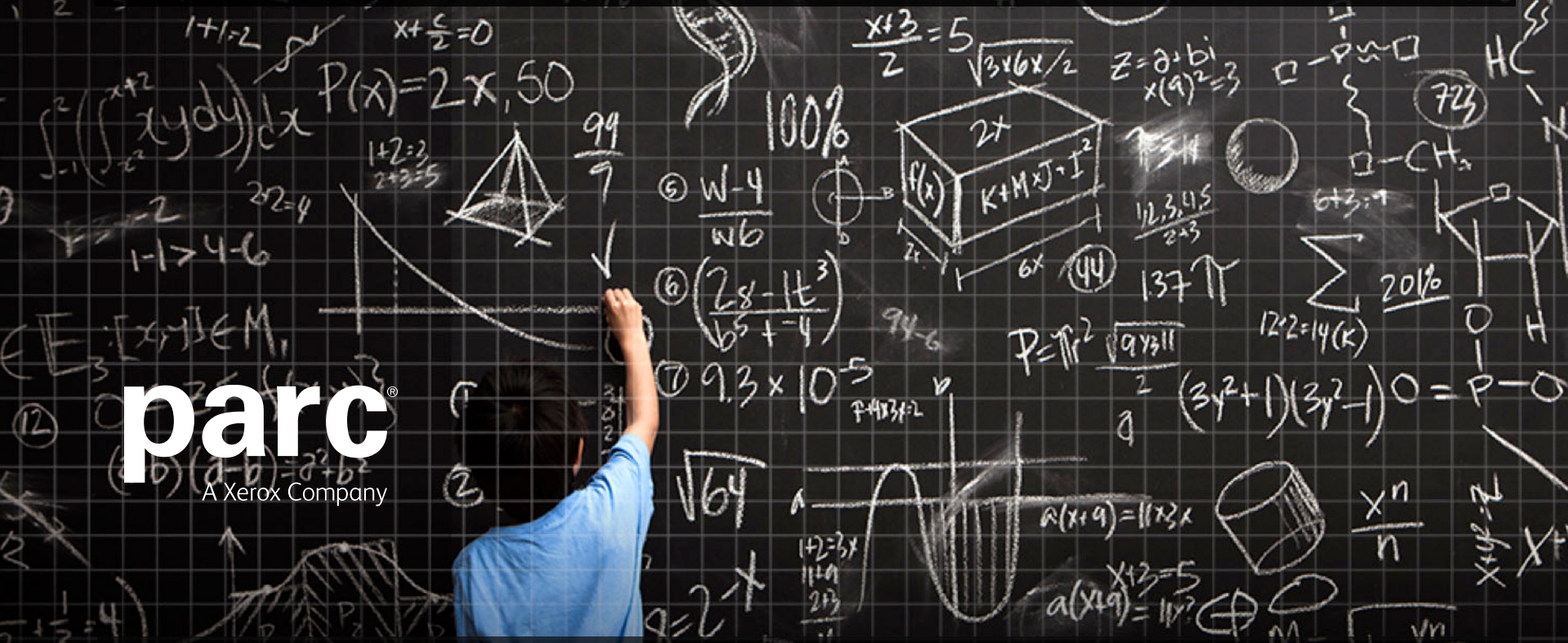
ALL-IN-ONE STREAMS FOR CONTENT CENTRIC NETWORKS



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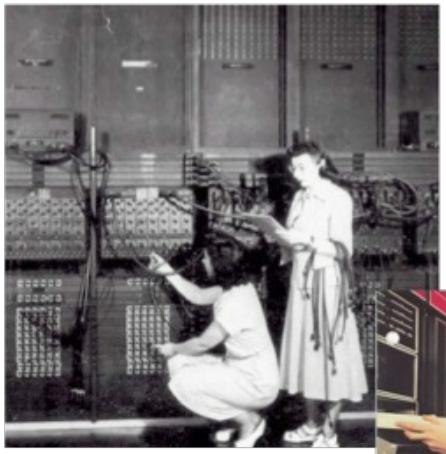
Marc Mosko, Palo Alto Research Center (PARC)

CONNET 2015

The International Symposium on Advances in Content-oriented Networks and Systems

Computer networks started as wires or virtual wires



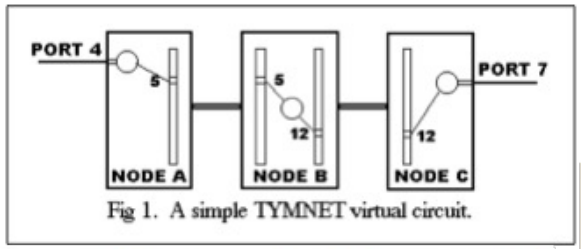
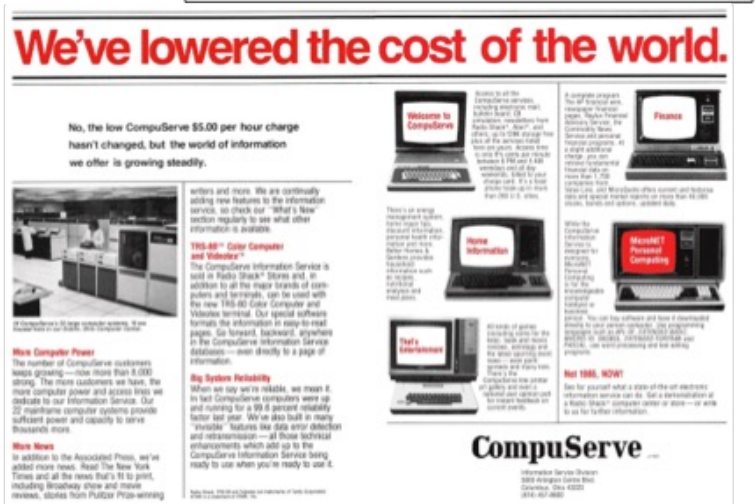
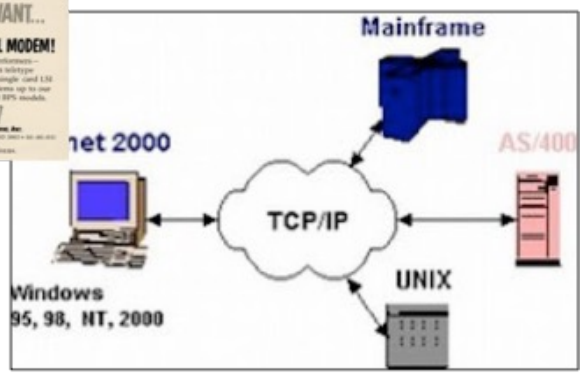


Fig 1. A simple TYMNET virtual circuit.





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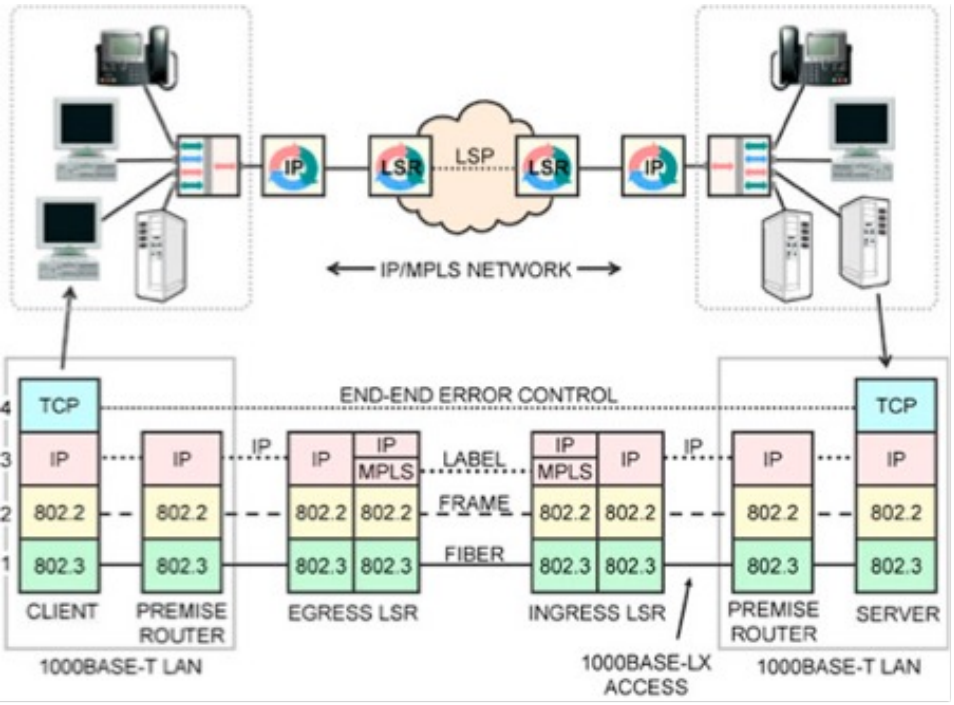

