

Networking Named Content: Content-Centric Networking

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Overview

- Replacing traditional host based routing with named content routing
 - “Consumers” request a data’s name instead of a host (ip address)
 - Breaking packets into content allows packets to be cached more easily
 - Each CCN router acts as a cache of internet traffic
 - Theoretically content providers will only have to send their data once, it will be cached from there on out
 - Specifying content over a destination allows each packet to be individually authenticated

Problems with TCP/IP

- Original model was designed for resource sharing
- Operated under host to host routing connecting two machines
 - IP Addresses represent a single machine

The CCN Model

□ Interest

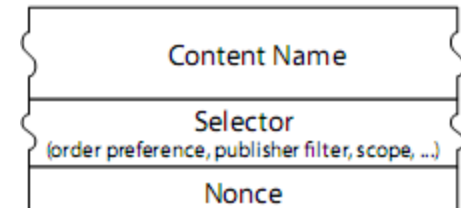
□ A request for Data

- Consists of Content Name, Selector, and Nonce

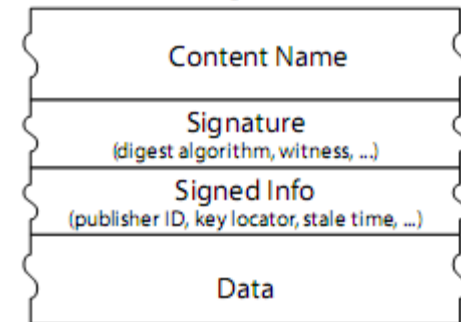
▪ Data

- Self explanatory
- Consists of Content Name, Signature, Signed Info, Data

Interest packet



Data packet



CCN Node

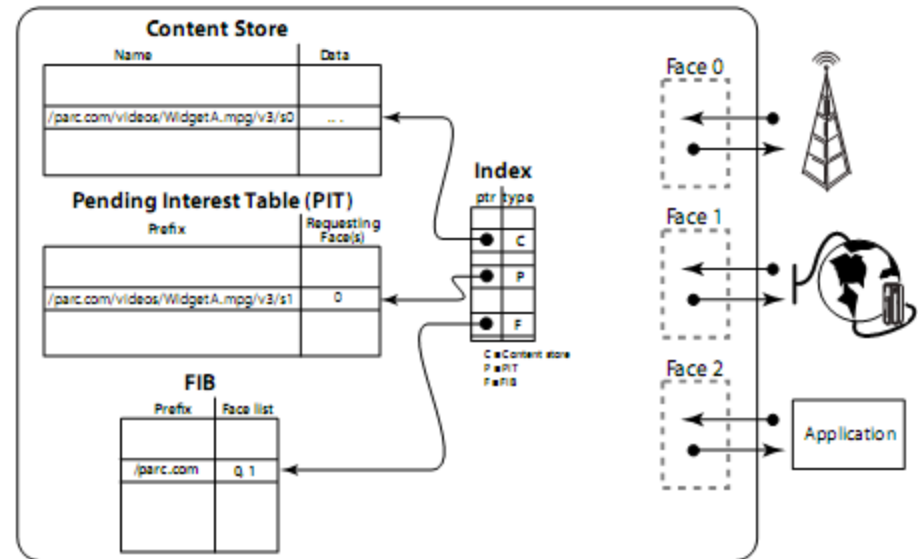
- FIB (Forwarding Information Base)
 - Forwards Interest packets towards potential sources of matching data
 - Allows for a list of outgoing interfaces instead of a single one, allowing parallel querying
- Content Store (Buffer Memory)
 - Similar to the buffer memory of an IP router
 - Except that an IP transaction is a point to point transaction, but a CCN transaction is for named content, and are idempotent, self-identifying and self-authenticating
 - They are stored since they may also be useful to other consumers

CCN Node cont...

