

# Using erasure codes to enable interactions over networks

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# BitRipple founding team

## Experienced Leadership Team

- Prior startup with acquisition by Qualcomm
- Well respected for major contributions to the most broadly used wireless and streaming standards (MPEG DASH, 3GPP MBMS, IETF RFCs)
- World renowned experts with a history of utilizing technology expertise to successfully drive leading edge solutions into the marketplace
- Adept at creating revenue generating relationships with multiple commercial and defense companies (bootstrap mode)
- Strong board of advisors with experience in targeted markets



### **Michael Luby: BitRipple, CEO and cofounder**

- Digital Fountain, CTO and cofounder
- Qualcomm Technologies, VP of Technology
- Multiple entrepreneurship, standardization, and research awards
- Math BSc (MIT) , Computer Science PhD (UC Berkeley)
- National Academy of Engineering, IEEE Fellow, ACM Fellow



### **Lorenz Minder: BitRipple, VP Engineering and cofounder**

- Qualcomm Senior Staff Engineer
- Software developer, software architect, scientist
- Mobile delivery & video streaming expertise
- Mathematics Diploma of Engineering and PhD (EPFL)



### **Pooja Aggarwal: BitRipple, VP Systems and cofounder**

- Qualcomm Principal Engineer (MediaFLO and ATG incubator teams)
- Mobile delivery & security expertise
- Systems architect, software developer
- Computer Science and Engineering BTech (NIT, India), CS MSc (SUNY)

# Summary

## Mission

### **Virtual Interactive Network**

**Enabling flawless  
interactive experiences**

## Competitive advantages

- **5x more responsive** user experience
- **Predictable low-latency data delivery**
- **Scalable and flexible**
  - VPN-like integration
  - No changes to deployments

## Applications

- Cloud gaming
- AR/VR
- Telematics
- Remote collaboration

## Problems solved

- Eliminates stalls, lags, jitter, pixelation
- Predictable experience over wireless
- Increases data delivery robustness

