ICN LoWPAN

draft-irtf-icnrg-icnlowpan-02
IETF 104, Prague

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Draft Updates

`draft-irtf-icnrg-icnlowpan-01` $\Rightarrow$ `draft-irtf-icnrg-icnlowpan-02`

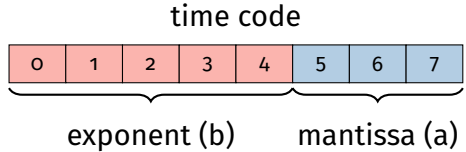
Update since -01

- Time TLV: InterestLifetime & ContentFreshness
- Implementation Report & Guidance section

RFC5497 – Time TLV

Objective

- Represent time value in Mobile Ad Hoc Networks (MANETs)
- Encoding uses 1 byte
- Focus on wide range with less precision



time value = $(1 + \frac{a}{8}) \cdot 2^b \cdot C$

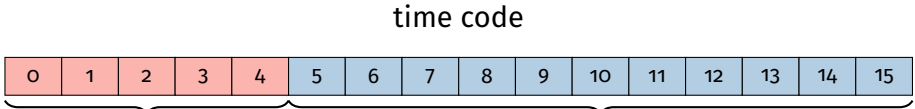
$C = \frac{1}{1024}$

min: $(1 + \frac{0}{8}) \cdot 2^0 \cdot \frac{1}{1024} = \frac{1}{1024} \approx 0.9\ ms$

max: $(1 + \frac{7}{8}) \cdot 2^{31} \cdot \frac{1}{1024} = 15 \cdot 2^{28} \cdot \frac{1}{1024} \approx 45\ days$

ICNLoWPAN Time TLV (1)

- Time values for InterestLifetime (CCNx/NDN) & ContentFreshness (NDN)
- Former approach: linear scaling using 2 bytes $\approx$ 64 seconds
- Reuse 2 bytes for Time TLV



time value = $(1 + \frac{a}{2048}) \cdot 2^b \cdot C$, with $C = \frac{1}{1024}$

min: $(1 + \frac{0}{2048}) \cdot 2^0 \cdot \frac{1}{1024} = \frac{1}{1024} \approx 0.9\ ms$

max: $(1 + \frac{2047}{2048}) \cdot 2^{31} \cdot \frac{1}{1024} = 4095 \cdot 2^{20} \cdot \frac{1}{1024} \approx 48\ days$

ICNLoWPAN Time TLV (2)

- min: $C = \frac{1}{1024}\ s \approx 0.9\ ms$, not possible to represent 0 s
- Protocols MAY use 0 s, e.g., InterestLifetime/ContentFreshness of 0 s
- We define: time code 0 = 0 s instead of C s

$\Rightarrow$ 1. minimum = 0 *ms*, for $a = 0$, $b = 0$

$\Rightarrow$ 2. minimum $\approx$ 0.9 *ms*, for $a = 1$, $b = 0$

$\Rightarrow$ maximum $\approx$ 48 *days*, for $a = 2047$, $b = 31$

ICNLoWPAN Time TLV Problems

- Application may choose invalid time value

Interest

- Originator: round-up to nearest time code **before signing**
- Forwarder: round-up **only if no signature is present**
- Forwarder: send uncompressed **if invalid time value & signature is present**

Data

- Originator: round-up to nearest time code **before signing**
- Forwarder: send uncompressed **if invalid time value**

Experimental Evaluations

ICNLoWPAN – Named-Data Networking for Low Power IoT Networks

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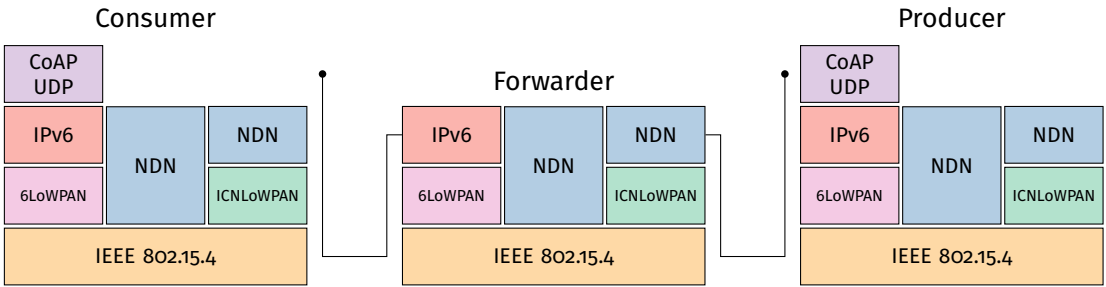
IFIP Networking 2019