- PID (Pending Interest Table)
 - Keeps track of Interests forwarded upstream toward content sources
 - Acts as “bread crumbs” for data packets to be sent back downstream
 - Are only used once and are erased after successfully forwarding a matching data packet

CCN Node Interest Process

- Interest Packet arrives and longest-match lookup is done on ContentName
- Order of lookup:
 1. Content Store - Data returned
 2. PIT - Interest arrival face added to PIT entry
 3. FIB - Interest sent upstream
- If there is no match, the Interest is discarded



CCN Node Data Process

- Data simple follows chain of PIT entries (bread crumbs) back to original requester
- A longest-match lookup of the ContentName is done
 - A Content Store match means data is duplicate so it is discarded
 - A FIB match means there are not matching PIT entries, so data is unsolicited and discarded
 - A PIT match means data was requested by Interest(s) and sent out to the correct face(s).

CCN Transport

- Designed to run on top of unreliable packet delivery services
- CCN Senders are responsible for re-requesting unsatisfied Interests
- Looping is controlled through the 'Nonce' value on the Interest packet
 - While there is not data looping, there can be Interest looping
- Flow balance is achieved in each hop, since each router is involved in the interest/data transaction

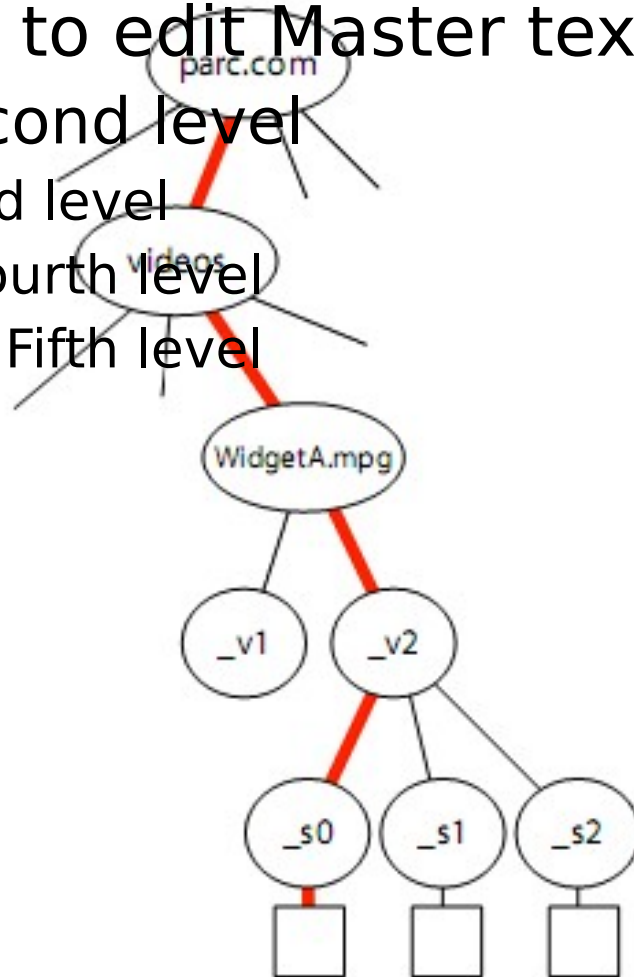
CCN Transport - Sequencing



- A TCP conversation is identified by sequence numbers
- CCN names are presented like URIs
- End with a version number “_v” and a segment number “_s” which uniquely identify each data packet

CCN Transport Sequencing cont...

- Click to edit Master text styles
- Second level
- Third level
 - Fourth level
 - Fifth level



