# TLS 1.3

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# Goals for TLS 1.3

*Clean up:* Remove unused or unsafe features

*Improve privacy:* Encrypt more of the handshake

*Improve latency:* Target: 1-RTT handshake for naïve clients;
0-RTT handshake for repeat connections

*Continuity:* Maintain existing important use cases

# Talk Overview

- Removed features
- Current status
- Remaining work

# Removed Feature: Static RSA Key Exchange

- Most SSL servers prefer non-PFS cipher suites [SSL14] (specifically static RSA)
- Obviously suboptimal performance characteristics
- No PFS
- Gone in TLS 1.3
- Important: you can still use RSA certificates
  - But with ECDHE or DHE
  - Using ECDHE minimizes performance hit

# Removed Feature: Compression

- Recently published vulnerabilities [DR12]
- Nobody really knows how to use compression safely and generically
  - Sidenote: HTTP2 uses very limited context-specific compression [PR14]
- TLS 1.3 bans compression entirely
  - TLS 1.3 clients MUST NOT offer any compression
  - TLS 1.3 servers MUST fail if compression is offered

# Removed Feature: Non-AEAD Ciphers

- Symmetric ciphers have been under a lot of stress (thanks, Kenny and friends)
  - RC4 [ABP+13]
  - AES-CBC [AP13] in MAC-then-Encrypt mode
- TLS 1.3 bans all non-AEAD ciphers
  - Current AEAD ciphers for TLS: AES-GCM, AES-CCM, ARIA-GCM, Camellia-GCM, ChaCha/Poly (coming soon)

# Removed Feature: Custom (EC)DHE groups

- Previous versions of TLS allowed the server to specify their own DHE group
  - The only way things worked for finite field DHE
  - (Almost unused) option for ECDHE
- This isn't optimal
  - Servers didn't know what size FF group client would accept
  - Hard for client to validate group [BLF+14]
- TLS 1.3 only uses predefined groups
  - Existing RFC 4492 [BWBG+06] EC groups (+ whatever CFRG comes up with)*
  - New FF groups defined in [Gil14]

*Bonus: removed point format negotiation too

# Removed Feature: Renegotiation

- Previous versions of TLS allowed either side to initiate a new handshake
  - This was always kind of confusing to applications
  - And has been a source of vulnerabilities [RRDO10, BLF+14]
- TLS 1.3 simply prohibits renegotiation