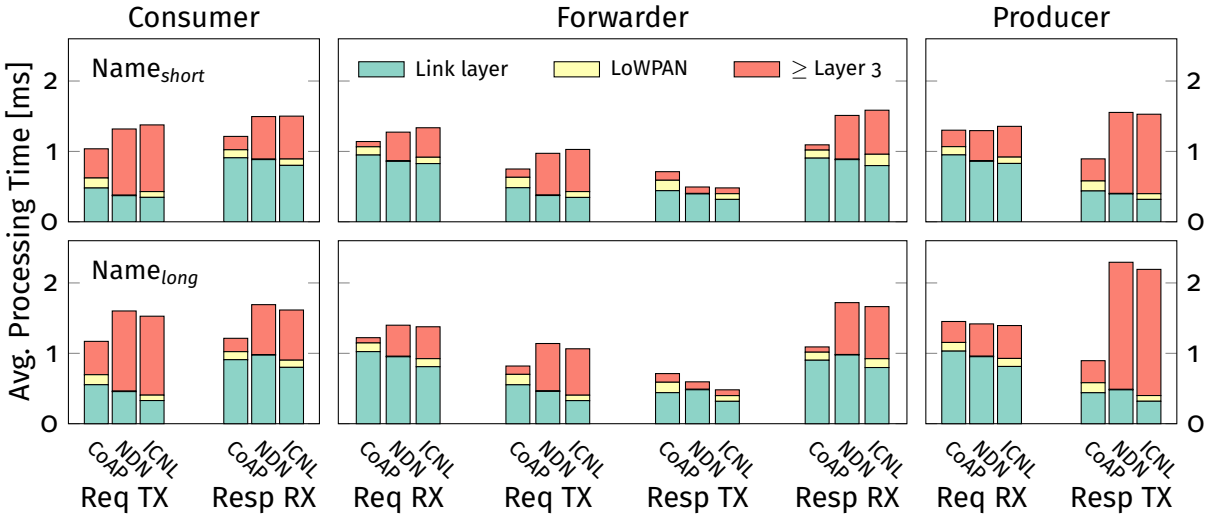
Experimental Evaluations: Setup



Name_{short} = /org/example/temp/id_x

Name_{long} = /org/example/building/1/floor/4/room/481/temp/id_x

