Coupling Technology Overview and Planning

What's the right stuff for me?

SHARE San Francisco

EWCP

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IBM

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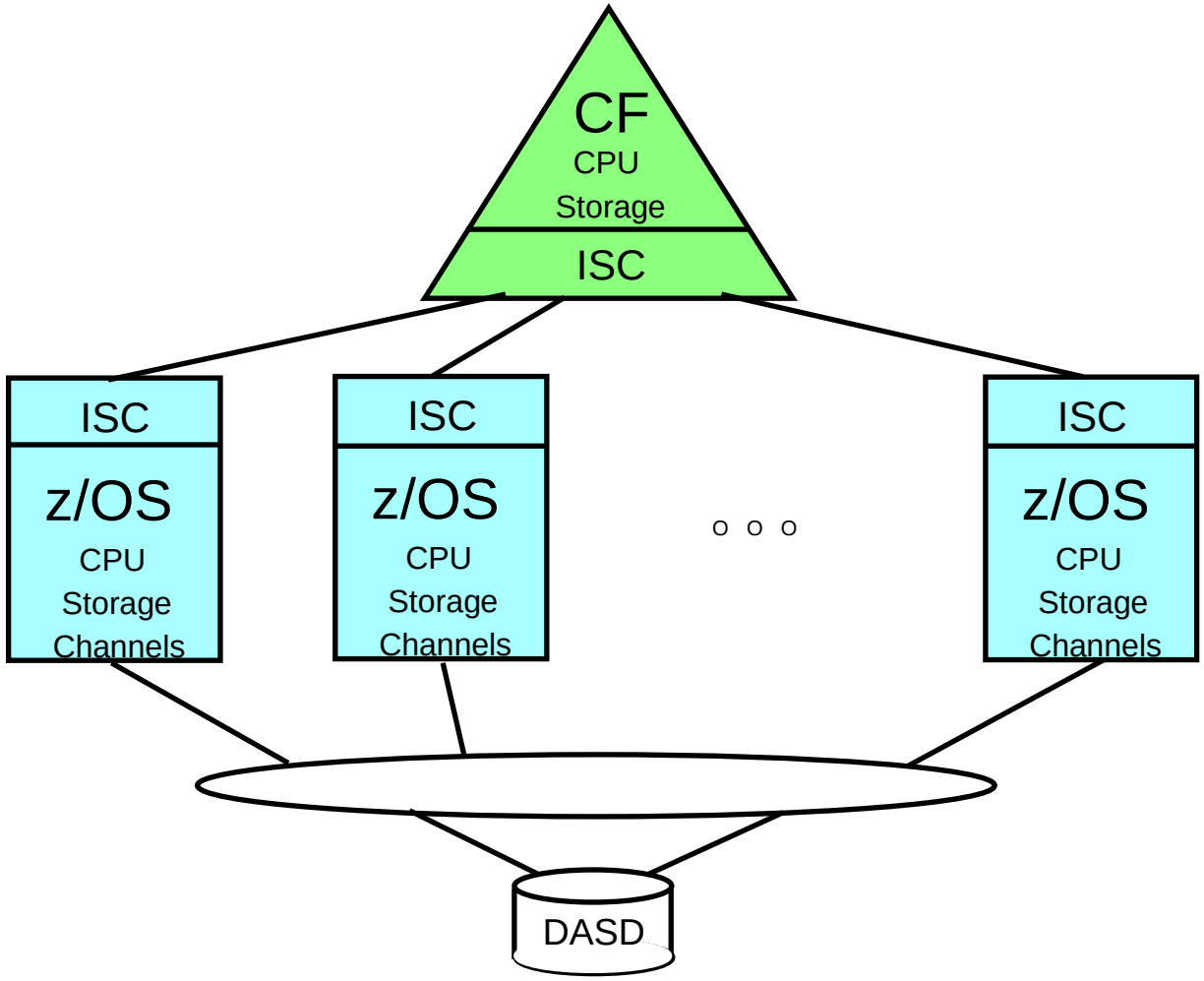
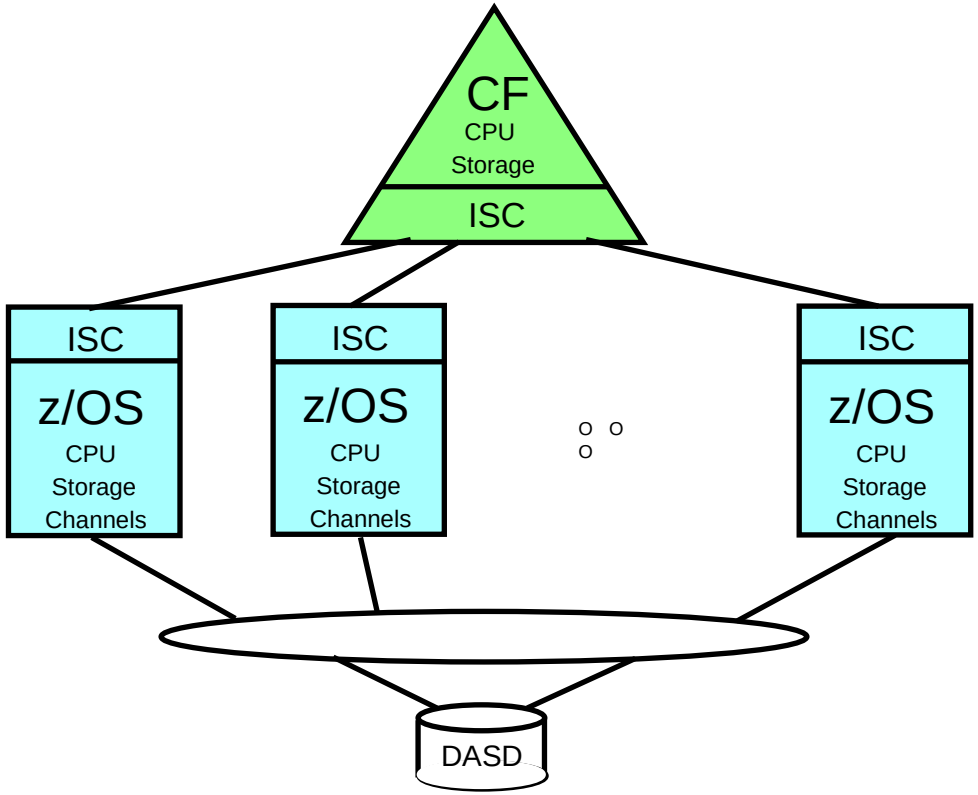
Parallel Sysplex
Overview and hottest players

