#### **O-RTT TCP Converters**

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## The Basic Design

- Converter Protocol is an **application-level protocol** listening on a specific TCP port
  - Commands and responses are encoded as TLVs
    - Ensures extensibility
  - Commands are sent inside SYN
    - Provides **0-RTT** to minimize connection establishment delays
  - Responses are returned in SYN+ACK
  - A plain transport mode is used between Clients and Converters (no encapsulation)
- Clients can learn TCP options supported by Servers

   Allows Clients to bypass the Converter

## A Simplified Example



# Main Changes Since IETF#103

- Integrate feedback from implementors
  - Various tweaks and clarifications
    - Removed error TLV from RSTs since some stacks cannot send/parse such packets easily
  - Open-source client library and wireshark dissectors released by Tessares ( See https://www.tessares.net/technology/open-sourcecontributions/ )
- Simplified the design by removing the requirement from using TFO
  - The protection provided by TFO in the previous design is now provided in the Convert protocol itself









### **Converted-Assisted MPTCP: Bypass**



## Status & Next Step

- A simplified design which takes into account feedback from implementors and comments raised during email discussions
- Adoption from other standardisation bodies
  - Broadband Forum for WT-378
  - 3GPP for the ATSSS service in 5G networks (TS 23.501)
- We believe that the document is ready for WG Last Call

## Backup

• Examples from a first packet trace

#### SYN from client to converter

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	49	9.4105	75	1.1.1	.1	1.1.1.2	CON	V	112	54546→5124	[SYN]	Seq=0	Win=2920	00 Len=24 M	SS=1460 SA	.CK_PERM=1 TSval=2	
	52	9.41093	19	1.1.1	.1	1.1.3.2	TCP		76	54546→8080	[SYN]	Seq=0	Win=281	50 Len=0 MS	S=1408 SAC	K_PERM=1 TSval=37	
	53	9.4110	56	1.1.3	.2	1.1.1.1	TCP		76	8080→54546	[SYN,	ACK]	Seq=0 Acl	<=1 Win=289	60 Len=0 M	SS=1460 SACK_PER№	
	54	9.41100	69	1.1.1	.1	1.1.3.2	TCP		68	54546→8080	[ACK]	Seq=1	Ack=1 W	in=28160 Le	n=0 TSval=	3798003895 TSecr=	- 1
	55	9.41113	33	1.1.1	.2	1.1.1.1	MPT	СР	88	5124→54546	[SYN,	ACK]	Seq=0 Acl	<=25 Win=28	560 Len=0	MSS=1440 SACK_PEF	
	56	9.4111	71	1.1.1	.2	1.1.1.1	CON	V	96	5124→54546	[PSH,	ACK]	Seq=1 Acl	<=25 Win=28	608 Len=8	TSval=822832651 1	
	57	9.4113	13	1.1.1	.1	1.1.1.2	MPT	CP	96	54546→5124		Seq=2	5 ACK=1 \	Vin=29248 L	en=0 ISval	=2222812097 TSecr	- 1
	58	9.4113	25	1.1.1	•2	1.1.1.1	MPT		84		CK 55#1	L] 512	4→54546	[ACK] Seq=9	ACK=25 W1	n=28608 Len=0 TSV	_ 1
	59	9.4113	35 42		• ⊥ 1	1 1 1 2	MPT		84			LJ 545	40→5124	[ACK] Seq=2	5 ACK=1 W1	n=29248 Len=0 TSV	
	00	9.4115	+2	1.1.1	• 1	1.1.1.2	MP I	CF .	70	54540→5124		Seq-2	5 ACK-9 1	VIII-29240 L	en-o isvat	-2222012097 13001	
► Fr	ame 49	: 112 b	ytes o	n wire (	896 b	oits), 11	l2 bytes	captured	(896	bits)							
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#### SYN+ACK returned by converter

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49	9.4105	75	1.1.1	.1	1.1.1.2	CONV	112	54546→5124	[SYN] S	eq=0 Win=292	00 Len=24 M	1SS=1460 SA	ACK_PERM=1	TSval=2	
52	9.41093	19	1.1.1	.1	1.1.3.2	TCP	76	54546→8080	[SYN] S	eq=0 Win=281	60 Len=0 MS	SS=1408 SAC	CK_PERM=1 T	Sval=37	
53	9.41105	56	1.1.3	.2	1.1.1.1	TCP	76	8080→54546	[SYN, A	CK] Seq=0 Ac	k=1 Win=289	060 Len=0 №	1SS=1460 SA	CK_PER№	
54	9.41100	59	1.1.1	.1	1.1.3.2	ТСР	68	54546→8080	[ACK] S	eq=1 Ack=1 W	in=28160 Le	en=0 TSval=	=3798003895	TSecr=	
55	9.41113	33	1.1.1	.2	1.1.1.1	MPTCP	88	5124→54546	[SYN, A	CK] Seq=0 Ac	k=25 Win=28	8560 Len=0	MSS=1440 S	ACK_PEF	
56	9.4111	/1	1.1.1	.2	1.1.1.1	CONV	96	5124→54546	[PSH, A	CK] Seq=1 Ac	k=25 Win=28	3608 Len=8	ISval=8228	32651	
57	9.4113.	13	1.1.1	.1	1.1.1.2	MPTCP	96	54546→5124	[ACK] S	eq=25 ACK=1	W1n=29248 [	en=0 TSVal	l=222281209	/ TSecr	
28	9.4113	20	1.1.1	. 2	1 1 1 1 7		84 04		CK 55#1]	5124→54540 54546 -5134	[ACK] Seq=	ACK=25 WJ	in=20000 Le	n=0 TSV	
59	9.4113	12	1 1 1	1	1 1 1 2	MPTCP	76	54546-5124	[VCK] CK 21#1]	$54540 \rightarrow 5124$	$\frac{[ACK]}{Win=20248}$	on-0 TSval	11-29246 Le		
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Desti	ination	Port: 5	4546												
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Seque	ence num	ber: 0	(rela	tive	sequence	e number)									
Ackno	wledgme	nt numb	er: 25	(re	elative a	ack number)									
Heade	er Lengt	h: 52 b	ytes												
Flags	s: 0x012	(SYN,	ACK)												
Windo	ow size y	value:	28560												
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#### Response returned by converter