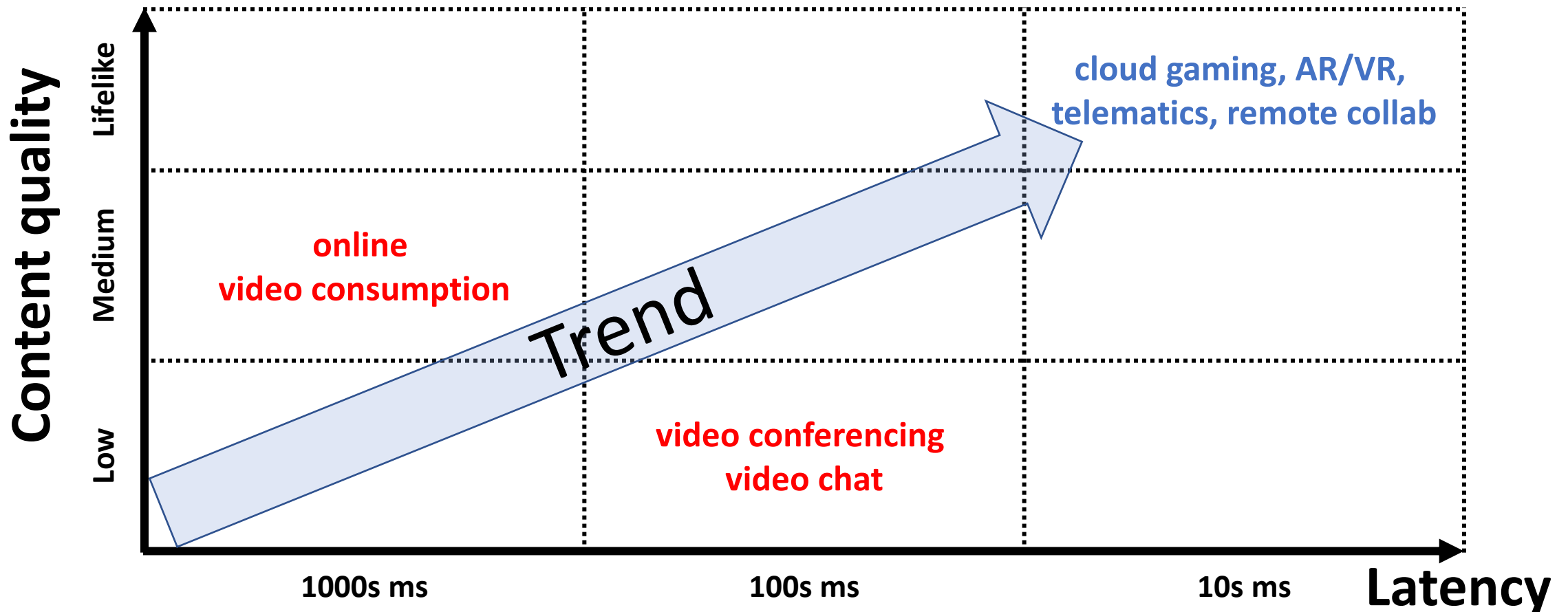
# Market trends

“Latency is the scourge of the modern era”

Gabriel Aul, VP, Meta Reality Labs Product + Engineering

“A 10 ms increase in latency reduces weekly play time by 6%”