Results: Processing Times



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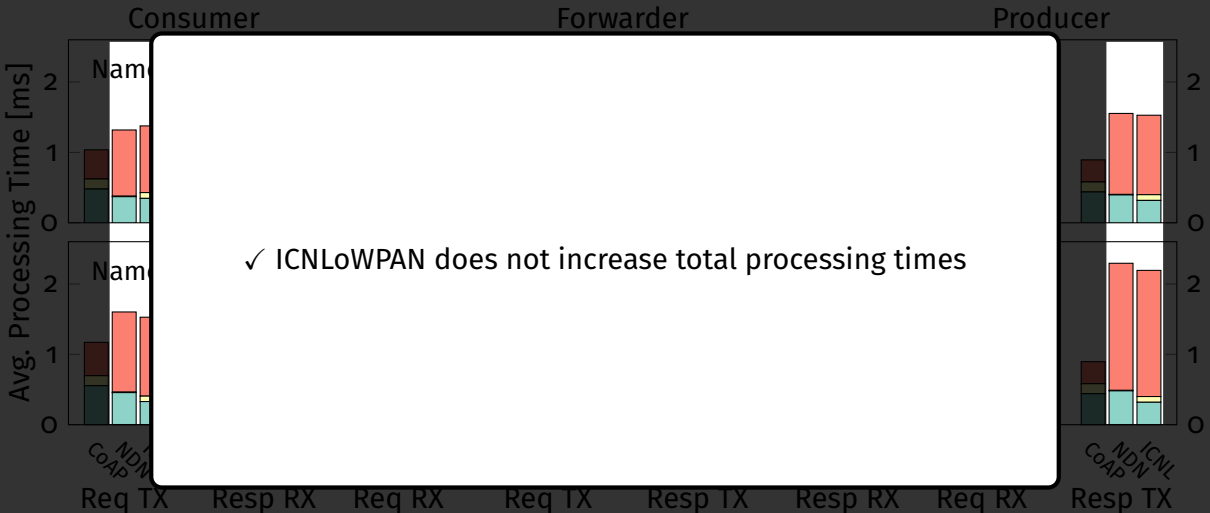
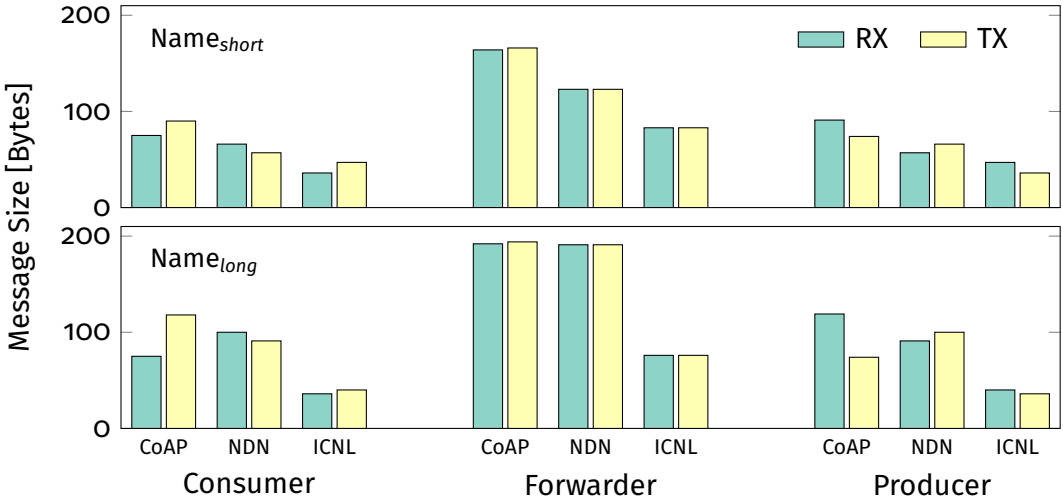
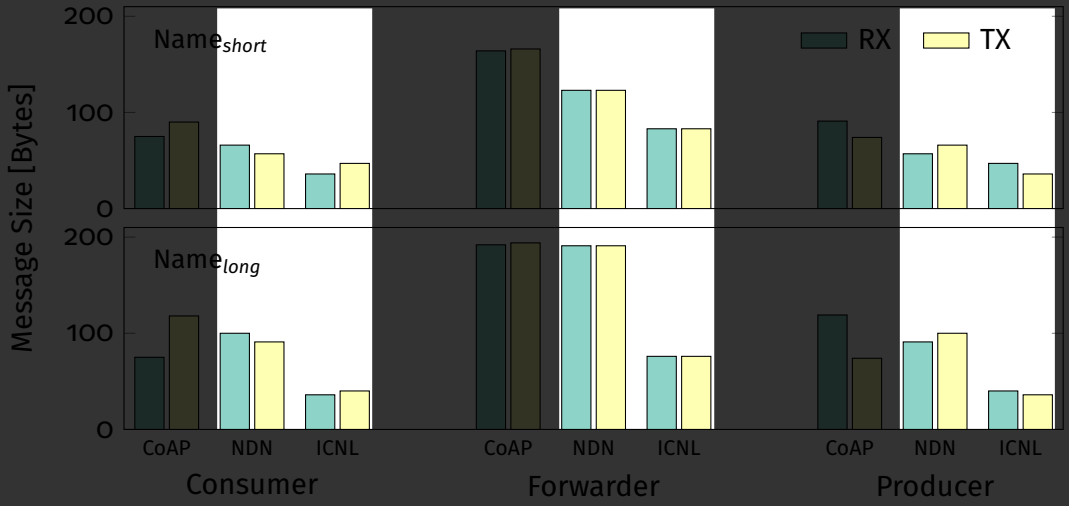


