Alleyoop Networks, Inc

A Fresh Approach to Header Compression For Streaming Media

Alleyoop Changes the Streaming Ground Rules

From: Ingrained assumptions create lasting inefficiency

Redundant: Large headers contain two globally unique addresses per packet

Repetitive: These unchanging headers are required in every packet of a stream

Demanding: IP routing consumes computing power along entire WAN transport path

To: Session Bridge creates a modern streaming paradigm

Efficient: Large headers are replaced with minimal header over a virtual circuit, LSP, or eLAN connection

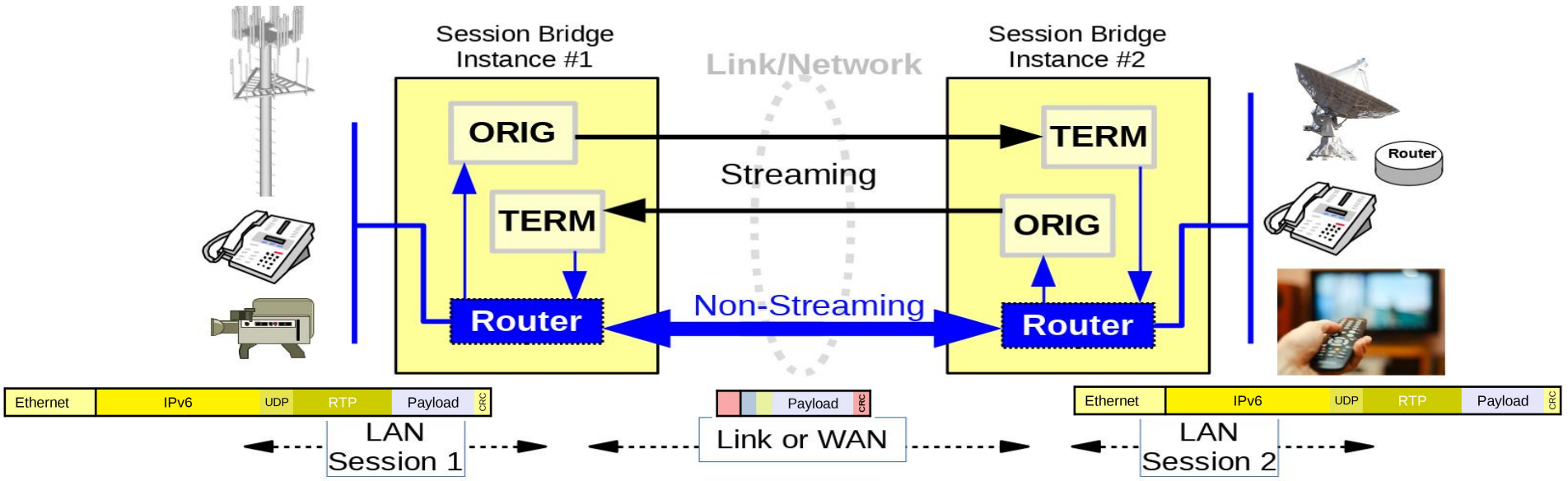
Seamless: End devices are unaffected as full headers are reconstructed for downstream devices

Extendable: Session Bridge savings can be extended across the entire core network and to the RAN

Demonstrated in working proof of concept

Patented Session Bridge Process

- **Headers at ORIGin replaced by short Bridge Tag**
- **TERMination creates headers in separate protocol session**



What Makes Change Worthwhile?