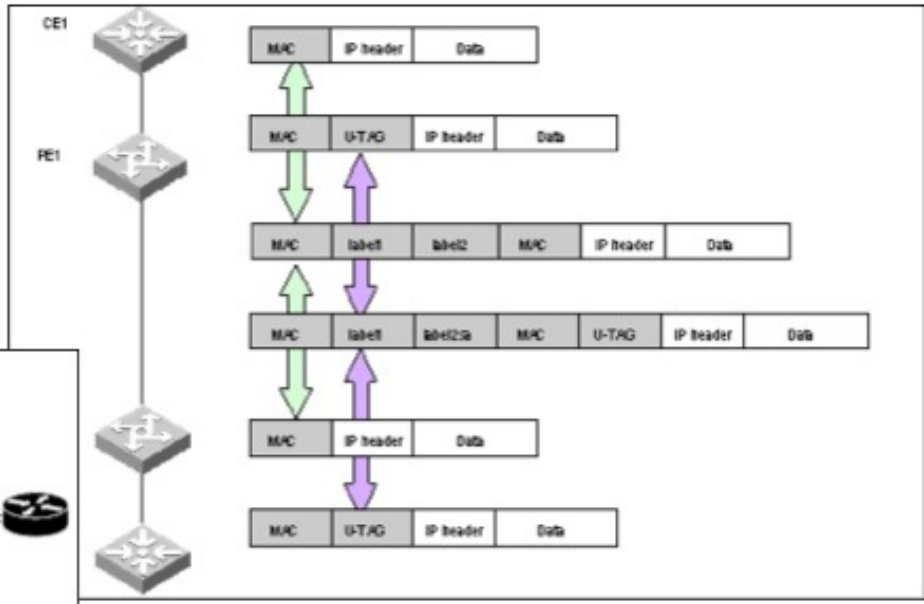

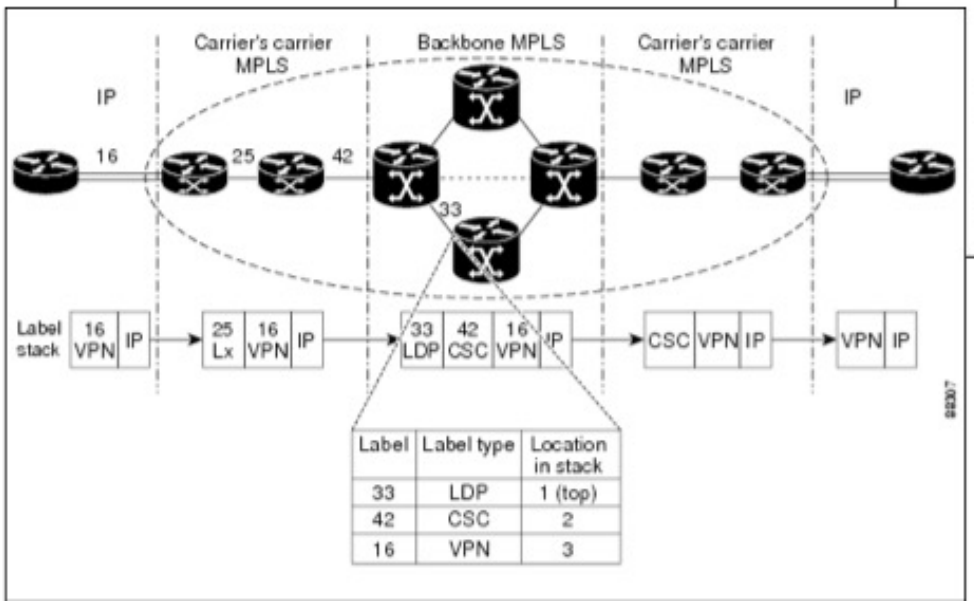

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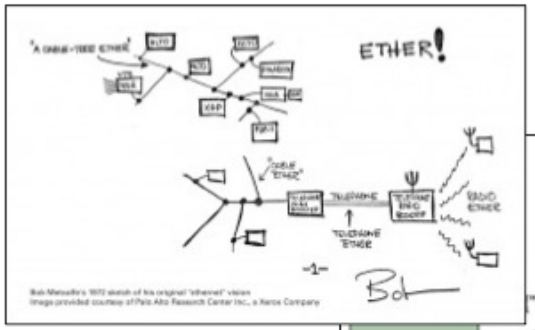
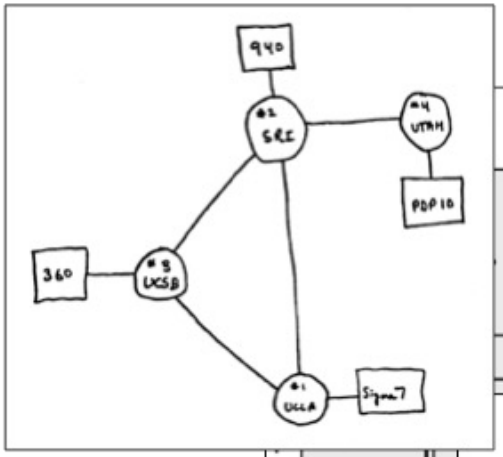
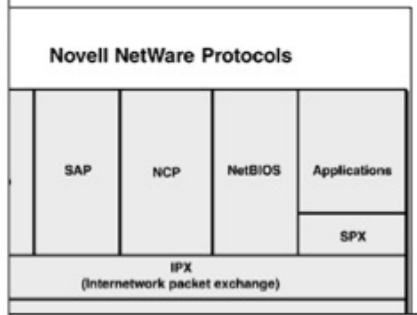
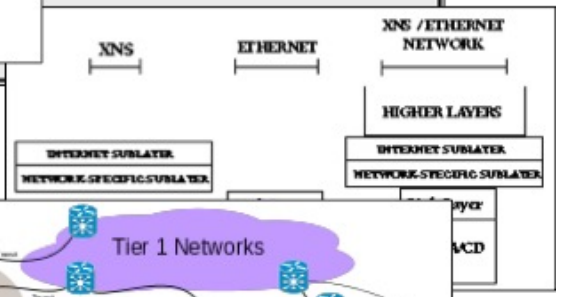
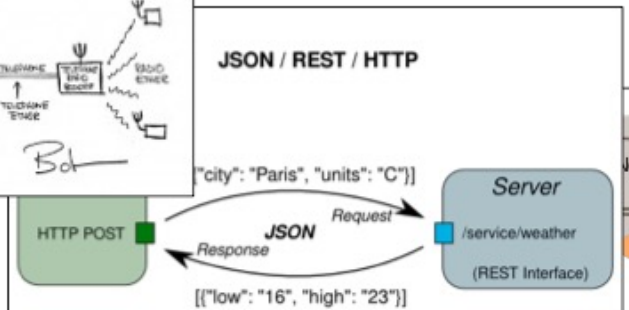
Then evolved to distributing content

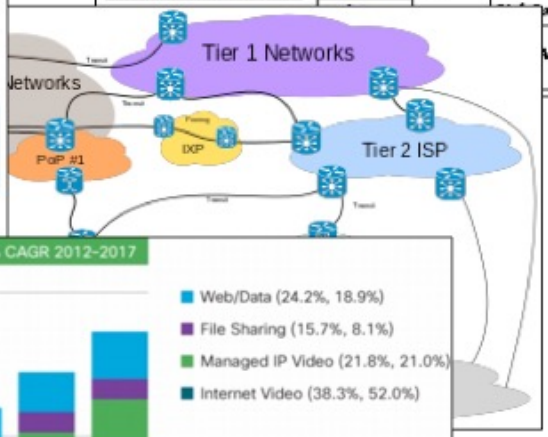












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We no longer connect wires

We move content (information)