- Resource Sharing
  - XCF
  - GRS Star
  - logs
- Data sharing
  - locking
  - global buffer pool
- Workload management
  - VTAM
  - CICS TS
  - IMS SMQ
  - MQ shared queues



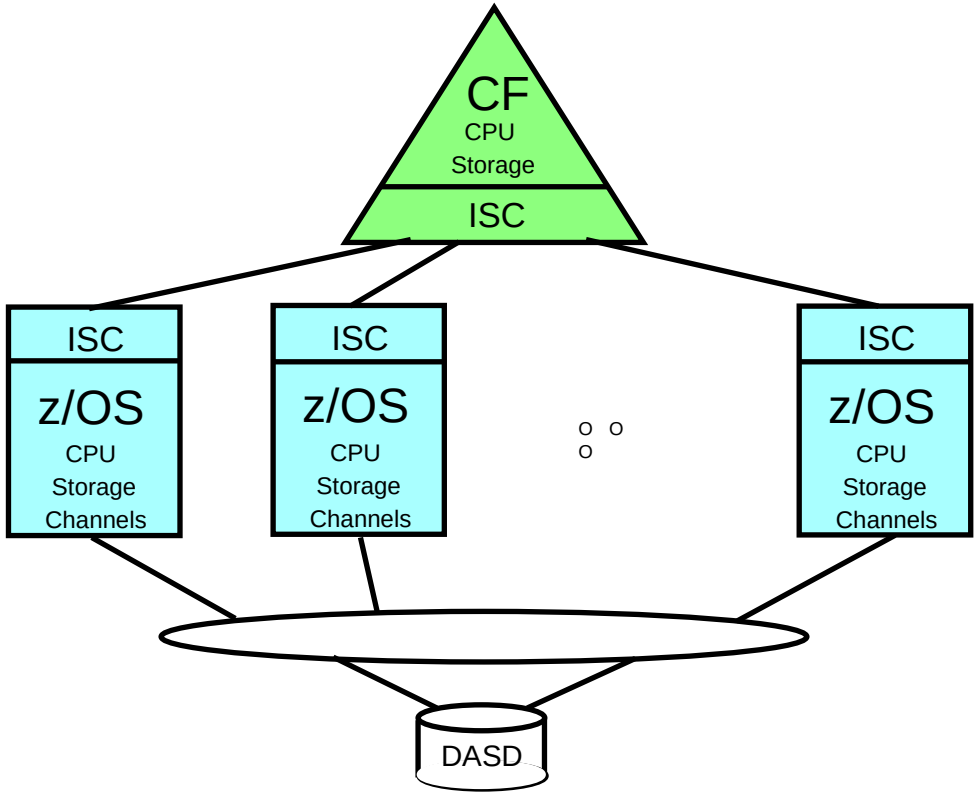
What coupling technology is right for me?

