

UOD RAPTORQ FEC SCHEME

draft-luby-uod-raptoq-00

IETF

PRAGUE

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Mike Luby & Thomas Stockhammer

UOD RaptorQ

- UOD = Universal Object Delivery
- Provides simpler file delivery than RaptorQ FEC Scheme
 - No separate limitations on the number of source blocks and on the number of source symbols per source block
- Simple changes only
 - FEC Payload ID format simplified
 - The same FEC OTI per object
 - – Extended for delivering multiple objects
 - No changes to the RaptorQ FEC code
- Provides additional file delivery services in a simple way
 - UEP file delivery
 - Bundled file delivery

UOD RaptorQ – FEC Payload ID

0	1	2	3
0123456789	0123456789	0123456789	01

Universal Object Symbol Identifier (UOSI) (32 bits)

UOD RaptorQ shared parameters

- FEC Encoding ID – 7 (TBD)
- Number of objects (D) (8 bits)
- Symbol alignment parameter (AI) (8 bits)
- For $I = 1, \dots, D$, for object I: (10 octets per object)
 - Encoding symbol size (T(I)) (16 bits)
 - Transfer length (F(I)) (40 bits)
 - Number of source blocks (Z(I)) (12 bits)
 - Number of sub-blocks per source block (N(I)) (12 bits)

UOSI \leftrightarrow (SBN, ESI) mapping

- From UOSI value C to (SBN,ESI) values (A,B) for an object with Z source blocks:
 - $B = \text{floor}(C/Z)$
 - $A = C - B*Z$
- From (SBN,ESI) values (A,B) for an object with Z source blocks to UOSI value C :
 - $C = A + B*Z$

Sender parameter generation

- Applied to each of the D objects independently
 - $F(I)$ is the size of object I
 - $T(I)$ is the size of an encoding symbol for object I
 - $Kt(I) = F(I)/T(I)$ determines the priority of object I
 - $Kt(I)$
 - the number of source symbols for object I
 - Practically, the number of any packets required to recover object I
- Applied exactly as described in the RaptorQ FEC Scheme

Sender encoding packet generation

- For each UOSI value $C = 0, 1, 2, 3, \dots$, generate and send an encoding packet as follows:
 - Set the value of the FEC Payload ID of the encoding packet to the UOSI value C .
 - For $I = 1, \dots, D$,
 - Determine the (SBN, ESI) values $(A(I), B(I))$ for object I that correspond to UOSI value C .
 - Generate the encoding symbol $E(I)$ of size $T(I)$ that corresponds to (SBN, ESI) values $(A(I), B(I))$ from object I according to the procedures of the RaptorQ FEC Scheme.
 - Add encoding symbol $E(I)$ to the payload of the encoding packet.
 - Send the encoding packet.

Receiver parameter usage

- Applied to each of the D objects independently
 - $F(I)$ is the size of object I
 - $T(I)$ is the size in each packet for encoding symbols of object I
- Exactly the same as described in the RaptorQ FEC Scheme