INFORMATION CENTRIC NETWORKS

Name the data

Transfer data based on the names

Break end-to-end paradigm

Ted Nelson's Project Xanadu (1979)

CONTENT CENTRIC NETWORKS (CCNX)

TRIAD (1999) / DONA (2006)

CCNx at PARC in 2007 (Van Jacobson)

CCNx 0.1 Software (2009-2013)

Named Data Networking Project (2010)

CCNx 1.0 (2012-present)

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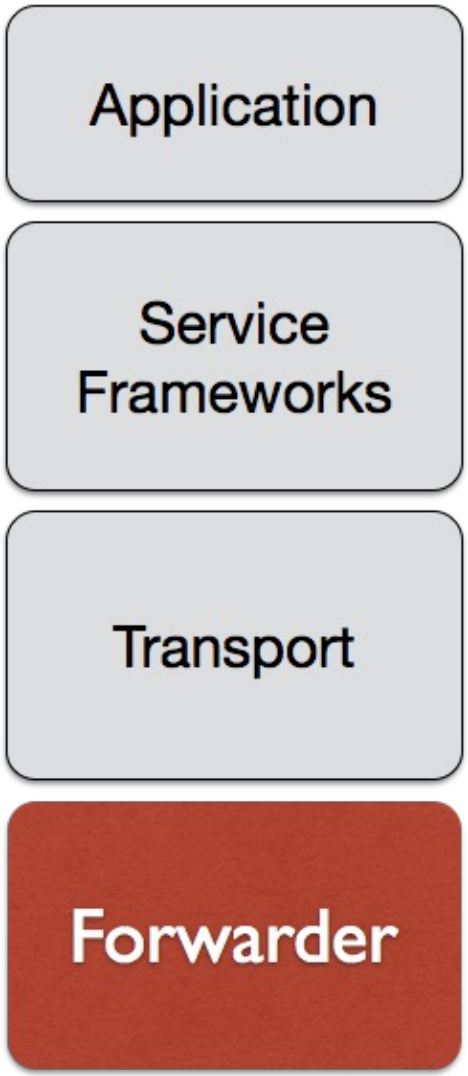
HOW IT WORKS



lci:/com/xerox/parc/pubs/connet2015.pptx

lci:/com/xerox/parc/pubs/connet2015.pptx,
Publisher key = 0x184839a3eff90…

lci:/com/xerox/parc/pubs/connet2015.pptx,
Publisher key = 0x184839a3eff90…
Chunks = 0, 1, …

Name Forwarding Table
Pending Interest Table (reverse path)

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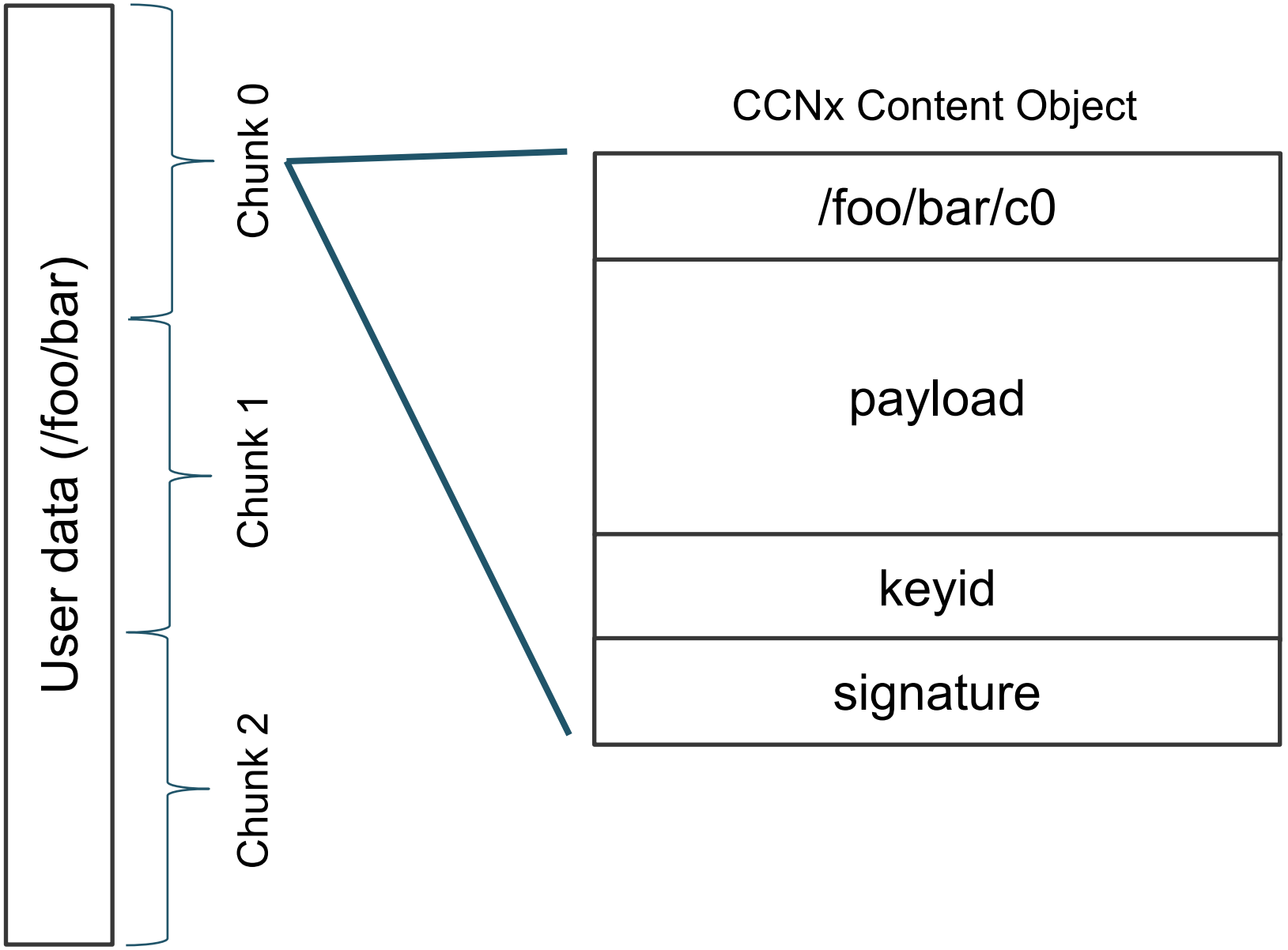

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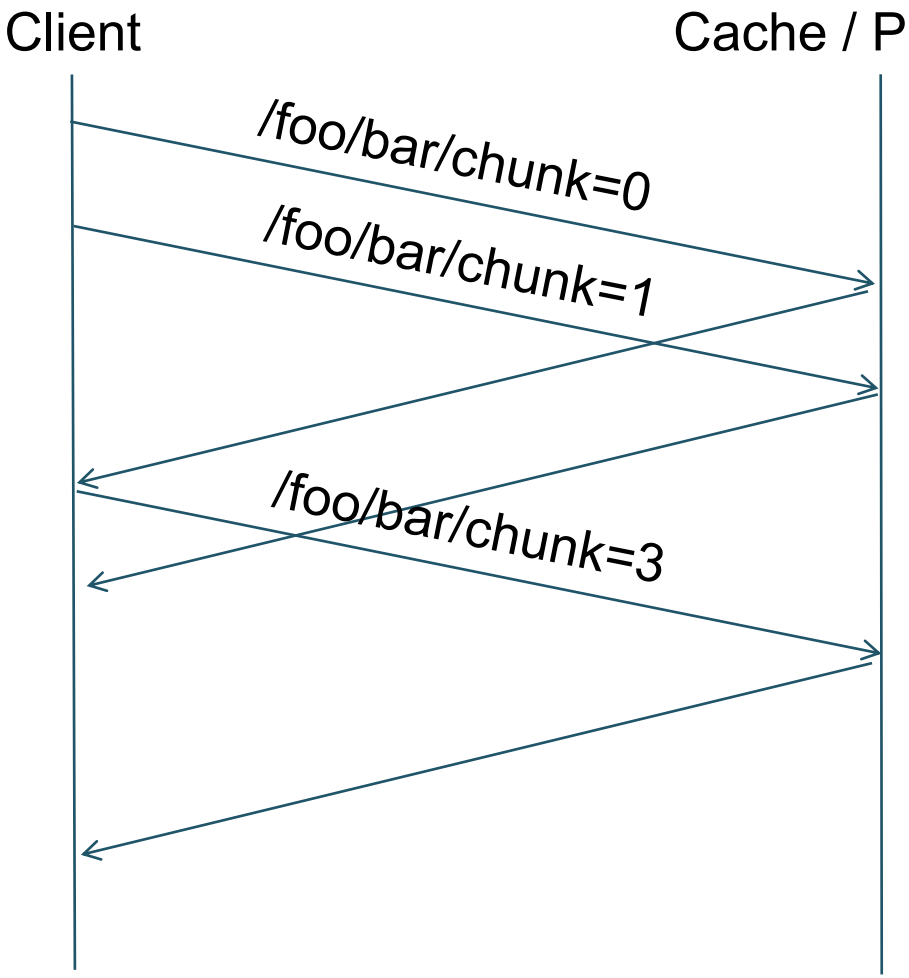
REQUEST/RESPONSE PROTOCOL