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	49	9.4105	75	1.1.1	l.1			1.1.3	1.2		CONV	112	54546→5124	
	52	9.410919 1.1.1.1					1.1.3	3.2	TCP	76	54546→8080			
	53	3 9.411056 1.1.3.2					1.1.3	1.1	TCP	76	8080→54546			
	54	9.411069 1.1.1.1					1.1.3	3.2	TCP	68	54546→8080			
	55	9.411133 1.1.1.2						1.1.3	1.1	MPTCP	88	5124→54546		
+	56	9.4111	71	1.1.1	1.2			1.1.1	1.1	CONV	96	5124→54546		
	57	9.4113	13	1.1.1	1.1			1.1.	1.2	MPTCP	96	54546→5124	1	
	58	9.4113	25	1.1.1	L.2			1.1.3	1.1		MPTCP	84	[TCP Dup AC	
	59	9.411335 1.1.1.1						1.1.3	1.2	MPTCP	84	[TCP Dup AC		
	60	9.411342 1.1.1.1						1.1.1	1.2	MPTCP	76	54546→5124		
	61	9.427585 1.1.1.1					1.1.3	1.2	MPTCP	169	54546→5124			
	62	9.427600 1.1.1.2					1.1.3	1.1	MPTCP	76	5124→54546			
	63	9.42762	.427625 1.1.1.1					1.1.3	3.2	HTTP	149	GET /100KB		
	66	9.427887 1.1.1.1						1.1.2	2.2	MPTCP	88	37325→5124		
_														

- Frame 56: 96 bytes on wire (768 bits), 96 bytes captured (768 bits)
- Linux cooked capture
- Internet Protocol Version 4, Src: 1.1.1.2, Dst: 1.1.1.1
- > Transmission Control Protocol, Src Port: 5124, Dst Port: 54546, Seq: 1, Ack: 25, Len: 8
- ▼ 0-RTT TCP Convert Protocol Data

Version: 1 Total Length: 2 (8 Bytes) Unassigned: 0

▼ Extended TCP Header TLV

Type: 20 (Extended TCP Header TLV)

Length: 1 (4 Bytes)

Unassigned: 0

TCP Header: <MISSING>

## HTTP GET from client

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	49	9.4105	75	1.1.1	.1			1.1.1.	2		CONV	112	54546→5124		
	52	9.4109	19	1.1.1	.1			1.1.3.	2		TCP	76	54546→8080	<u> </u>	
	53	9.4110	56	1.1.3	.2			1.1.1.	1		TCP	76	8080→54546		
	54	9.4110	69	1.1.1	.1			1.1.3.	2		TCP	68	54546→8080		
	55	9.4111	33	1.1.1	.2			1.1.1.	1		MPTCP	88	5124→54546		
	56	9.4111	71	1.1.1	.2			1.1.1.	1		CONV	96	5124→54546		
	57	9.4113	13	1.1.1	.1			1.1.1.	2		MPTCP	96	54546→5124		
	58	9.4113	25	1.1.1	.2			1.1.1.	1		MPTCP	84	[TCP Dup A		
	59	9.4113	35	1.1.1	.1			1.1.1.	2		MPTCP	84	[TCP Dup A		
	60	9.4113	42	1.1.1	.1			1.1.1.	2		MPTCP	76	54546→5124		
	61	9.4275	85	1.1.1	.1			1.1.1.	2		MPTCP	169	54546→5124		
	62	9.4276	00	1.1.1	.2			1.1.1.	1		MPTCP	76	5124→54546		
	63	9.4276	25	1.1.1	.1			1.1.3.	2		HTTP	149	GET /100KB		
	66	9.4278	87	1.1.1	.1			1.1.2.	2		MPTCP	88	37325→5124		
🕨 Fra	ame 63	3: 149 b	oytes on	wire (	1192 b	its),	149 byte	s captured	(1192 bits)						

Linux cooked capture

Internet Protocol Version 4, Src: 1.1.1.1, Dst: 1.1.3.2

Transmission Control Protocol, Src Port: 54546, Dst Port: 8080, Seq: 1, Ack: 1, Len: 81

Hypertext Transfer Protocol

▶ GET /100KB HTTP/1.1\r\n

User-Agent: curl/7.29.0\r\n Host: 1.1.3.2:8080\r\n Accept: \*/\*\r\n \r\n <u>[Full request URI: http://1.1.3.2:8080/100KB]</u> [HTTP request 1/1]