[The Metaverse Primer](#) – Networking and the Metaverse





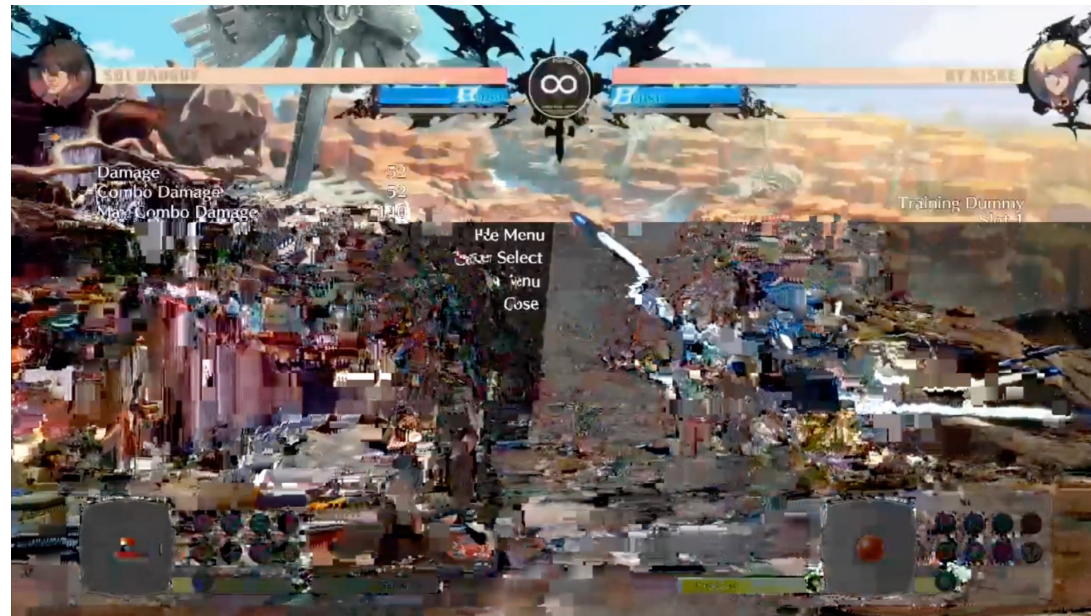
## Opportunities

- cloud gaming
- AR/VR
- telematics
- remote collaboration



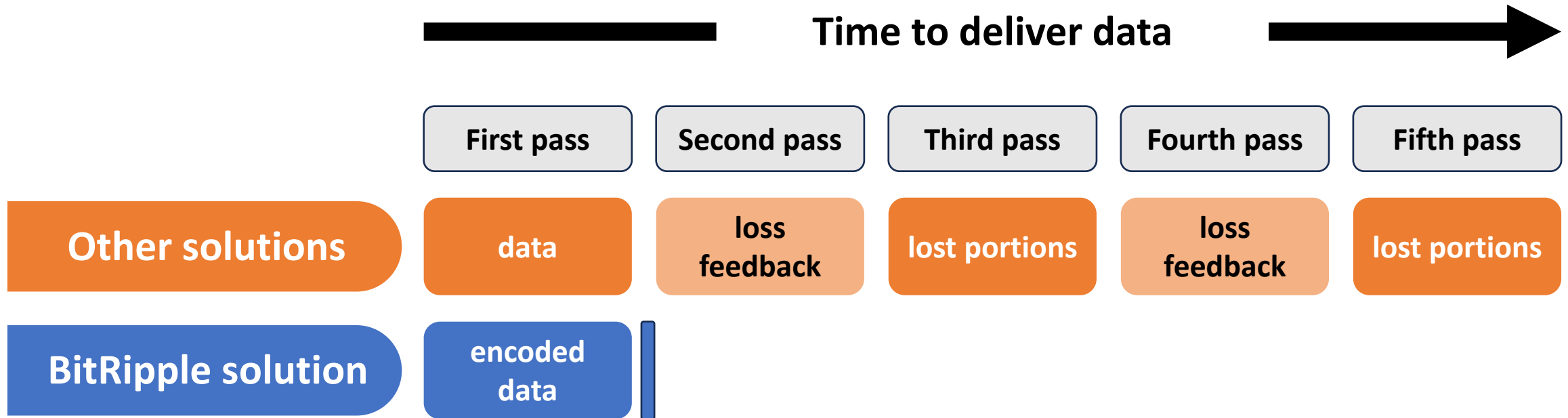
## Problems

- stalls
- lags
- jitter
- pixelation



**Xbox Cloud Gaming  
WiFi**

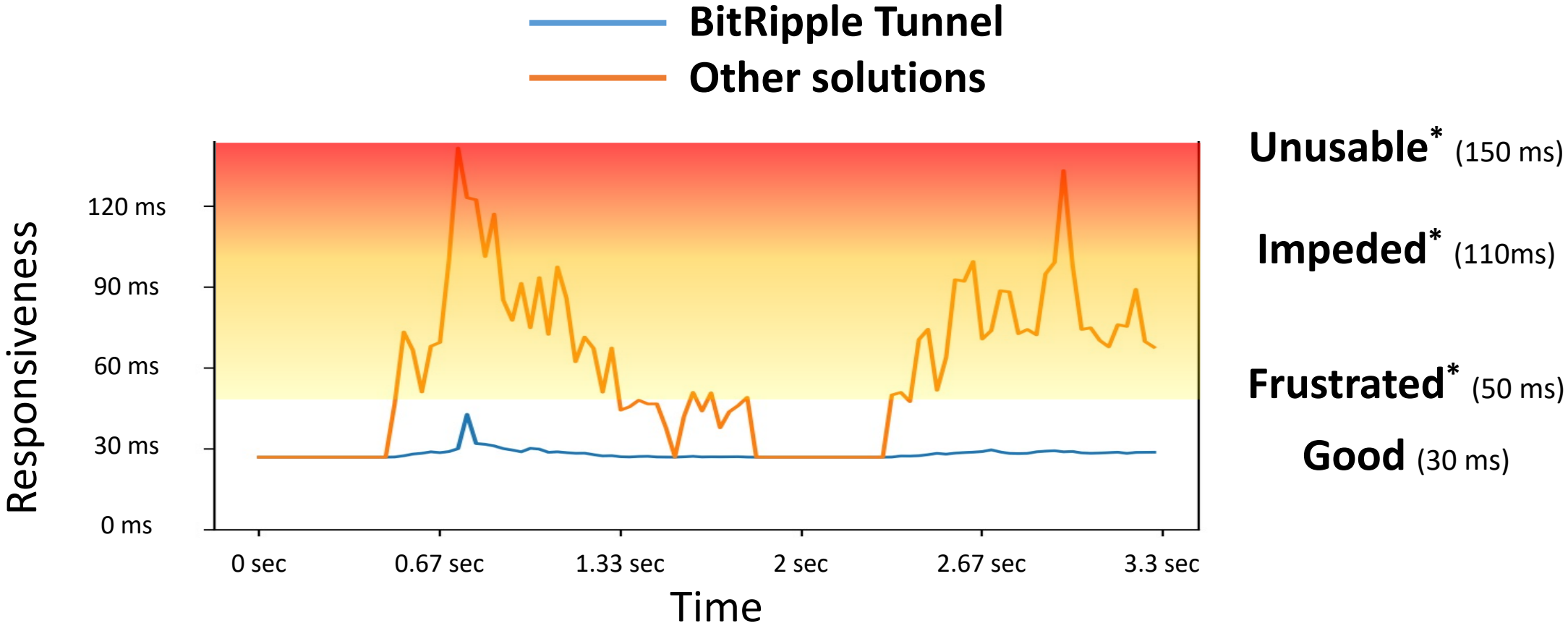
# BitRipple – a better way to move data



- **Encoded data** is generated using RaptorQ\* from a data block that is **expandable** and **interchangeable**
- **Expandable:** Any amount of packet loss can be overcome by generating as much **encoded data** as needed.
- **Interchangeable:** Data recoverable from receiving enough **encoded data**, independent of what is lost

\*RaptorQ erasure code is standardized as IETF RFC 6330. BitRipple personnel are principal inventors of RaptorQ.