Client sends “Interest” with name

Cache/Producer sends “Content Object”

Transfer using “window” of outstanding Interests

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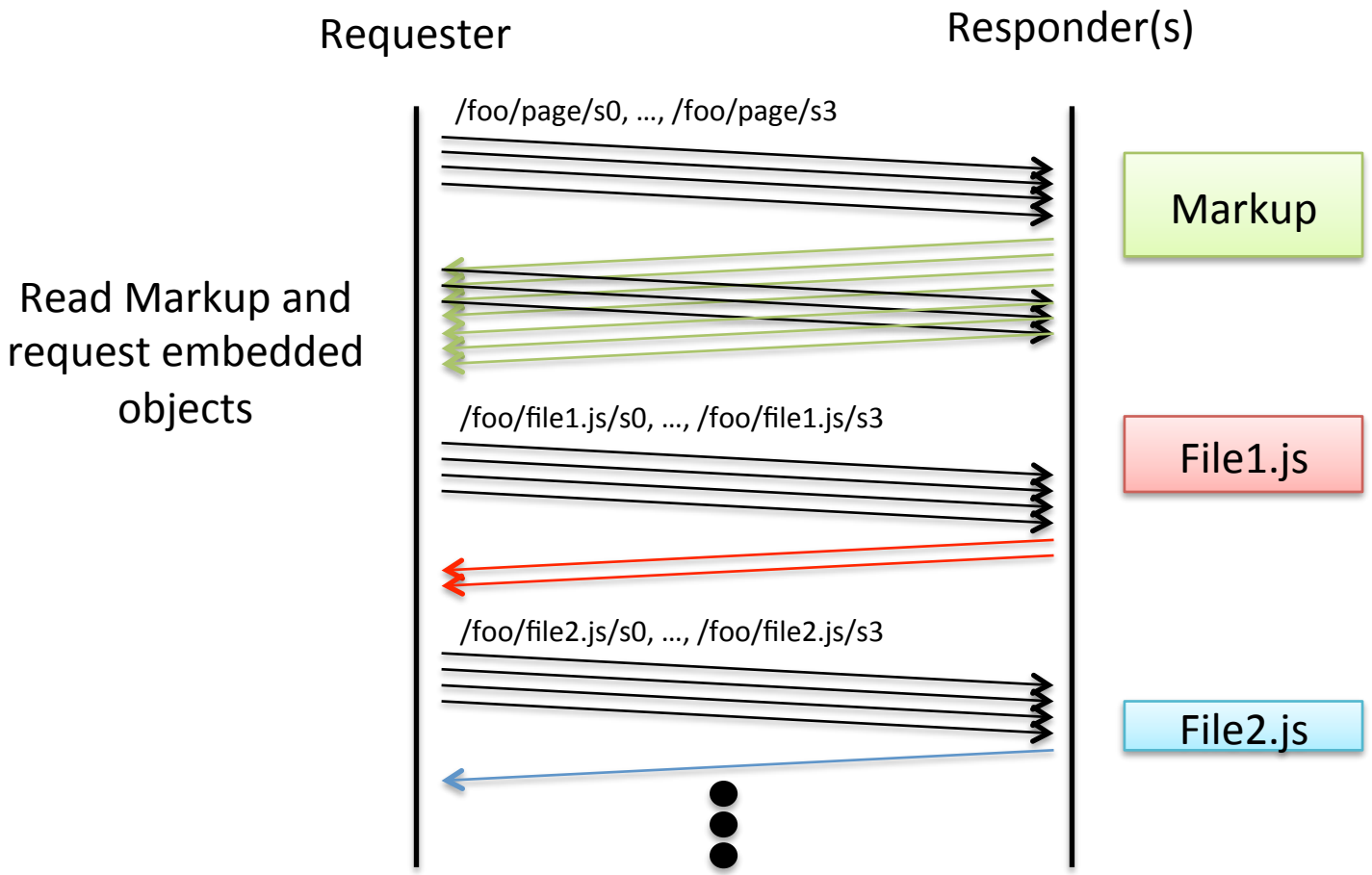
MULTIPLE WINDOW PROBLEMS



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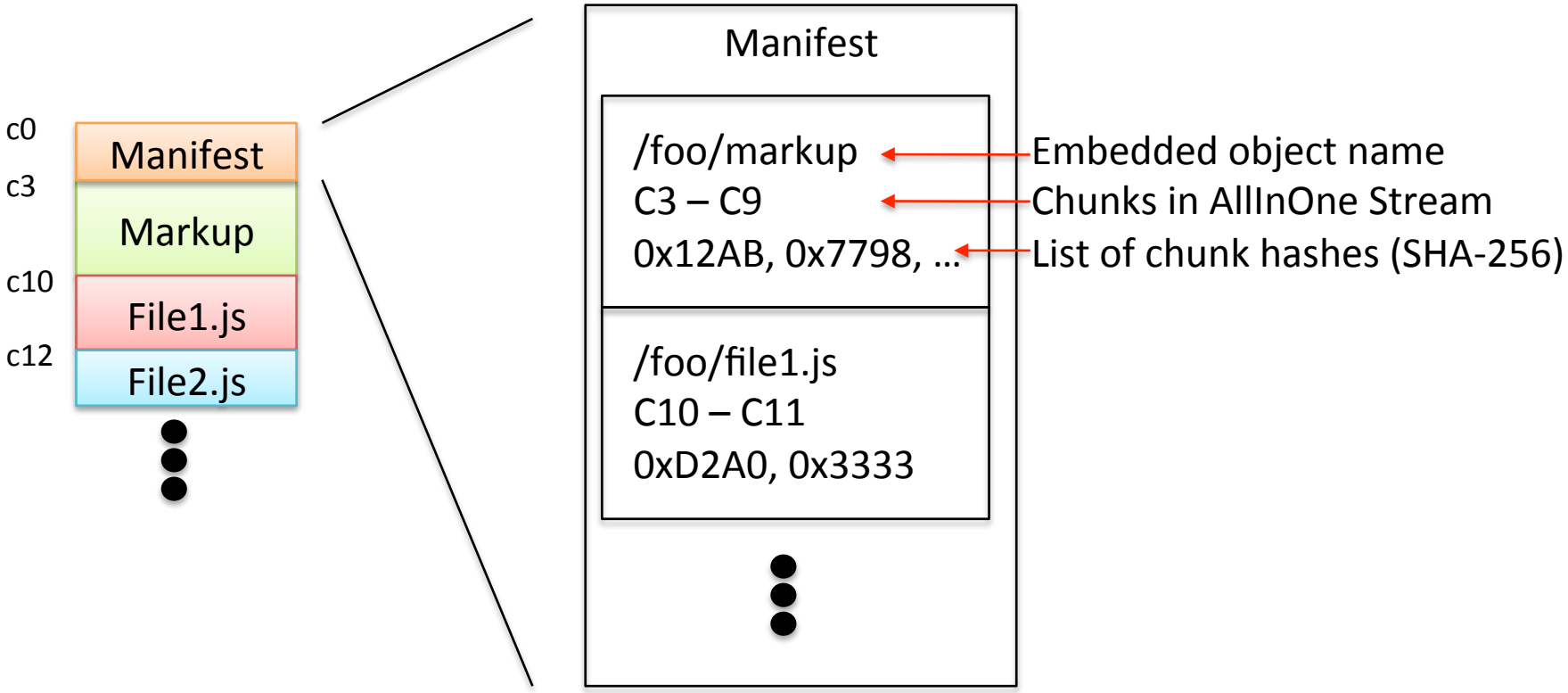
COMBINE ALL OBJECTS TO ONE STREAM