- **Reduced bandwidth consumption**
  - Optimal for links with many real-time voice connections—saves 65%
  - Video in maximum Ethernet frame (1500 bytes)--saves 6%
  - Measured packets during video download/viewing were 350-450 bytes; removing RTP/UDP/IP headers saves 20% to 26%
- **Lower latency**
- **Ease migration to 5G, build network for the future**
- **Cost savings**
  - Applicable to rising volume of music, video, and social media traffic
  - Reduce carrier congestion
  - Outstanding ROI in major use cases

ROI for the VoIP Customer

Line Speed	$/month	SB Cost	Breakeven		Savings	ROI
10 Gbps	$14,000					
1 Gbps	$5,500				$102,000 / 1 year	8:1
Difference	$8,500	$12,500	2 months		$204,000 / 2 years	16:1
2 x T-1 (1 5 Mbps)	$1,200					
1 x T-1	$600				$7,200 / 1 year	3.6:1
Difference	$600	$2,000	4 months		$14,400 / 2 years	7:1

Premise: Session Bridge appliances postpone increases in capacity of a single link, delaying costs. Savings and ROI depend on the length of the delay. At 30% growth per year, delay would be about 2.5 years for 1.5 Mbps, more than 5 years for 1 Gbps.

Security/Privacy of Virtual Circuits

- **Connection path set by carrier, network orchestrator**
- **Path not easily changed by third party**
- **Intermediate nodes hold only local forwarding information that doesn't identify end points**
- **Harder to trace or 'break into' a connection**
- **Often part of private network without routable addresses accessible from the Internet**

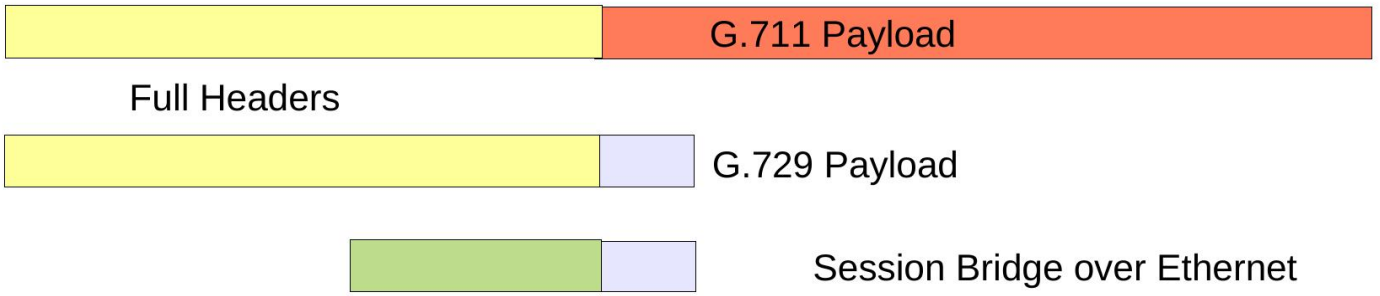
Facing Growth In Bandwidth Demand

- **Customers expect constant connectivity**
- **‘Telephone’ functions moving to more streaming video, music, social networks, OTT TV delivery**
- **New Technologies adding to network congestion**
  - Migration of PSTN circuit traffic to packet networks (SIP trunks)
  - 5G capacity feeding into core networks
  - IPv6 deployment increases header size

Insufficient Responses To Growing Demand

- **Deploy more fiber—slow, expensive**
  - The problem is at the RAN and distributed end points
  - Hybrid networks add to delay and additional header delays
- **Compress packet payloads, ignoring headers**
  - Long since done for voice—not much more to gain
  - Work continues on video encoding—still some potential, will aid Session Bridge
- **Header compression**
  - ROHC: per-hop only, imposes CPU loads, adds latency
  - Tie to single-session adds complexity,
- **Alleyoop offers a new, simple version of header compression**