# Why did we want renegotiation anyway?

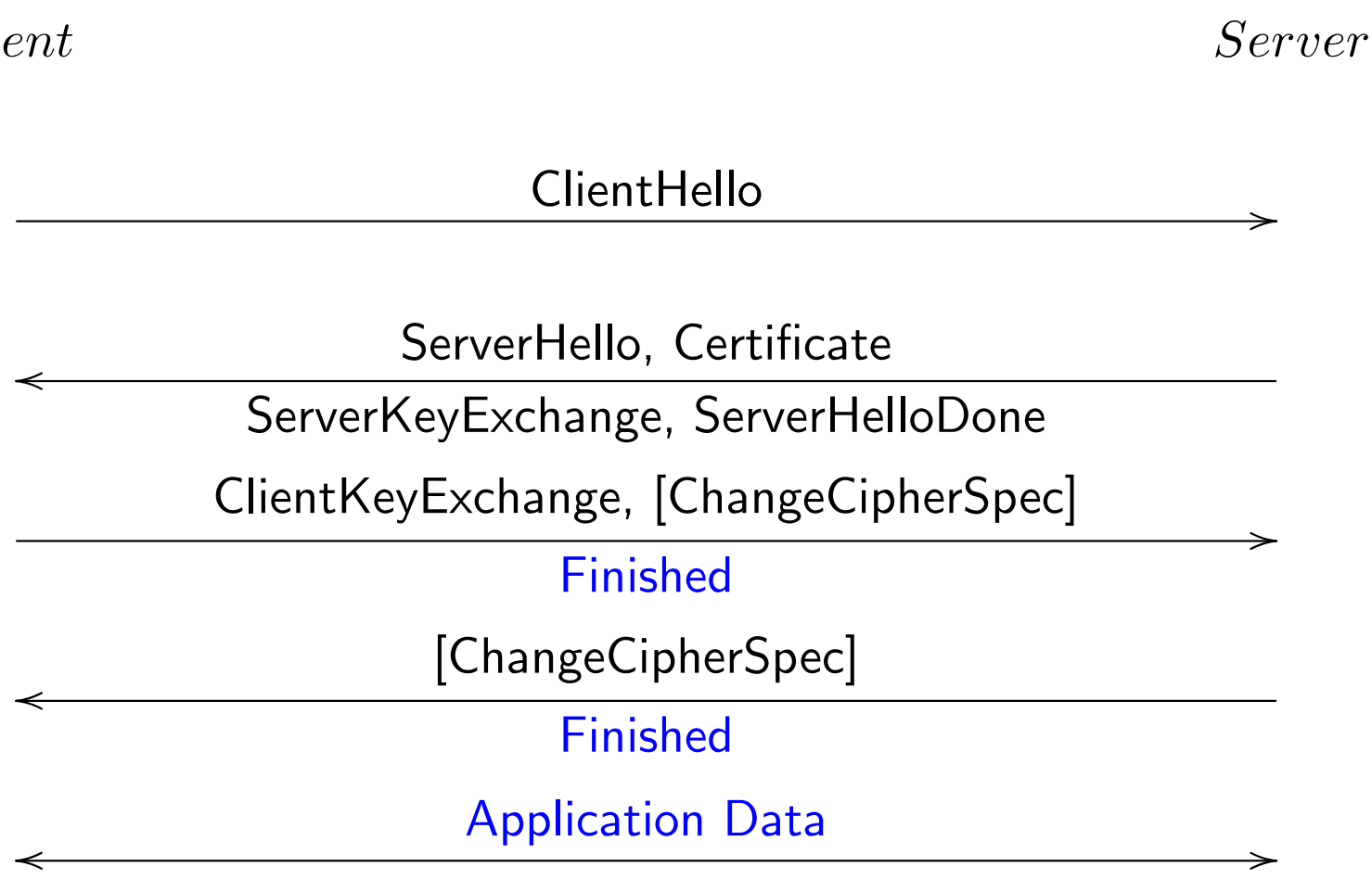
- Connection re-keying
  - Cryptographic exhaustion
  - PFS refresh
- Adding client authentication (or doing private client auth)

- We need to re-add at least some of this.
- For the rest, drop connection and start over

# Features we need to keep

- Client authentication
- Pre-shared keys
- Session resumption (with tickets)
- Extensions (ALPN, DTLS-SRTP, etc.)