# BitRipple Tunnel

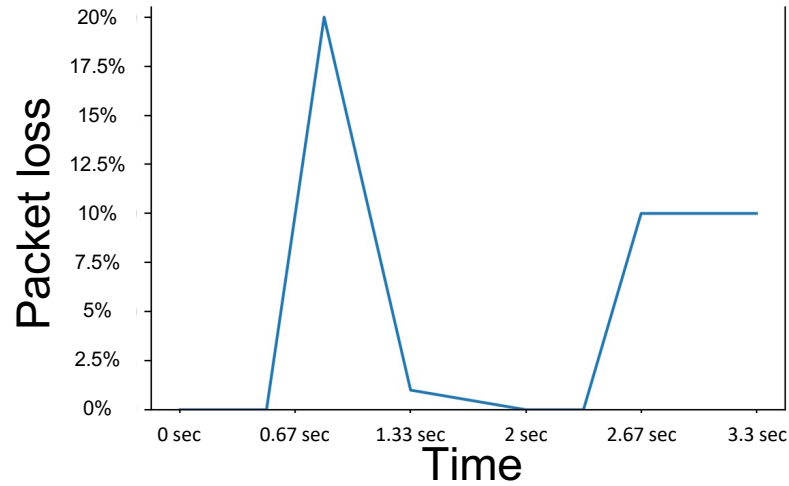


\*[The Metaverse Primer](#) – Networking and the Metaverse, Jun 29, 2021, [Matthew Ball & Jacob Navok](#)