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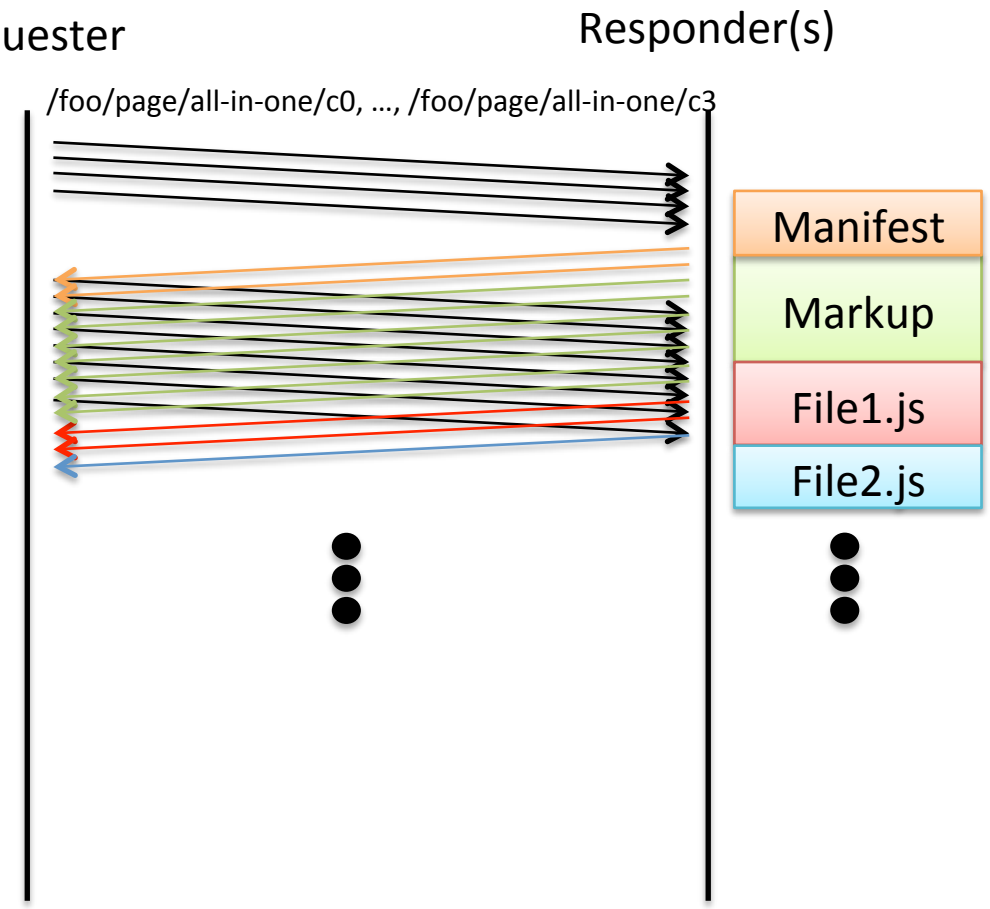
SINGLE WINDOW FOR ALL OBJECTS

No need to read Markup, read a single stream



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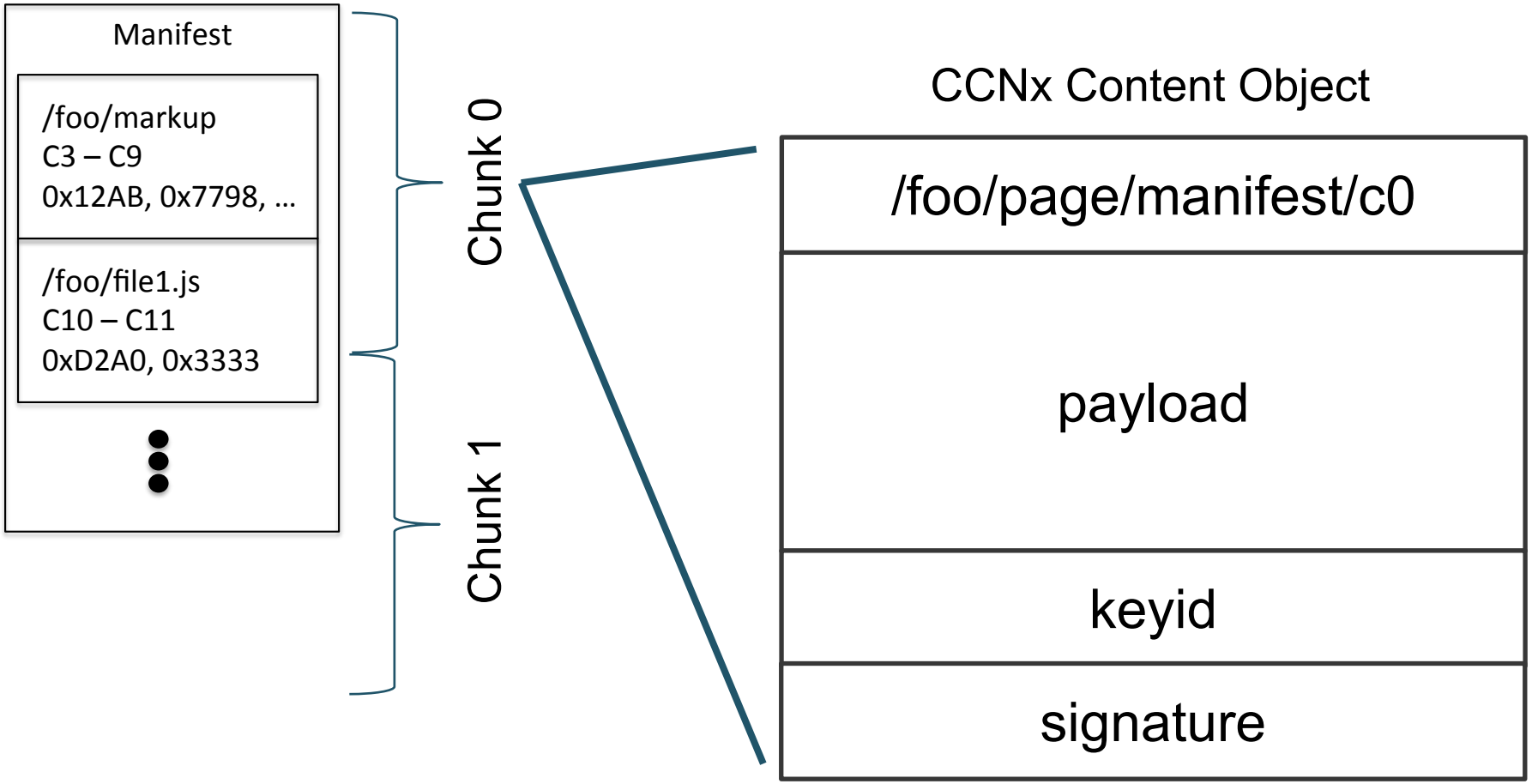

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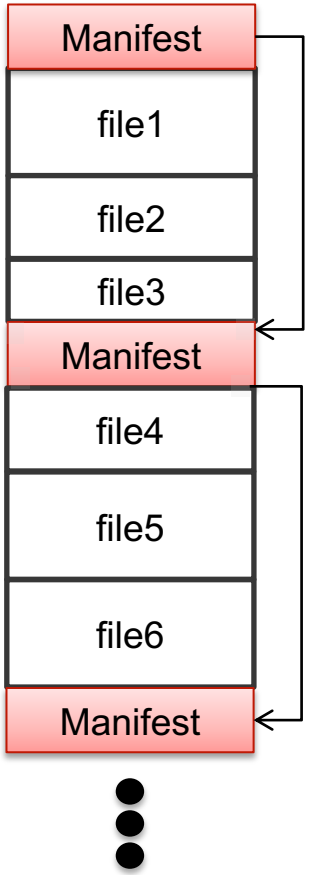