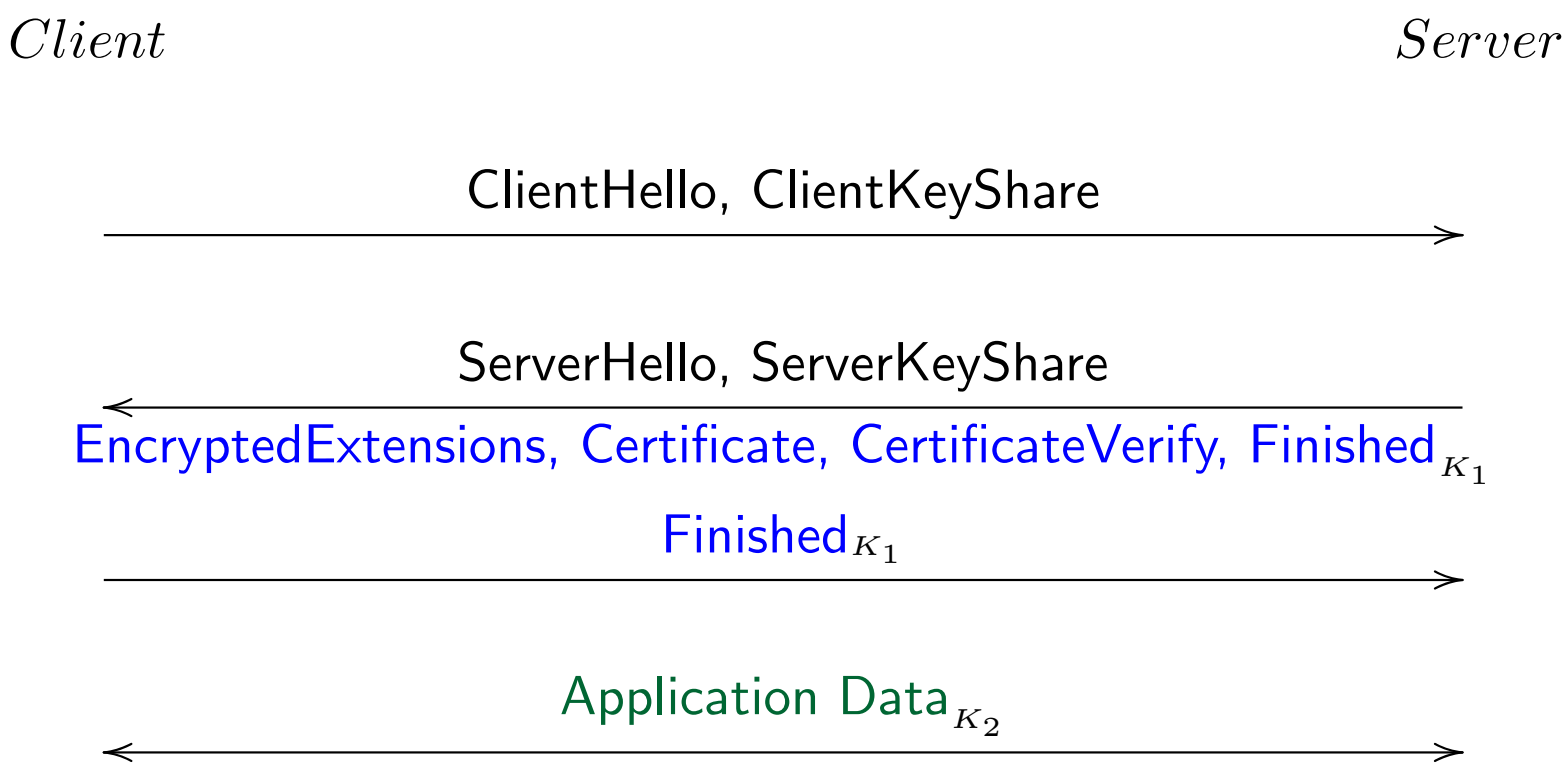
# Reminder: TLS 1.2 Handshake (PFS, no client auth)