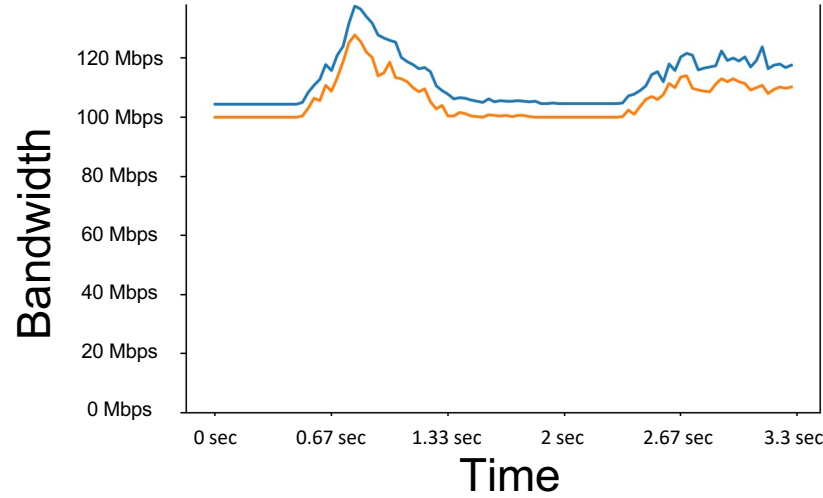
# BitRipple Tunnel

Consistently fast responsiveness and bandwidth-efficient

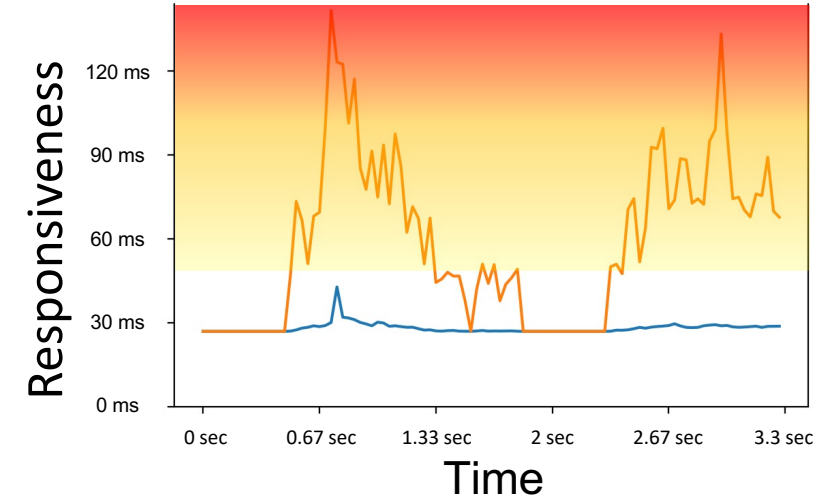
### Varying network conditions



### Bandwidth-efficient



### Consistently fast responsiveness



- BitRipple Tunnel**
- Optimal retransmission-based solution**