VoIP Packets



- Bandwidth savings of 50% to 80% in common use cases demonstrated in PoC

- Session Bridge software can run in VoIP Session Border Controller or appliance

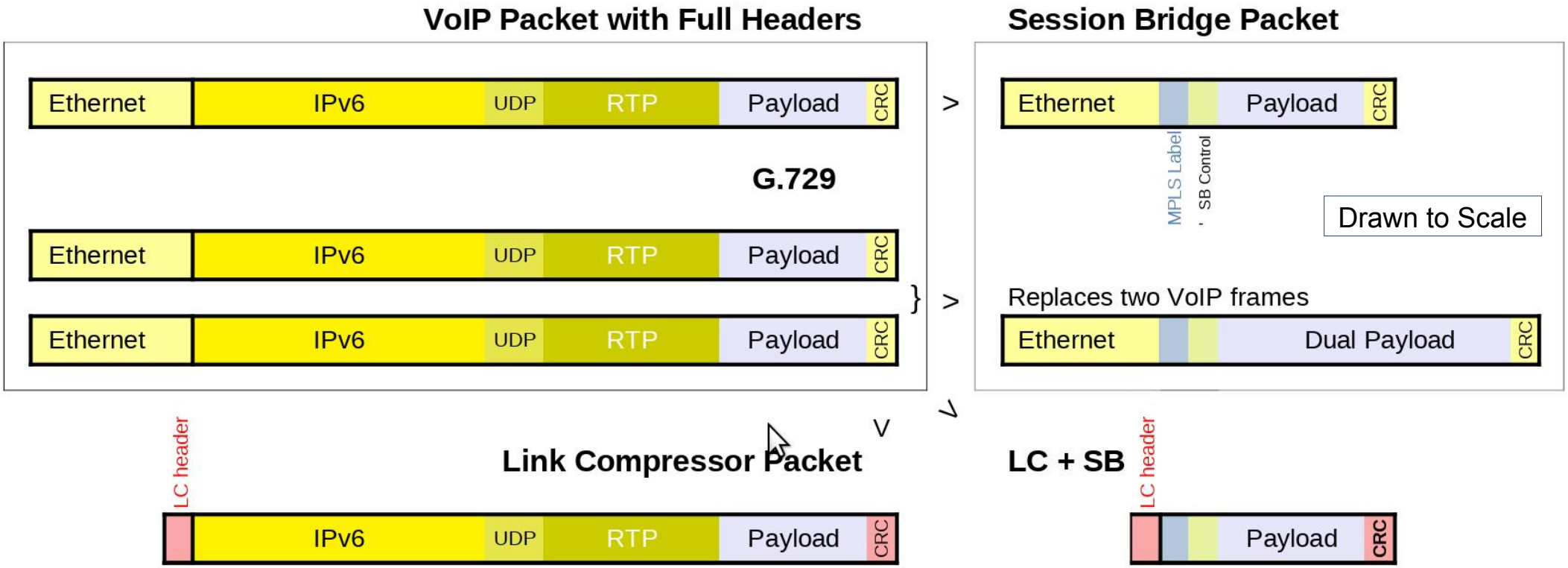
Alleyoop Targets Bandwidth Bottlenecks

- **Cellular backhaul, especially smaller carriers**
  - $40 billion/year spend on 10,000+ cell sites; rapidly expanding site count
  - Sharply rising demand from streaming video, 5G data, packet voice
- **Data Center and Metro transport**
  - Link Compressor NICs save 10% to 60% of bandwidth
  - DoE counts >3 million data centers in US
- **Call Centers and Campuses**
  - Millions of VoIP trunks replacing legacy access lines at call centers
  - Thousands of business, educational, and medical campuses
- **VoIP Carrier networks with leased transmission lines**

Easy to Deploy in Two Ways

- **Session Bridge Appliance or Virtual Instance in partner hardware**
  - Sends packets over existing WAN networks on Label Switched Path or eLAN connection
  - Hides header compression from end devices at edge of network, no impact there
  - Improves existing networks: increases PPS, extends useful life of router/switch hardware
- **Link Compressors**
  - Replace legacy Ethernet NICs transparently
  - Run Session Bridge software on programmable NICs
  - Optimize links within data centers and over ‘metro’ distances
  - Provides bandwidth reduction for all packets
  - In addition to savings of session bridging