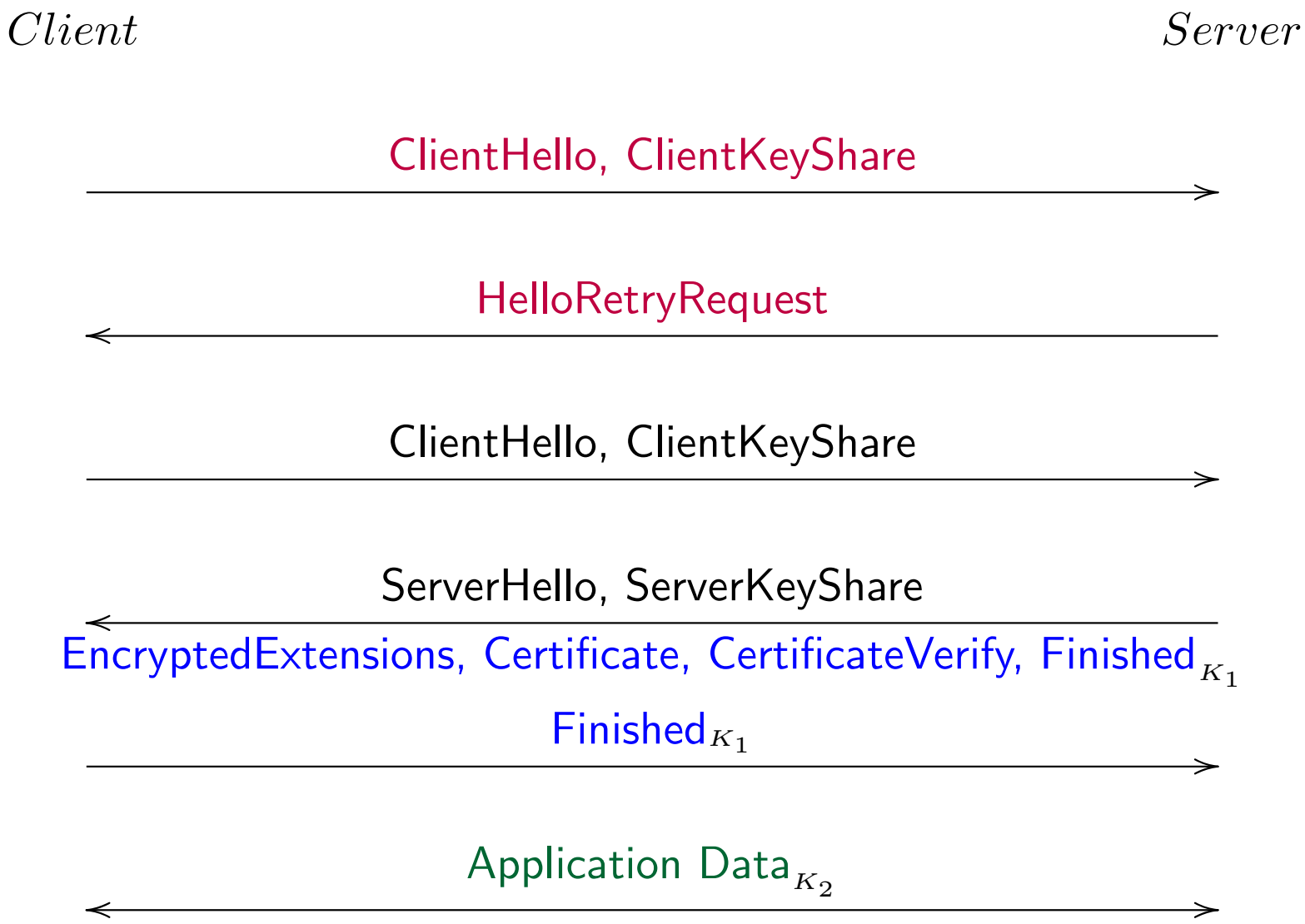
# Basic Idea: Optimistic keying

- Client provides (EC)DHE key shares from expected groups
- Server responds with authenticated ECDHE share
- If client uses an unsupported group, server corrects
- Timing:
  - Server can send data in first flight
  - Client can send data in second flight