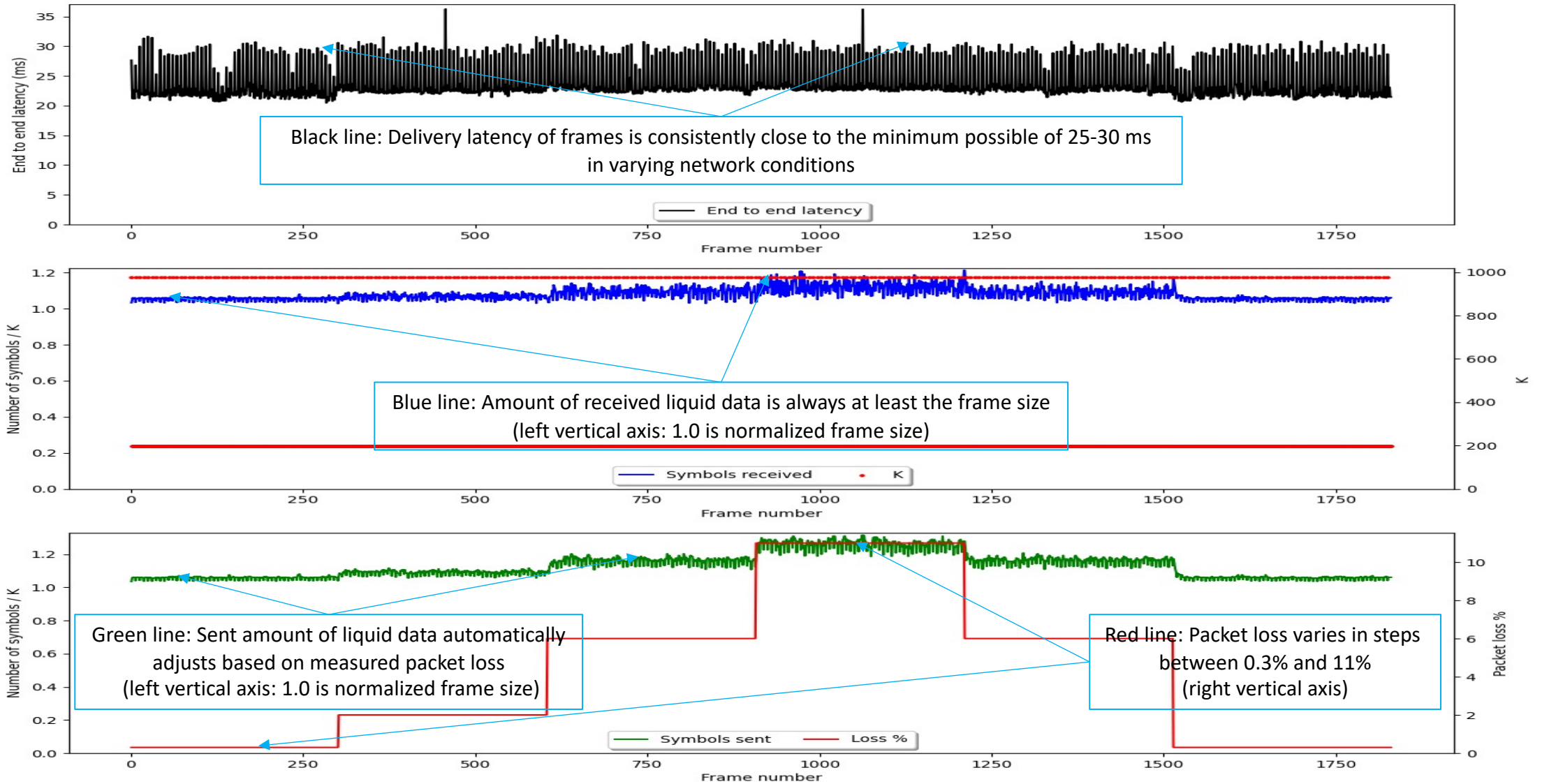
# BitRipple Tunnel Results

9.6Mbps – 30fps – 40KB frames – 3% spiky losses – 40ms RTT – 1 minute run

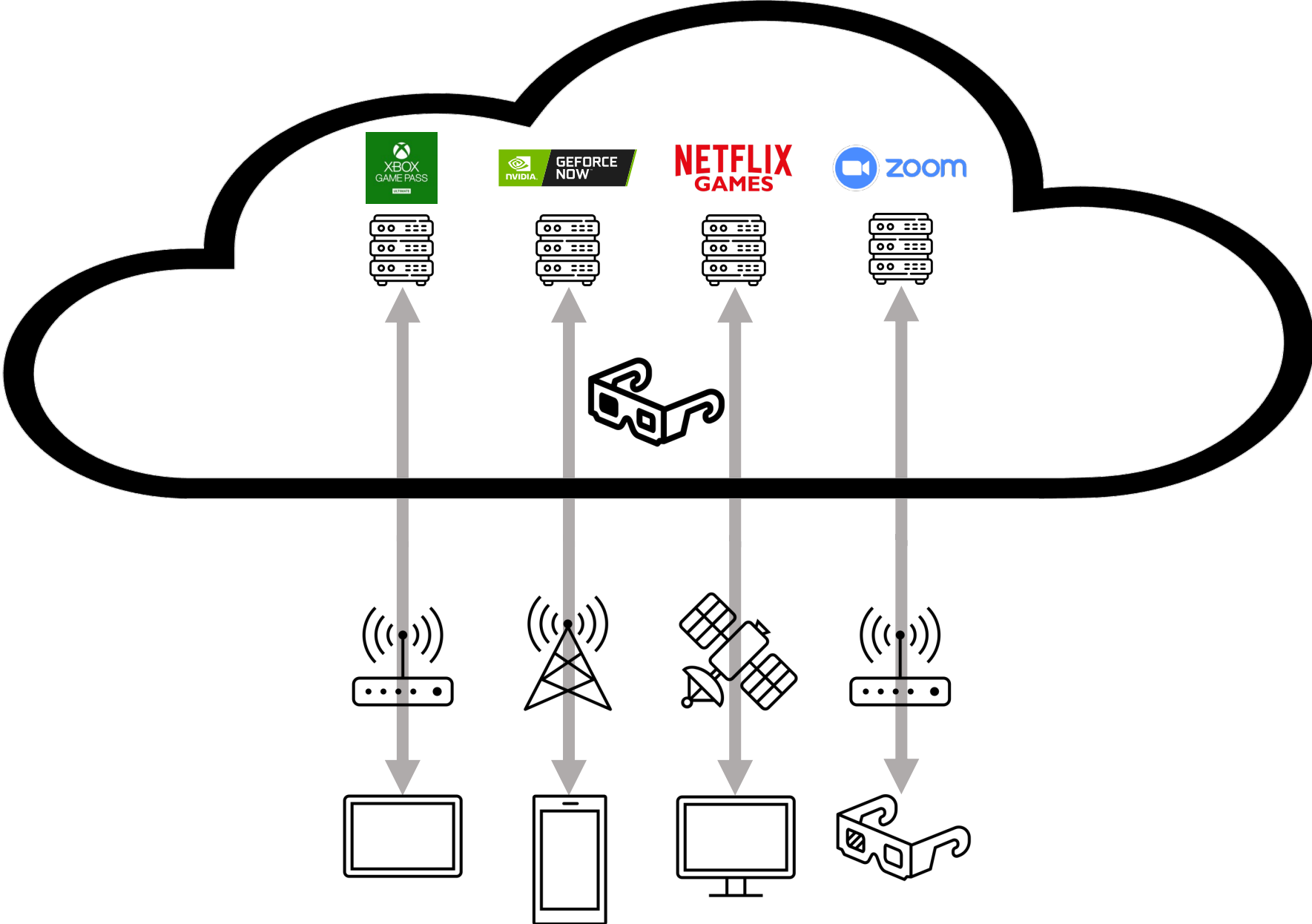


# BitRipple Tunnel Results

100Mbps – 30fps – Mix of 250KB + 1.25MB frames – steps losses – 40ms RTT – 1 minute run