✓ ICNLoWPAN does not increase total processing times

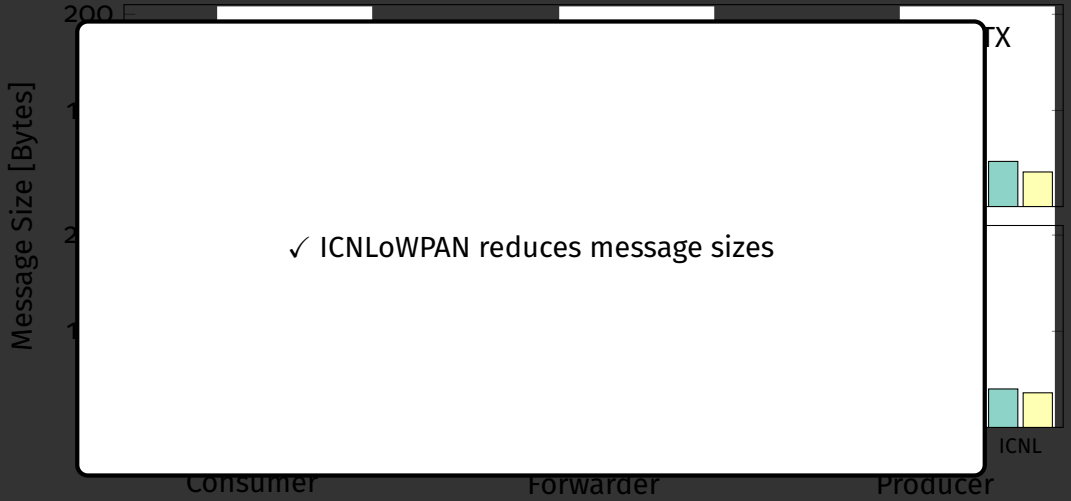
Results: Message Sizes



Results: Message Sizes

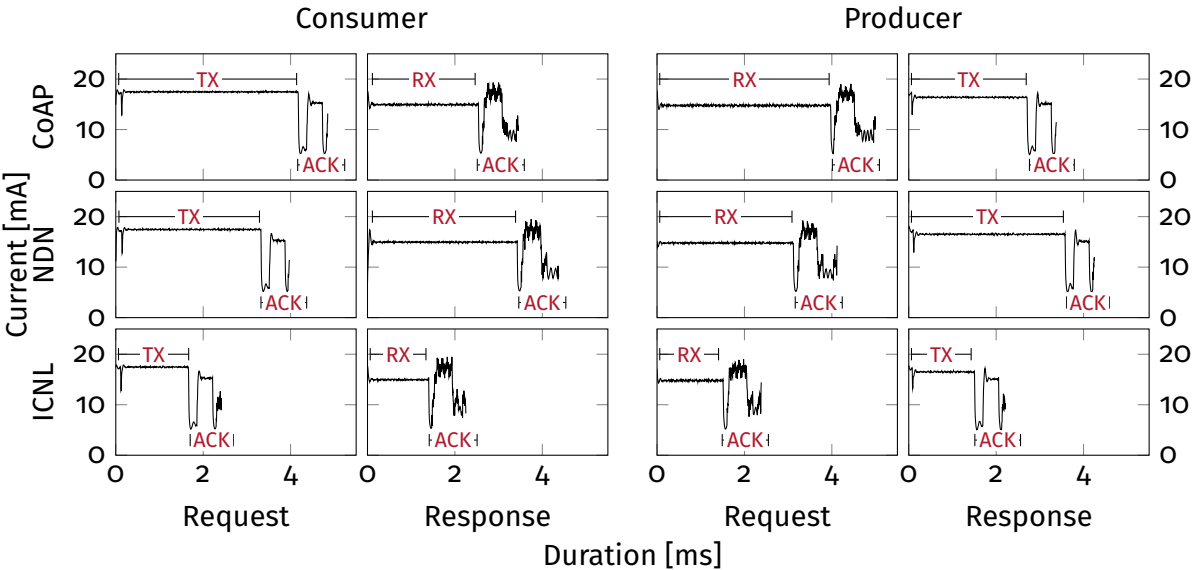


Results: Message Sizes

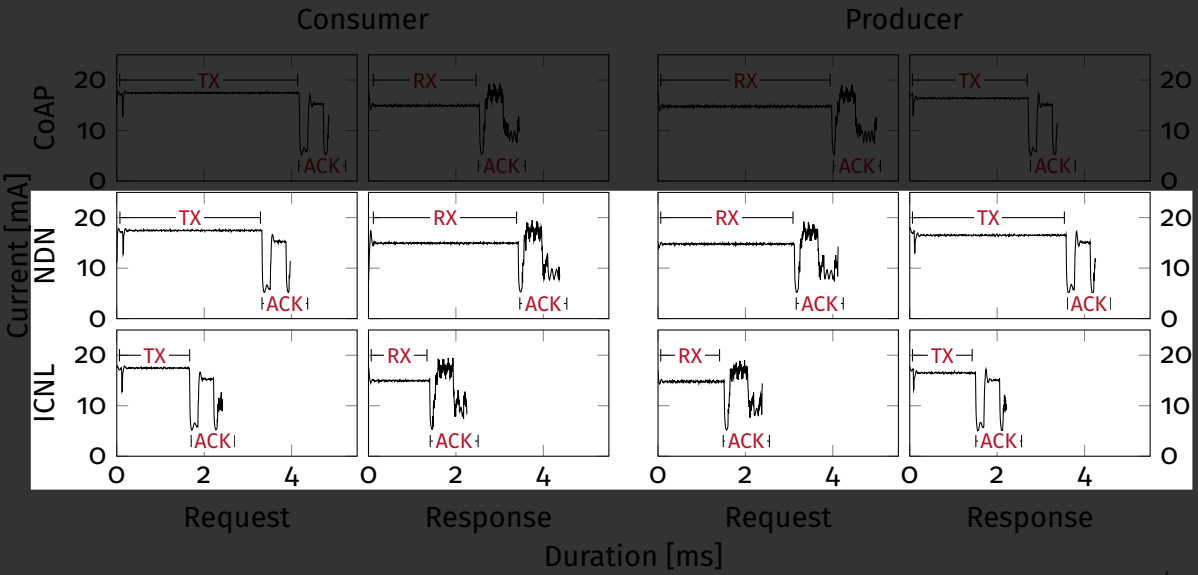


✓ ICNLoWPAN reduces message sizes

Results: Energy Consumption (1)



Results: Energy Consumption (1)



Results: Energy Consumption (2)

	Consumer		Forwarder		Producer	
	$Name_{short}$	$Name_{long}$	$Name_{short}$	$Name_{long}$	$Name_{short}$	$Name_{long}$
CoAP	548.58 μJ	612.24 μJ	967.41 μJ	1072.07 μJ	464.73 μJ	517.96 μJ
NDN	526.23 μJ	687.26 μJ	880.68 μJ	1152.02 μJ	422.55 μJ	584.82 μJ
ICNL	466.09 μJ	487.32 μJ	769.17 μJ	773.97 μJ	369.84 μJ	395.19 μJ

Energy consumption in μJ

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Results: Energy Consumption (2)

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✓ ICNLoWPAN reduces energy consumption

Outlook

ICNLoWPAN

- Adds minimal convergence complexity
- Reduces message buffer sizes
- Shortens in-flight time of messages
- Decreases energy consumption

$\Rightarrow$ Benefits outweigh added compression complexity

How should we proceed? Request more (technical) feedback?