Link Compressor Shortens all Packets



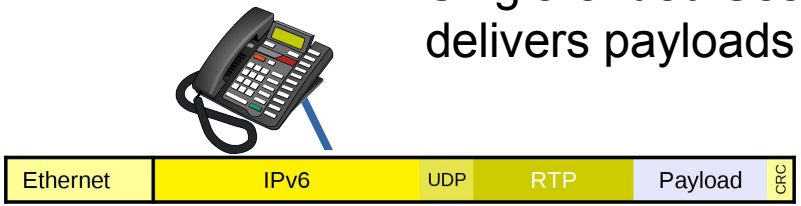
Session Bridge in Mobile Device

- **Session Bridge in end device (5G term: User Equipment, UE)**
  - Terminates Label Switched Path (LSP)
    - Delivers received payload to appropriate application
    - Eliminates need to recreate RTP/UDP/IP headers
  - Creates MPLS packets to send directly into LSP

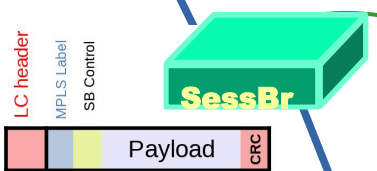
- **Session Bridge process at other end creates headers as needed**
- **Protected by separate patent**
- **Header compression benefits accrue across Radio Access Network, backhaul, and core transport network without additional processing**

Session Terminal Software in Mobile Device

Single-ended Session Bridging (patented) never regenerates headers, delivers payloads directly to end application



SIP Trunk



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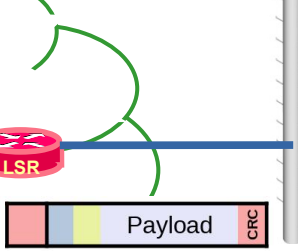
Core Network

LSR

LSR



Backhaul

Radio Access Network

User Equipment with SB function

Proven Ability to Innovate and Grow

- **Product vision based on decades of founder's successes**
  - Several companies profited from earlier product ideas based on understanding customer needs and what will sell
    - Found acquisition that moved FastComm from dial-up modems into frame relay and IP routers
    - Earliest advocate of very large networks (10,000 nodes) at Newbridge, which was sold to Alcatel
    - Avoided ATM in the LAN; advocate of virtual circuits for transport
  - Books for network operators have sold 100,000 copies
  - Experienced working with and managing creative people
- **Initial funding over $100,000**
  - Original coders produced proof of concept on prototype
  - Purchased two hardware setups for development and demonstrations

Project Plan to Innovate and Grow

- **Hardware/FPGA designer identified for Link Compressor task**
- **Multiple additional coders identified and available**
  - Experienced in embedded programming with C
  - Understand communications protocols from direct experience
  - Want to work on a disruptive technology at a startup
  - PoC for RTP; ready to add more formats
- **ANI is ready to move coders to FTE payroll when funded**
- **Key market segments targeted**
- **Many potential hardware partners identified for licensing**

Revenue Projections

Alleyoop Branded Hardware Appliance Sales

Year	Networks	Number of Session Bridge Appliances				Annual Revenue
		Large, h/w	*Large, License*	*Small, License*	*Small, h/w*	
1	10	12	12	100	100	$392,000
2	30	60	71	900	800	$2,707,000
3	80	100	164	2100	1200	$4,539,300
4	100	200	347	4100	2000	$8,298,370
5	200	350	663	6300	2200	$11,796,533

Software Licensing Potential Revenue

Immediate opportunities exist with OEMs of devices related to stream transmission, for inclusion in Session Border Controllers, media delivery servers, etc

In addition, a largest potential exists for the Session Terminal software in devices with cellular connectivity, particularly smartphones, tablets, and IoT devices

Funding Goals

- **Commitment of $4 M investment**
  - Month 1: Initial draw of $750,000 for R&D staff to add capability for additional formats and protocols (QUIC, Viper,
  - Month 8: Draw of $1.25 M to expand staff, start work on mobile Terminal Session, begin appliance production
  - Month 14: Draw of $2 M for sales, marketing, production, service/support operations