# Existing cloud services

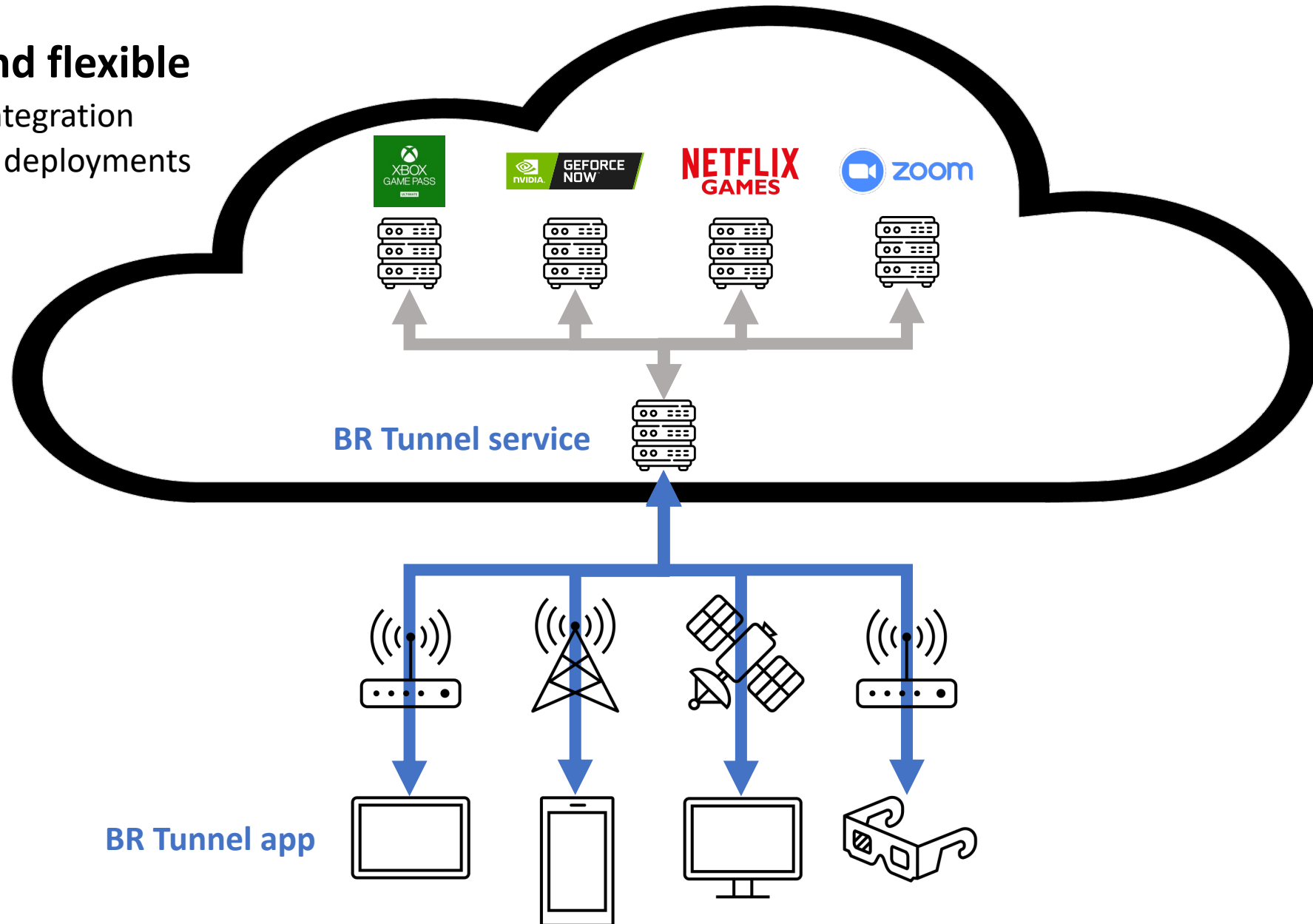


# Virtual Interactive Network

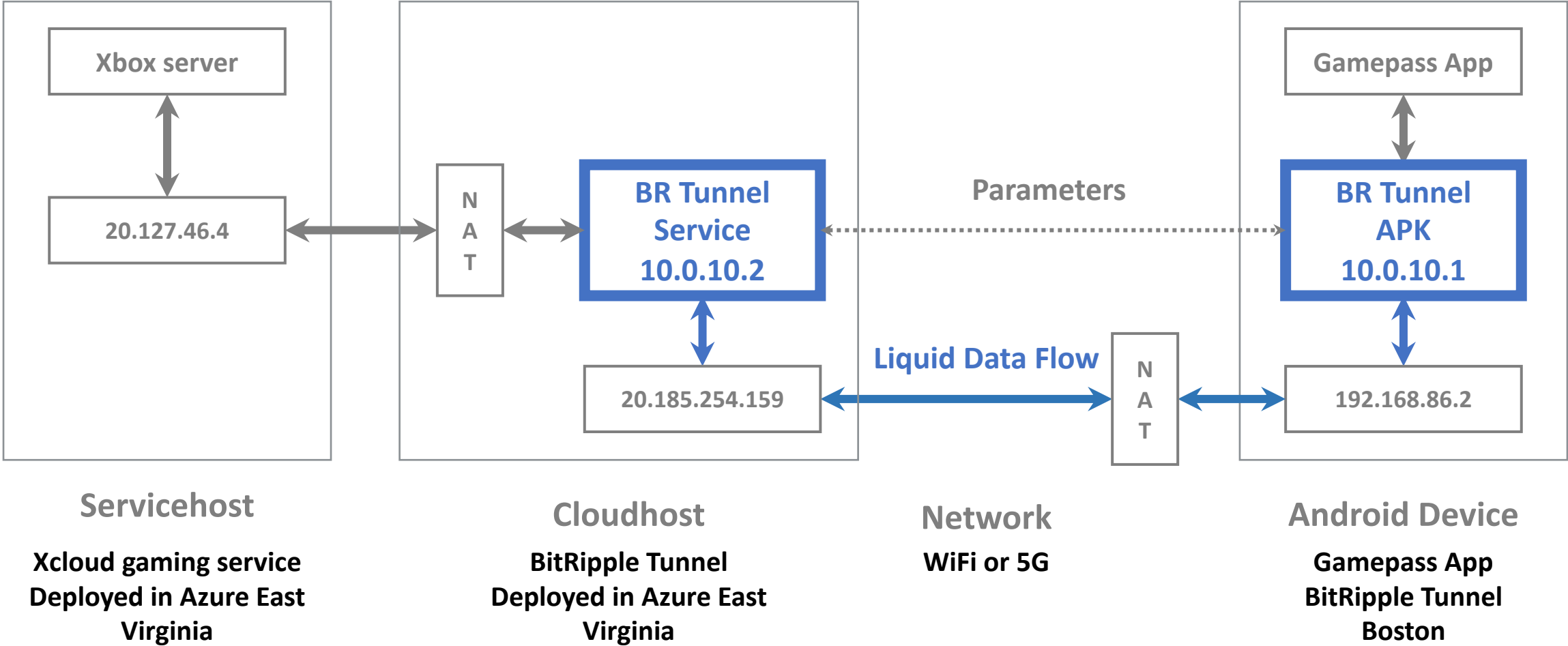
## Scalable and flexible

VPN-like integration

No changes to deployments



# System Setup





WiFi



Star link



Xbox Cloud Gaming

+ BitRipple Tunnel