/foo/page/all-in-one/c0

/foo/page/all-in-one/c13

/foo/page/all-in-one/c26

Allow chaining manifests

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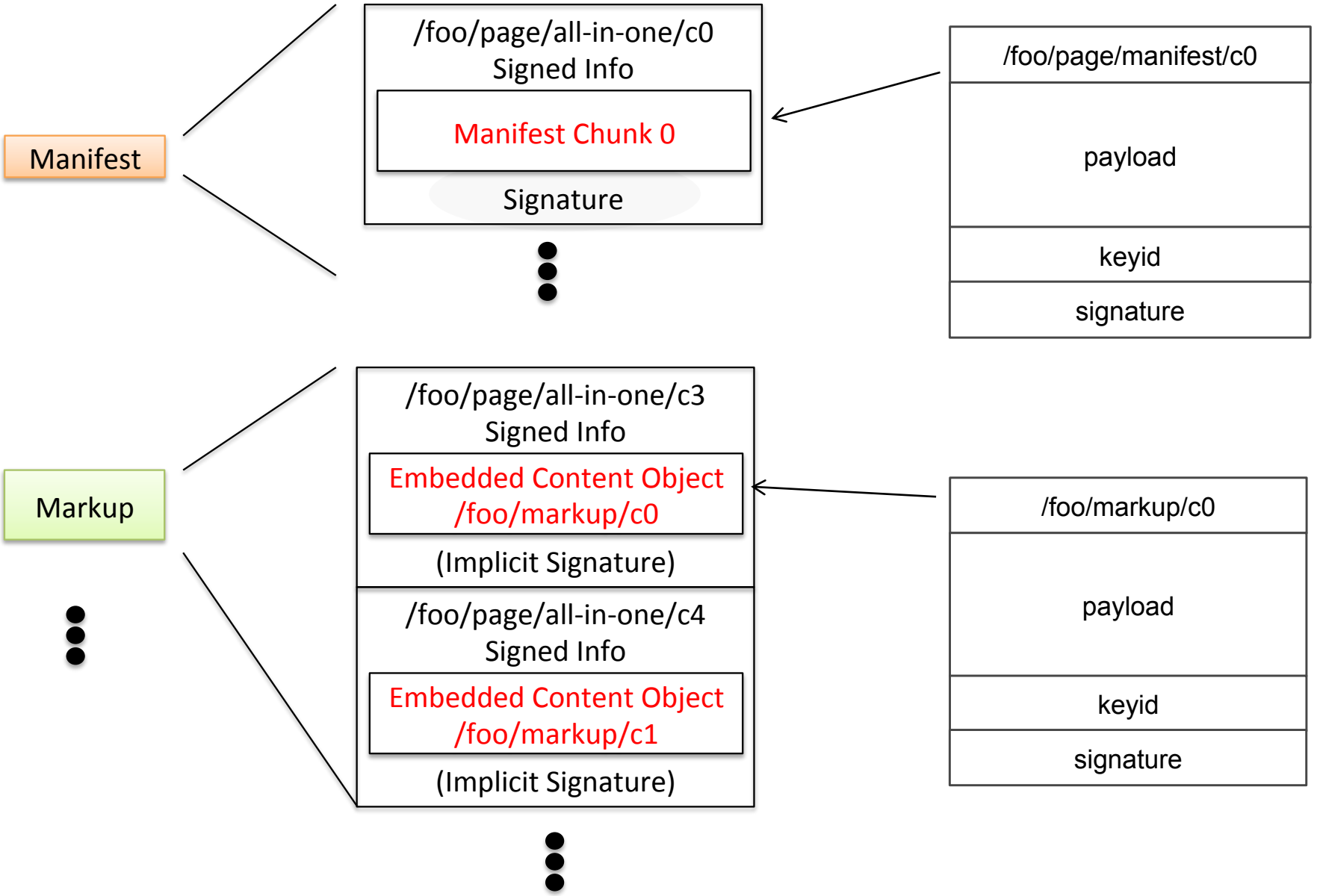

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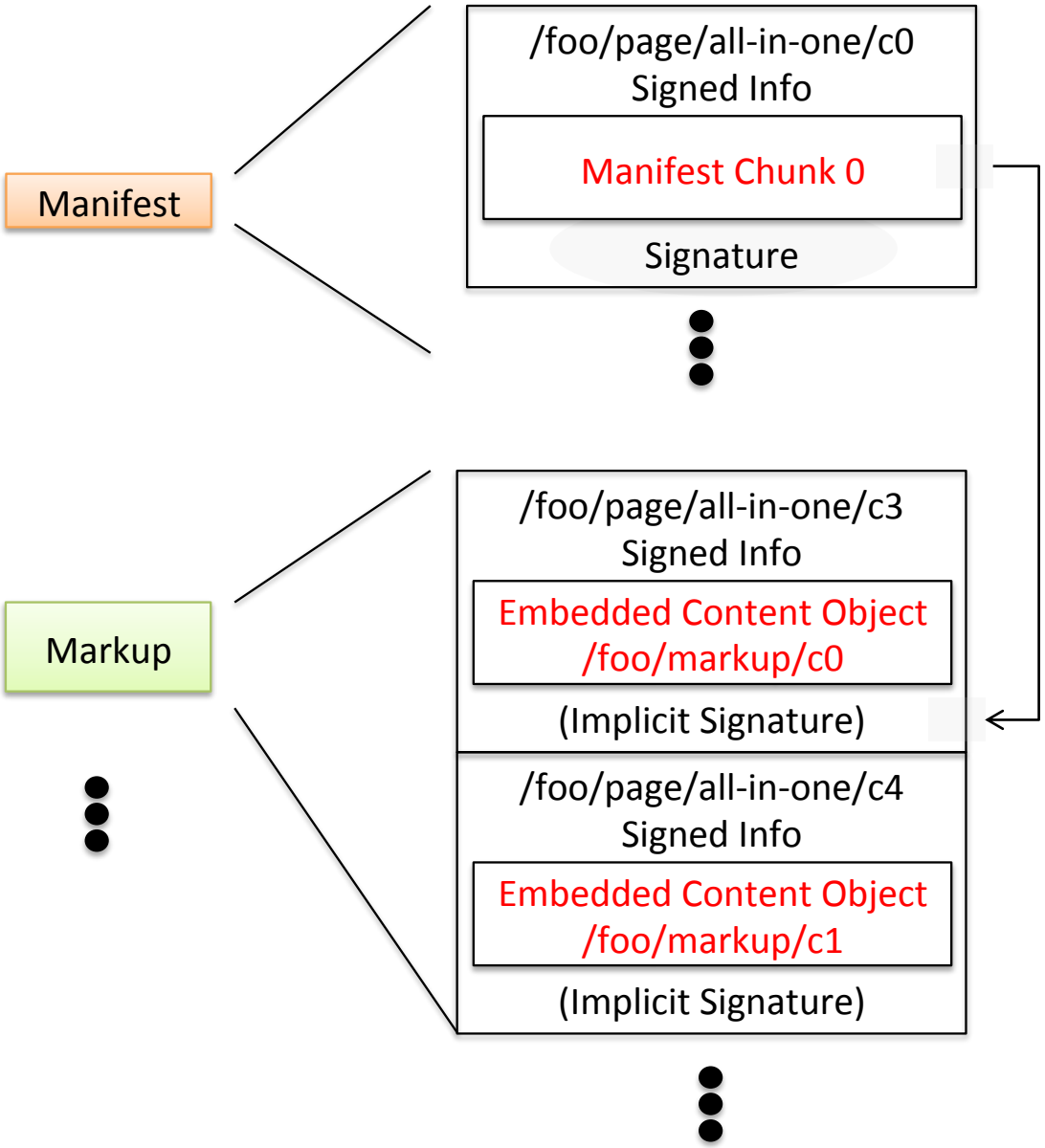

