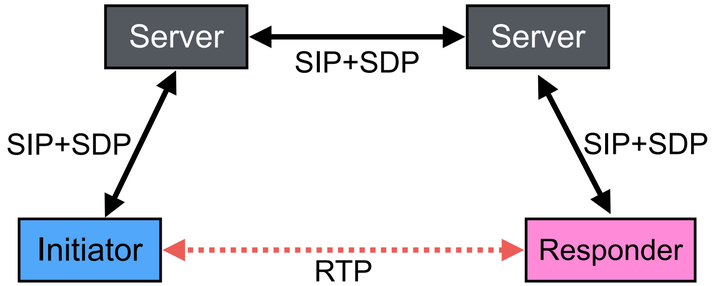
- Interactive sessions require negotiation
  - An **offer** to communicate: lists codecs, options and addressing details, identity of caller
  - The **answer** subsets codecs and options to those mutually acceptable, supplies addressing details, and confirms willingness to communicate



  - ICE algorithm (→ Lecture 2) probes NAT bindings, establishes path
  - Audio and video data flows
- SDP used as the negotiation format
  - SDP **was not** designed to express options and alternatives
  - Insufficient structure in syntax, semantic overloading
  - Complex → but complexity not initially visible; now too entrenched for alternatives to take off

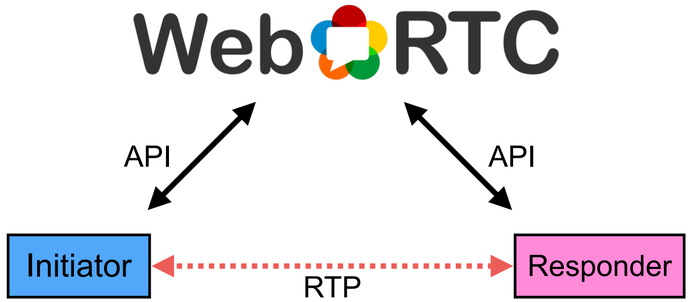
Control of Interactive Conferencing: SIP

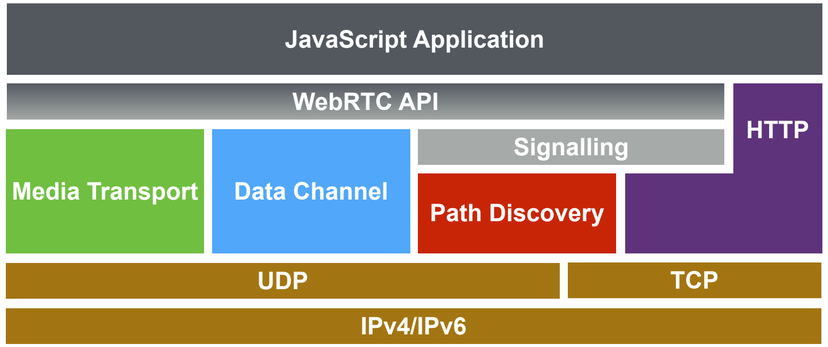
- The signalling protocol sets up the call
  - **Session Initiation Protocol** (SIP) for telephony and video conferencing
  - Conferencing servers with public IP addresses handle calls for a domain
  - SIP messages sent from initiator to responder via servers
    - Determine location of responder
    - Discover NAT bindings
    - Negotiate parameters and options for the call
    - An offer/answer exchange using SDP to describe the session being created
  - Alert the responding user – make phone ring! – and agree to setup a call
    - NAT binding discovery and connection probing takes place while alerting
  - Media then flows over direct peer-to-peer path



Browser-based Conferencing: WebRTC

- **WebRTC** is an alternative signalling protocol
  - Implemented in web browsers
  - Exposes standard JavaScript API





- Signalling messages delivered via HTTP to web server controlling the call
  - Offer/answer exchanges using SDP
- Media transport uses RTP – same as SIP
- Adds peer-to-peer data channel
- Designed to integrate video conferencing into web browsers and web applications

Future Directions for Interactive Applications

- New media types – holographic, tactile, augmented and virtual reality
  - Every stricter requirements on quality and latency
  - All can fit within the basic framework described

- Media over QUIC?
  - Active research and standardisation – expect rapid developments in this space

Interactive Applications

- Architecture for video conferencing
- Signalling and media traffic
- SIP, SDP, RTP → WebRTC