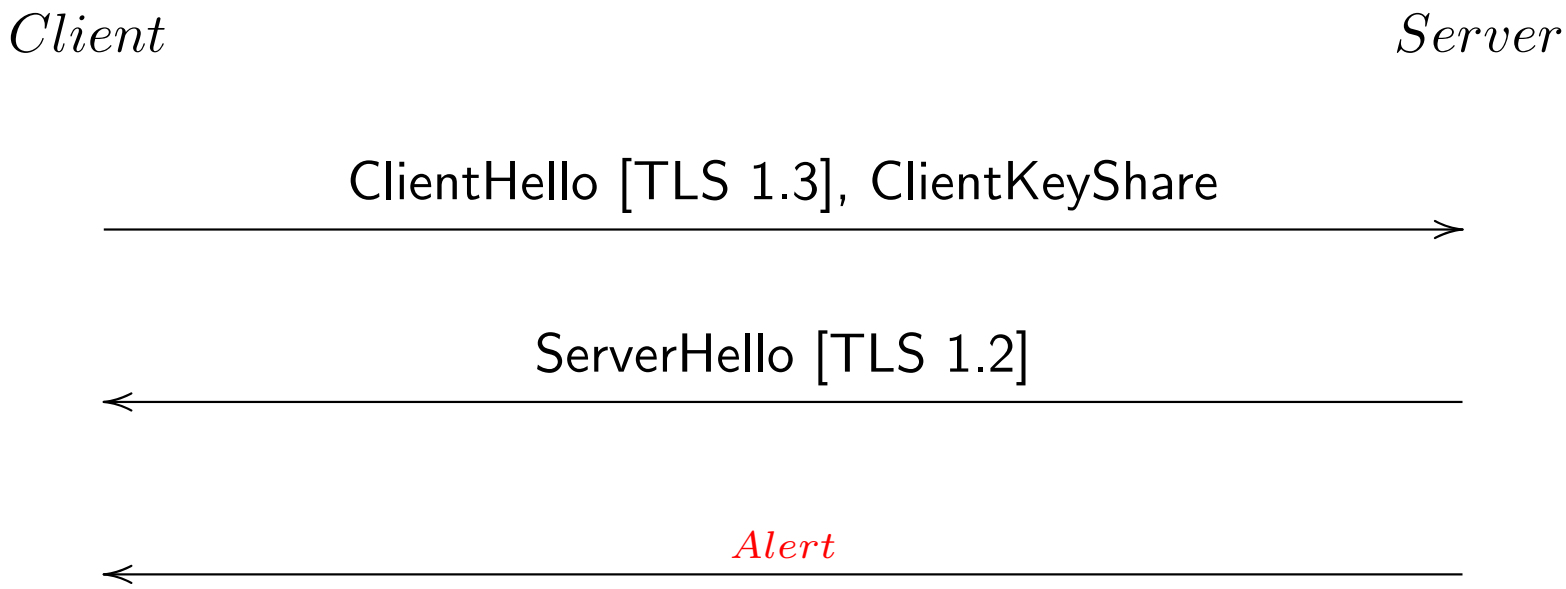
# Basic 1-RTT TLS 1.3 Handshake



# What if client uses an unsupported group?



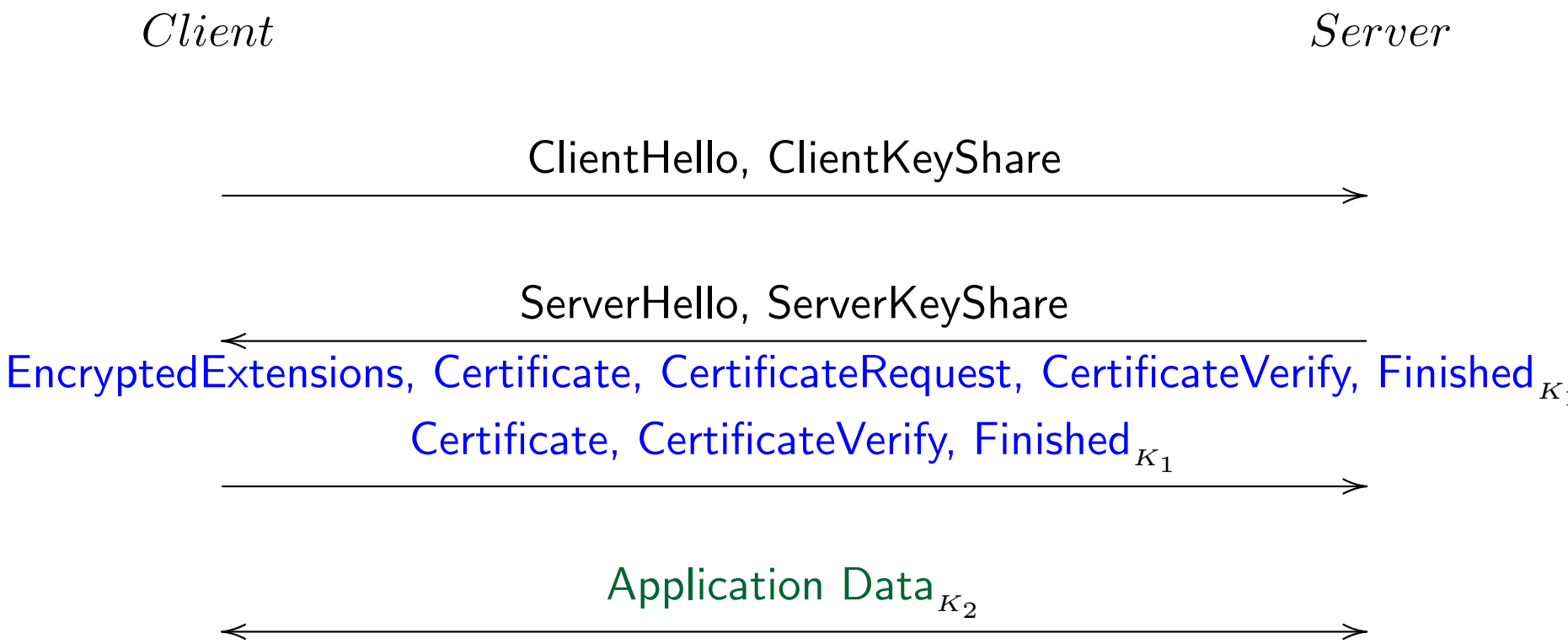
# Backward Compatibility




- This means any new messages in first flight need to go in client extensions
  - At least for initial connections
  - Maybe always because of middleboxes
- Also questions about version number negotiation