Implicit signature realized by hash chain from Manifest

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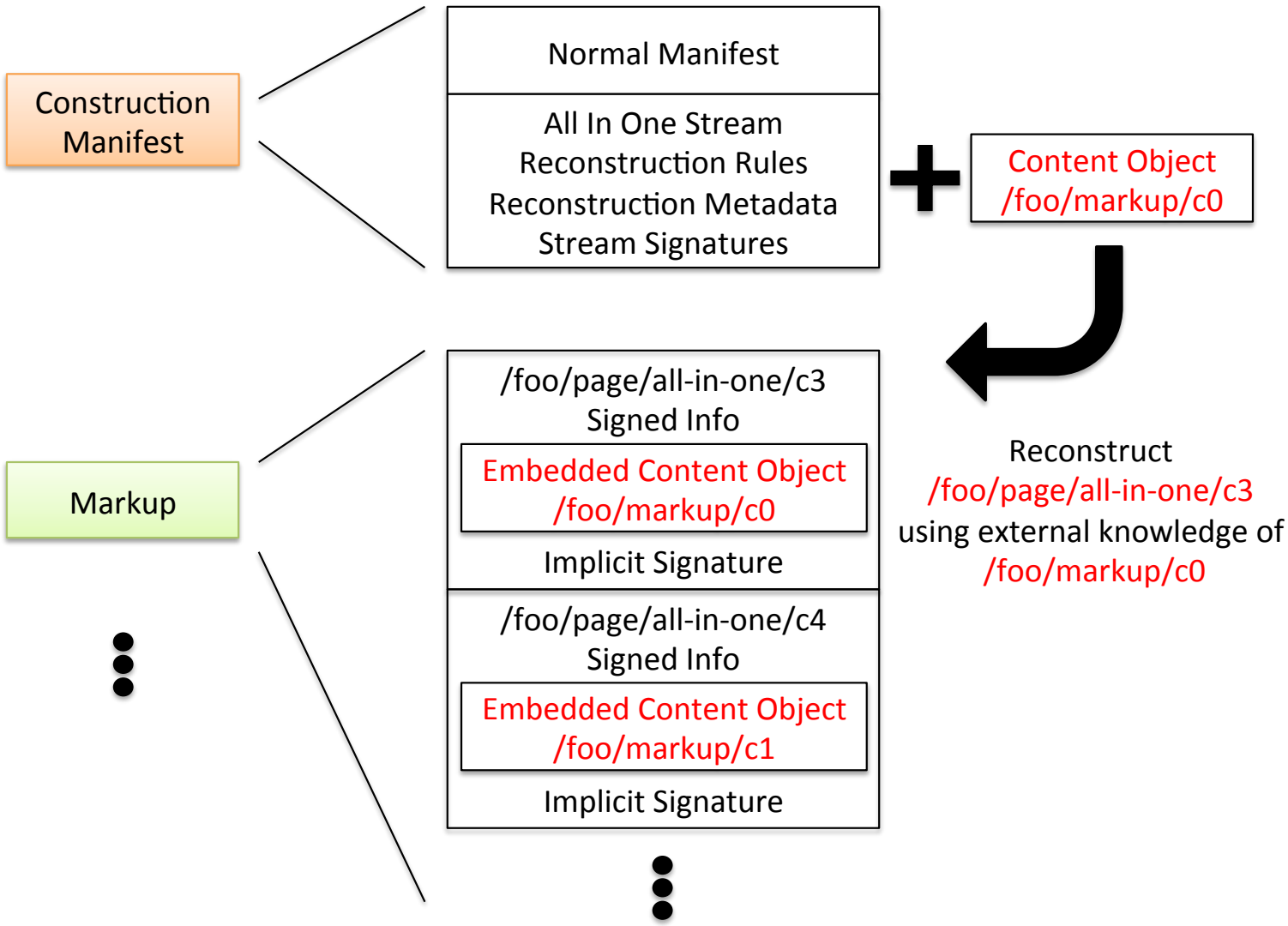
ENCAPSULATION

/foo/markup/c0

/foo/page/all-in-one/c3

What about caching?

CACHING ORIGINAL OBJECTS



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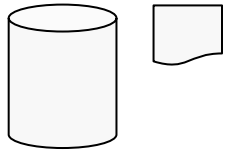
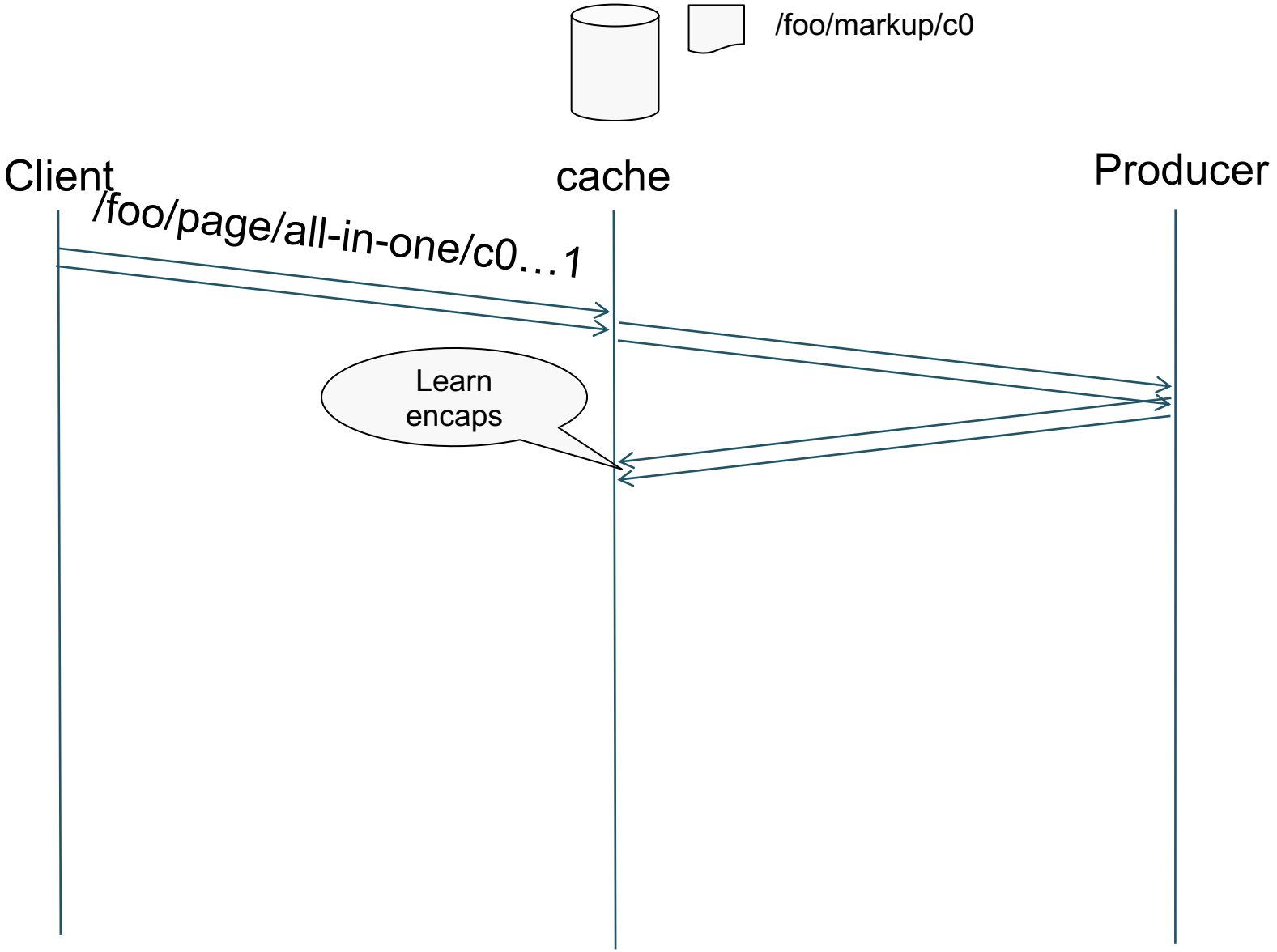