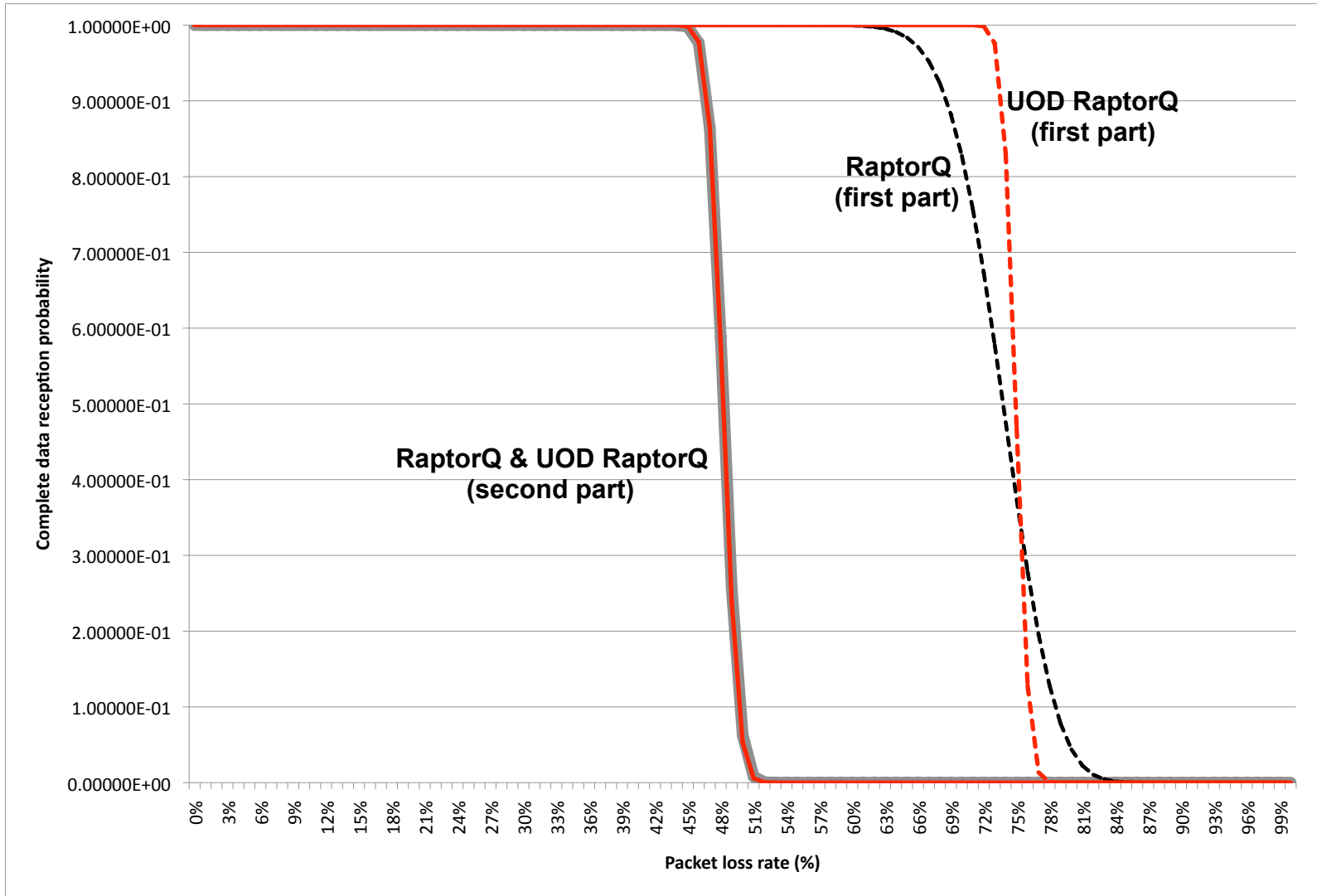
Receiver encoding packet processing

- When a packet is received with UOSI value C :
 - For $I = 1, \dots, D$,
 - Determine the (SBN, ESI) values ($A(I)$, $B(I)$) for object I that correspond to UOSI value C .
 - Extract the encoding symbol $E(I)$ of size $T(I)$ that corresponds to (SBN, ESI) values ($A(I)$, $B(I)$) of object I
 - Process the encoding symbol $E(I)$ and the (SBN, ESI) values ($A(I)$, $B(I)$) according to the procedures of the RaptorQ FEC Scheme applied to the parameters of object I .

UOD RaptorQ – UEP example

- File size = 1,024 KB – send 2,048 KB of encoded data
 - First part is 32 KB in size – send 128 KB of encoded data
 - Second part is 992 KB in size – send 1,920 KB of encoded data
 - Each encoded packet has a payload of 1 KB for encoded symbols
- RaptorQ
 - Send two parts separately
- UOD RaptorQ
 - $D = 2$
 - $F(1) = 32 \text{ KB}$, $T(1) = 64 \text{ bytes}$
 - $F(2) = 992 \text{ KB}$, $T(2) = 960 \text{ bytes}$
 - Generate and send 2,048 packets
 - 128 KB sent for first part
 - 1,920 KB sent for the second part