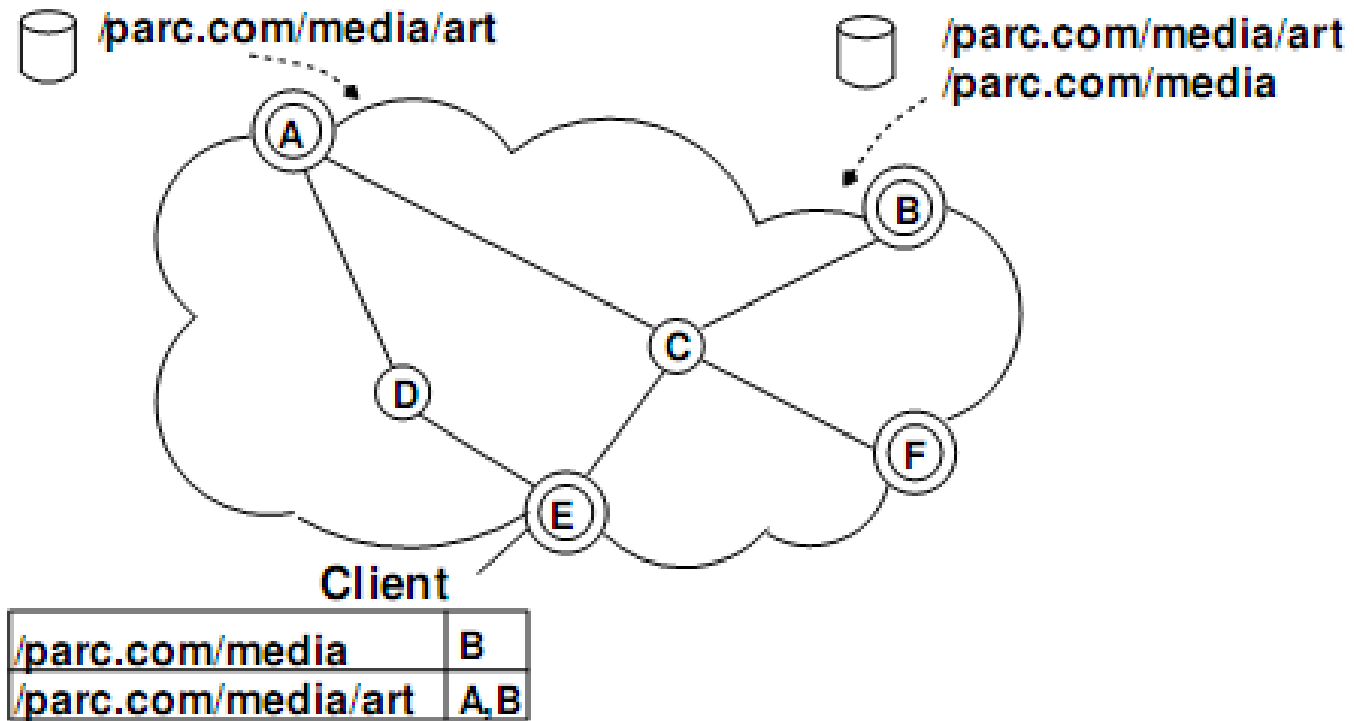
Strategy Layer

- Consists of a set of attributes, actions and triggers
 - Attributes are BroadcastCapable, isContentRouter, UsageBasedCharging, PeakUseLimited
- The “program” in an FIB entry is the “strategy” for obtaining data associated with an FIB prefix
- One example is to send an Interest on all BroadcastCapable faces first, then if no response try all other faces in sequence.

CCN Routing

- Any IP routing scheme should work well for CCN
 - It is a super set of IP routing since it has no restrictions to control looping
- Both use prefix based longest-matching lookups
- Content routers can be attached to existing routers by using TLV (type label values) to describe connected content
- CCN constructs topologies that are close to optimal
 - Data goes only where there is interest
 - At most one copy of the data is sent