Client

cache

Producer



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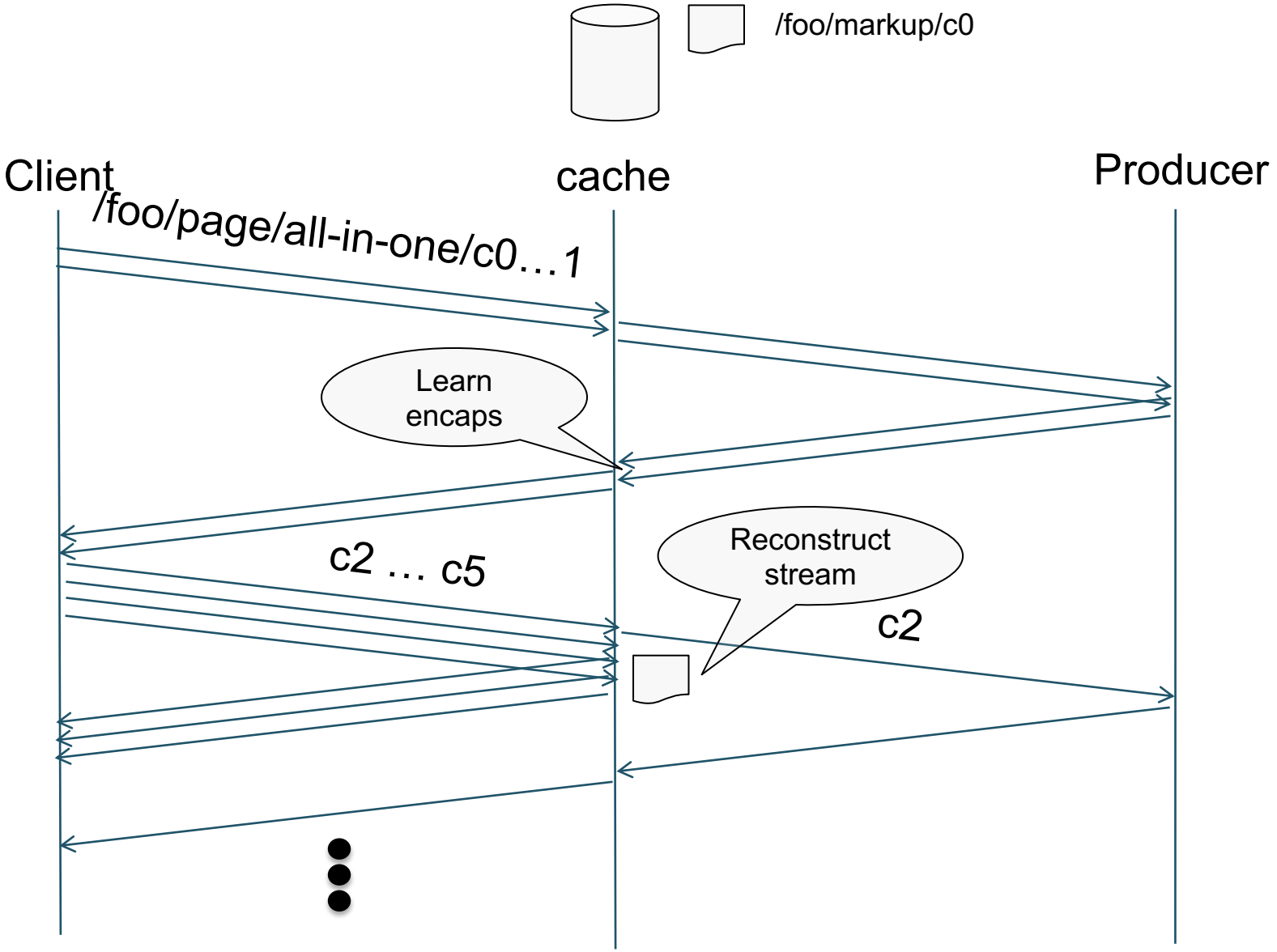

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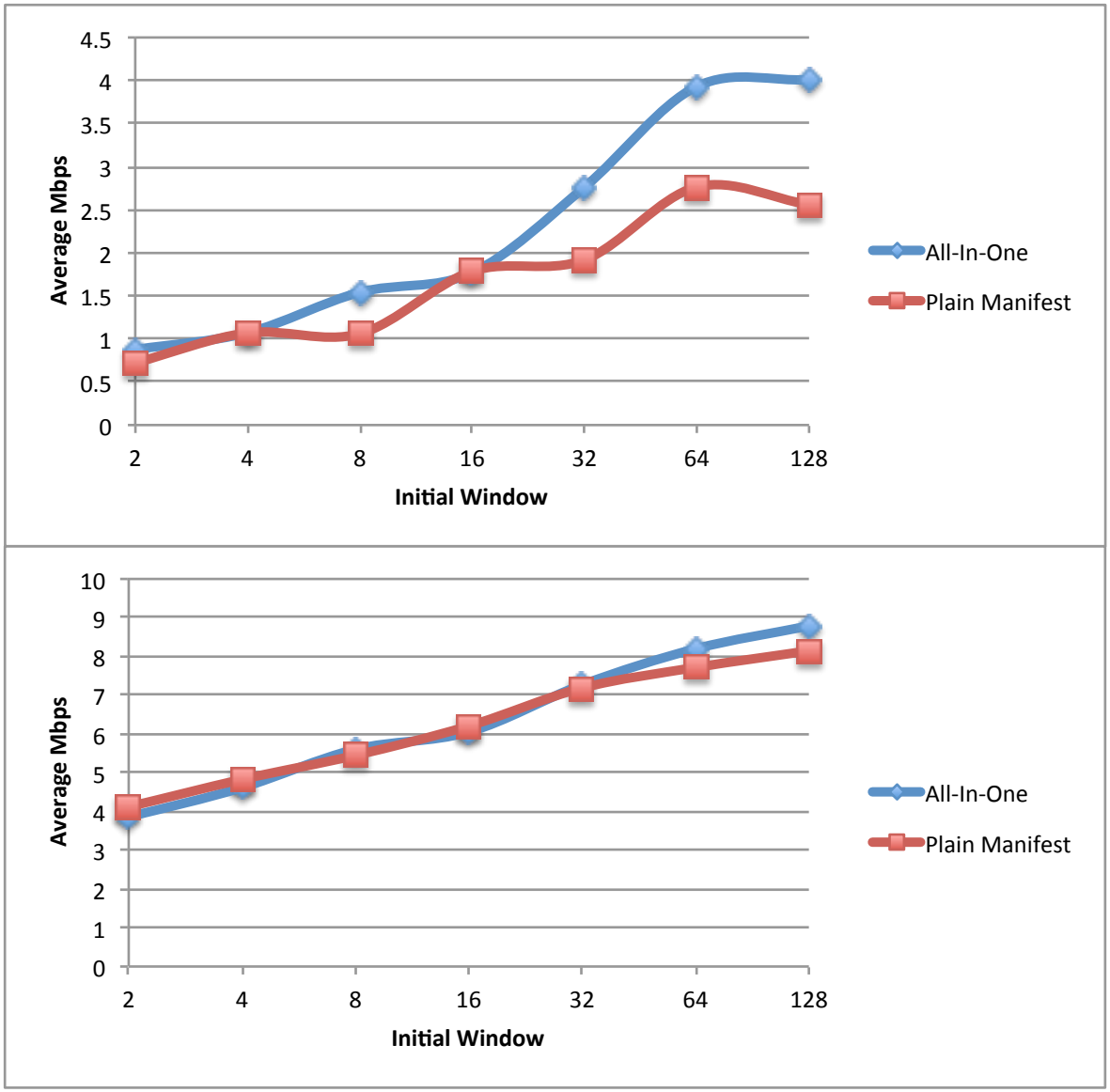
MODELING PERFORMANCE

- Compare All-In-One with TCP-like behavior.
- Each stream is 3, 10, or 30 embedded objects.
- Each object is uniformly 1KB – 50KB.
- Content Objects chunked to 1400 bytes (to fit in 1500 byte MTU).
- 10 Mbps bottleneck link.
- Doubling Interest window until bottleneck saturated.



Average 86 KB

Average 905KB

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CONCLUSION

- All-in-one streams addresses slow start on multiple windows when downloading multiple related objects.
- Uses hash chains from manifests, so only manifest objects need to be signed.
- Including metadata in manifest allows intermediate caches to reconstruct stream contents from cached copies of embedded objects.
- As expected, performance benefit seen primarily for smaller streams (under 1 MB) when using larger initial window.

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THANK YOU.