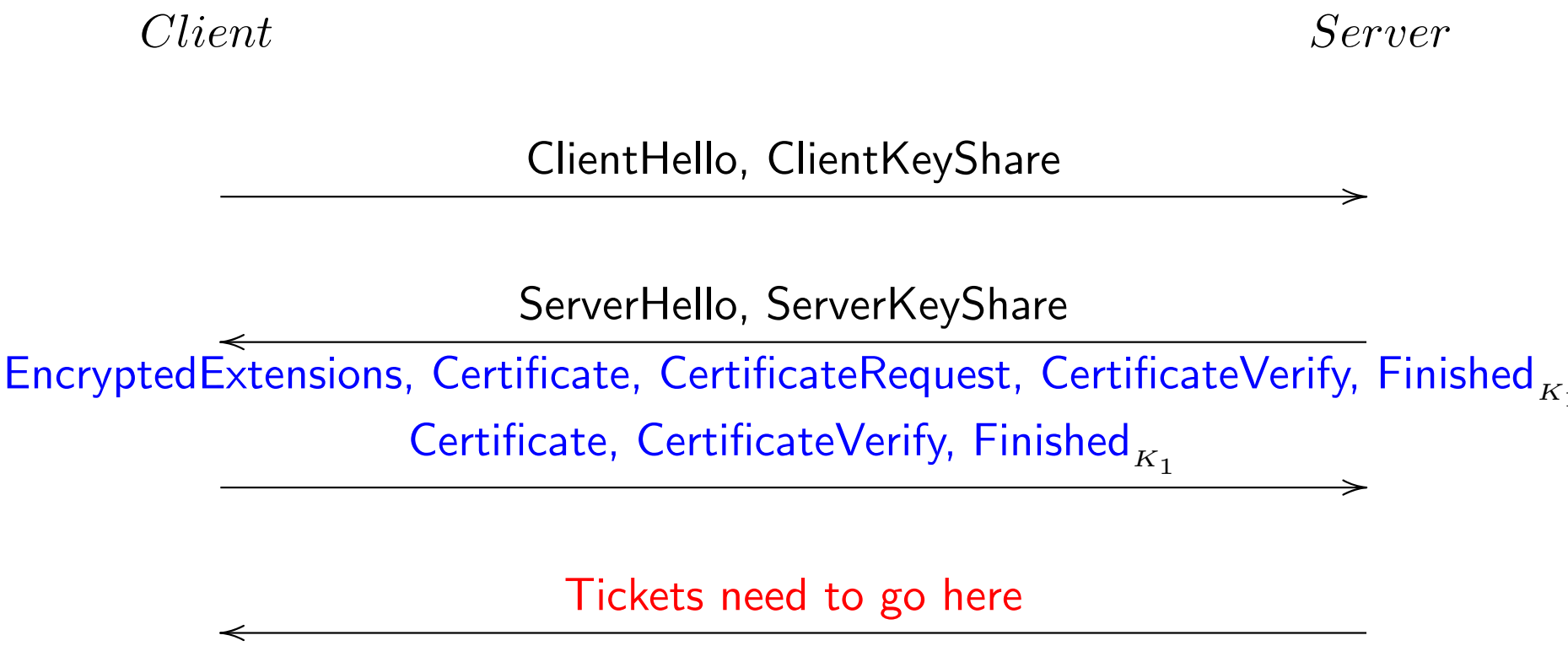
- Measurements needed here

# Client Authentication



# Session Resumption

- Resumption still works fine
  - ... But we just broke session tickets [SZET08]
  - And why do we have both anyway?
- Tickets are more conceptually general than resumption
  - So let's just do tickets