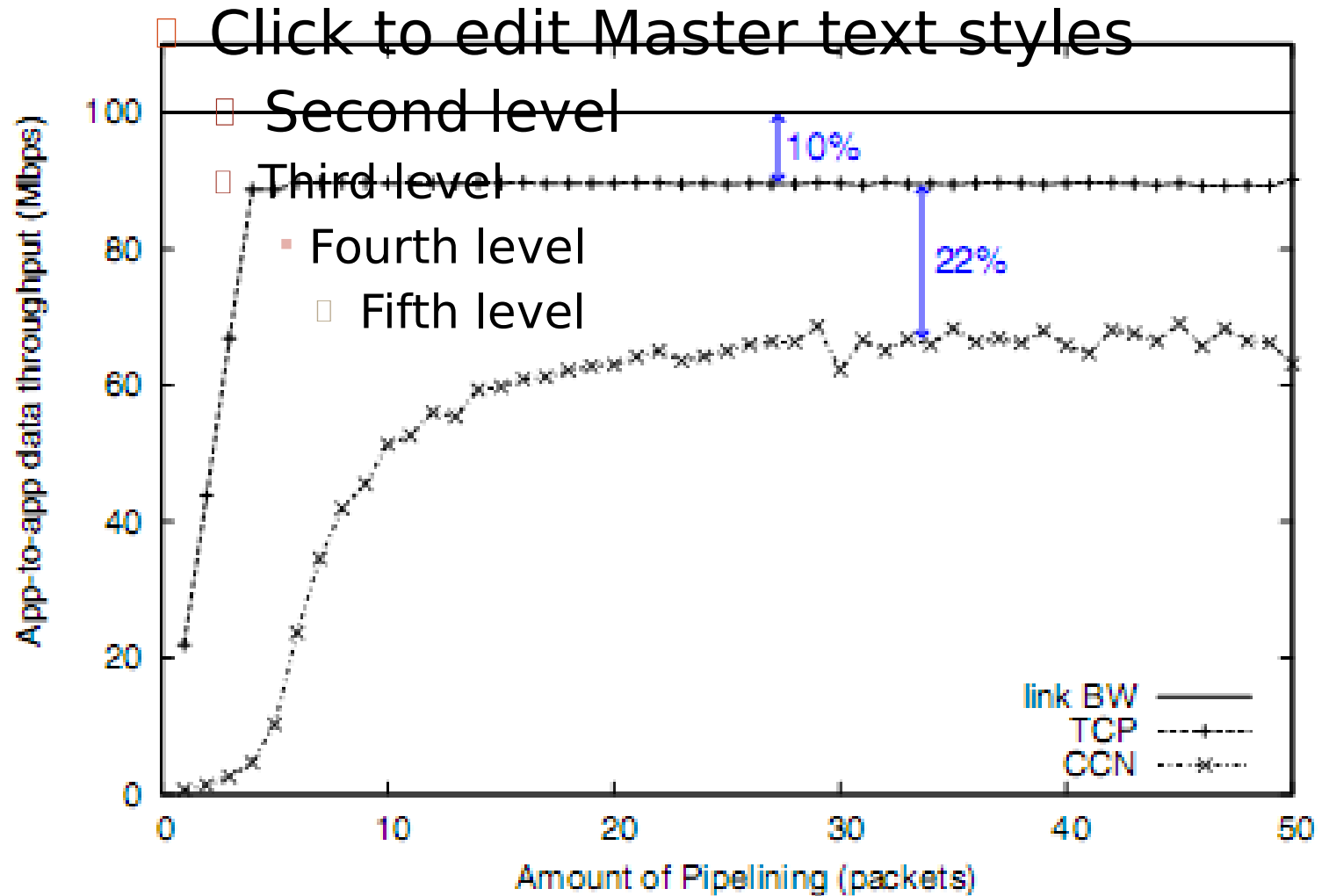
CCN Routing cont...



Security

- Content Based Security
 - Protection and trust travel within the content itself
 - Not a property of the connections it travels
 - All content is authenticated with digital signatures
 - Private content can be encrypted
 - Nearly eliminates the need for a trusted network