# GeForce NOW over WiFi



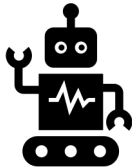
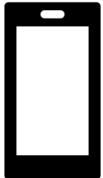
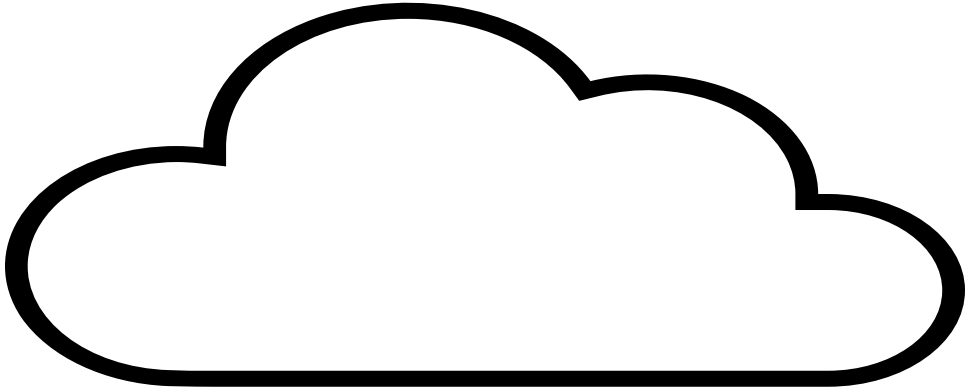
# GeForce NOW + BitRipple Tunnel over WiFi



GeForce RTX 4080	
120 (FPS)	GAME
61 (FPS)	STREAM
35 (ms)	PING
US East (NP-ASH-04)	



# Deployment examples



**Thank you!**