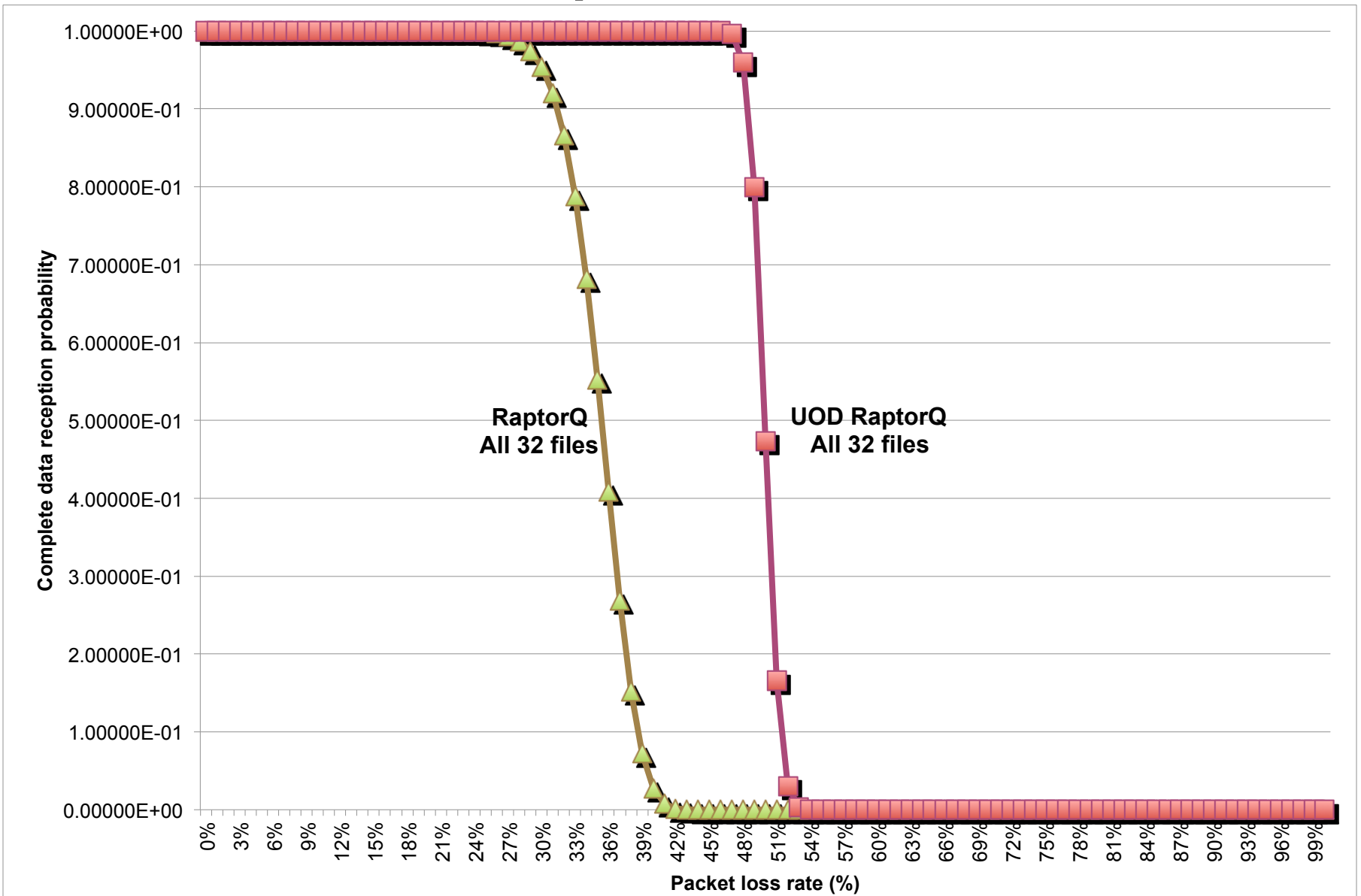
UOD RaptorQ and Simple RaptorQ



UOD RaptorQ – Bundling example

- 32 files to be transmitted as a bundle
 - Each file is of size 32 KB – send 64 KB of encoded data for each
 - Each encoded packet has a payload of 1 KB for encoded symbols
- RaptorQ
 - Send each file separately
- UOD RaptorQ
 - $D = 32$
 - $F(1) = F(2) = \dots = F(32) = 32 \text{ KB}$, $T(1) = 64 \text{ bytes}$
 - $T(1) = T(2) = \dots = T(32) = 32 \text{ bytes}$
 - Generate and send 2,048 packets

Comparisons



Request

- Adopt draft-luby-uod-raptorq-00 as a RMT working group item?