CCN Evaluation

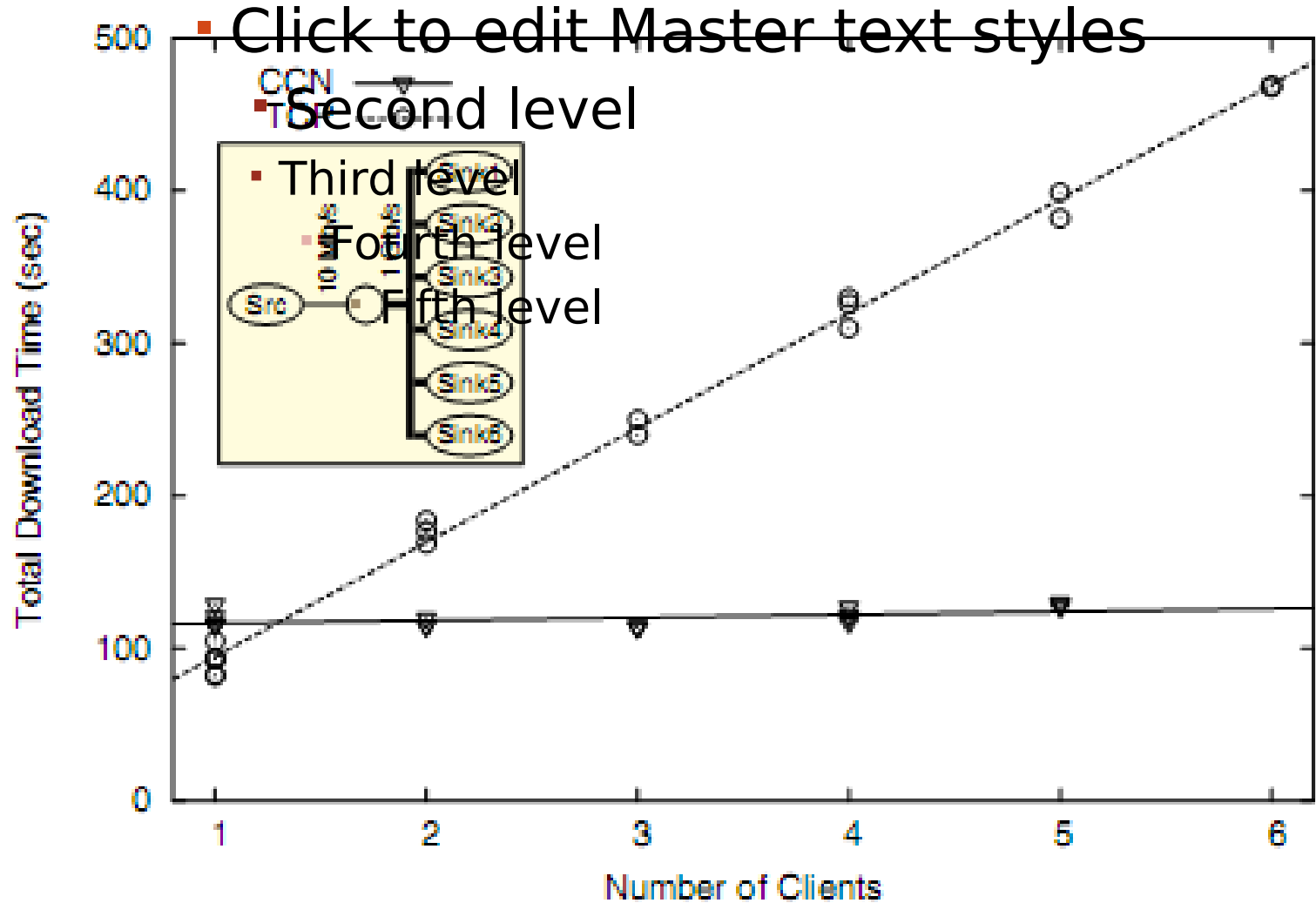


CCN Evaluation cont...

	Bytes (packets)		Overheads	
	Sent	Received	Encap	Transact
Web page (6429 bytes)				
HTTP	723 (9)	7364 (9)	15%	11%
CCN/ETH	811 (8)	8101 (6)	26%	13%
CCN/UDP	325 (3)	6873 (5)	7%	5%
Secured Web page (16944 bytes)				
HTTPS	1548 (16)	21232 (22)	25%	9%
CCN/ETH	1791 (16)	20910 (14)	23%	11%
CCN/UDP	629 (5)	18253 (14)	8%	4%

- CCN matches performance of traditional TCP over normal HTTP
- Since all CCN traffic is encrypted, CCN improves performance over TCP in HTTPS

CCN Evaluation cont...



Any Questions???