Client
Server
ClientHello, ClientKeyShare
ServerHello, ServerKeyShare
EncryptedExtensions, Certificate, CertificateRequest, CertificateVerify, Finished$_{K}$
Certificate, CertificateVerify, Finished$_{K_1}$
Tickets need to go here

# What about mid-connection client authentication?

- This was allowed in TLS 1.2 via renegotiation
  - It's gone now
- Should be easy to put it back in technically
- But what are the semantics?
  - Retroactively bless previous messages?
  - Impact on session resumption?
- Largely application, not protocol issues
- Interaction with HTTP [BPT14, Tho14]

# 0-RTT

- In general we understand how to do this [Lan10]
  - Client memorizes server's DHE parameters
  - And sends first application data
  - Server needs to keep track of every client nonce
    - Typically scoped by time window and/or a context token
  - Need to fall back if server loses state
- Protocol engineering details need to be worked out
  - How does server indicate readiness to do 0-RTT?
  - How does client indicate use of 0-RTT
  - How is first-flight application data carried?
- This is next on the WG agenda

# Implementations Planned/In-Progress

- NSS
- OpenSSL
- miTLS
- Pike programming language team
- Your name here
- 
- Planning to start interop testing on -04 (1-RTT) this month

# Advertisement: Interim

- Expect a call for dates on list soon

# Questions?

# References


[ABP+13] Nadhem J AlFardan, Daniel J Bernstein, Kenneth G Paterson, Bertram Poettering, and Jacob CN Schuldt. On the Security of RC4 in TLS. In *USENIX Security*, pages 305–320, 2013.

[AP13] N AlFardan and Kenneth G Paterson. Lucky 13: Breaking the TLS and DTLS record protocols. In *IEEE Symposium on Security and Privacy*, 2013.

[BLF+14] Karthikeyan Bhargavan, Antoine Delignat Lavaud, Cédric Fournet, Alfredo Pironti, and Pierre Yves Strub. Triple handshakes and cookie cutters: Breaking and fixing authentication over tls. In *Security and Privacy (SP), 2014 IEEE Symposium on*, pages 98–113. IEEE, 2014.

[BPT14] Mike Belshe, Roberto Peon, and Martin Thomson. Hypertext Transfer Protocol version 2. Internet-Draft draft-ietf-httpbis-

http2-14, Internet Engineering Task Force, July 2014. Work in progress.

[BWBG+06] S. Blake-Wilson, N. Bolyard, V. Gupta, C. Hawk, and B. Moeller. Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS). RFC 4492 (Informational), May 2006. Updated by RFCs 5246, 7027.

[DR12] Thai Duong and Juliano Rizzo. The crime attack. In *Presentation at ekoparty Security Conference*, 2012.

[Gil14] Daniel Kahn Gillmor. Negotiated Finite Field Diffie-Hellman Ephemeral Parameters for TLS. Internet-Draft draft-ietf-tls-negotiated-ff-dhe, Internet Engineering Task Force, August 2014. Work in progress.

[Lan10] Adam Langley. Transport Layer Security (TLS) Snap Start. Internet-Draft draft-agl-tls-snapstart-00, Internet Engineering Task Force, June 2010. Work in progress.

[PR14] Roberto Peon and Herve Ruellan. HPACK - Header Compression for HTTP/2. Internet-Draft draft-ietf-httpbis-header-compression-09, Internet Engineering Task Force, July 2014. Work in progress.

[RRDO10] E. Rescorla, M. Ray, S. Dispensa, and N. Oskov. Transport Layer Security (TLS) Renegotiation Indication Extension. RFC 5746 (Proposed Standard), February 2010.

[SSL14] SSL Pulse. `https://www.ssllabs.com/`, Dec 2014.

[SZET08] J. Salowey, H. Zhou, P. Eronen, and H. Tschofenig. Transport Layer Security (TLS) Session Resumption without Server-Side State. RFC 5077 (Proposed Standard), January 2008.

[Tho14] Martin Thomson. Client Authentication over New TLS Connection. Internet-Draft draft-thomson-httpbis-cant-01, Internet Engineering Task Force, July 2014. Work in progress.