- CF Functionality
- CF Capacity
- CF Service Time



What coupling technology is right for me?

- CF Functionality
  - CFCC levels
- CF Capacity
- CF Service Time

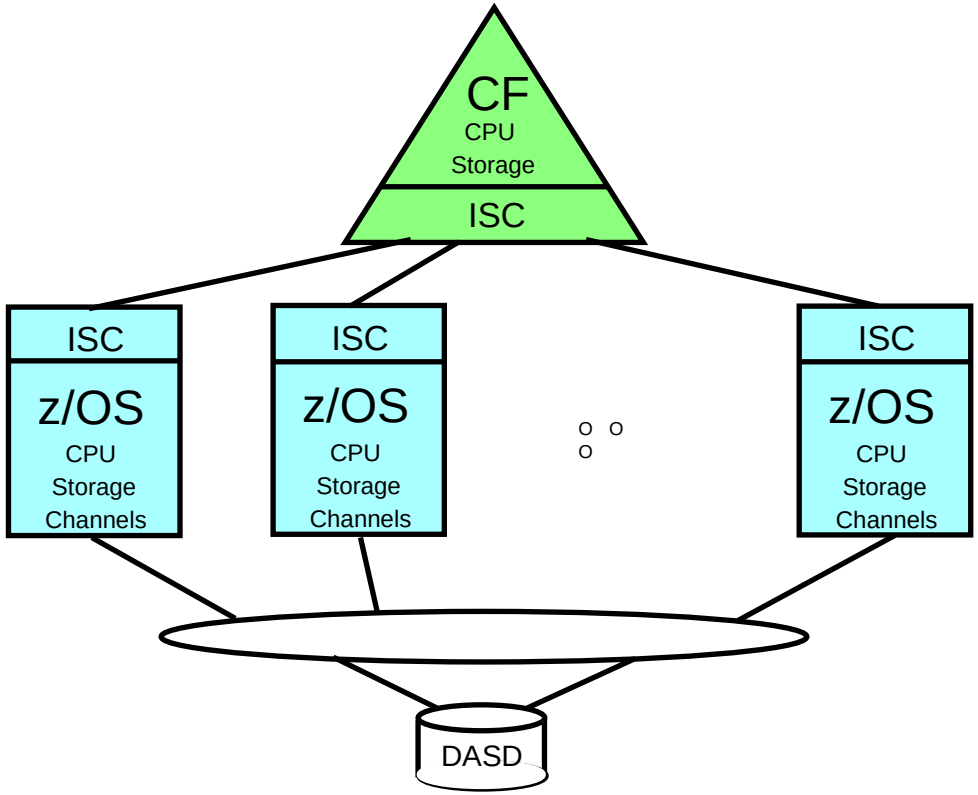


CFCC Level Functional Highlights

- z990/z900/z890/z800
  - CF level 1-10 functions plus ...
  - CF level 12: 64 bit exploitation, 48 tasks, SM structure duplexing
  - CF level 13: DB2 castout improvements
- z9EC/z9BC/z990/z890
  - CF level 14: CFCC dispatcher enhancements
- z9EC/z9BC/z10EC/z10BC
  - CF level 15: 112 tasks, CPU % by structure
- z10EC/z10BC
  - CF level 16: improved SM duplexing, improved LN for IMS and MQ
- z196/z114
  - CF level 17: 2047 structures, enhanced serviceability
- zEC12
  - CF level 18: enhanced serviceability, improved structure size alters

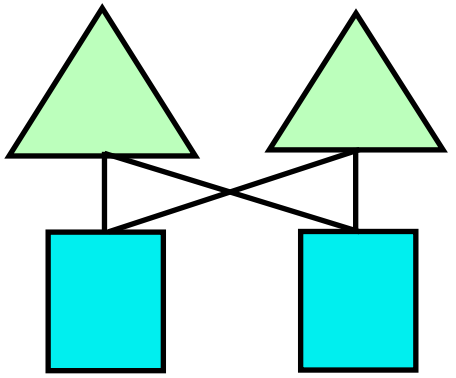
What coupling technology is right for me?

- CF Functionality
  - ► CFCC levels
  - ► CF Partitions
    - –dedicated versus shared processors
    - –standalone versus internal
      - •CF Duplexing
- CF Capacity
- CF Service Time

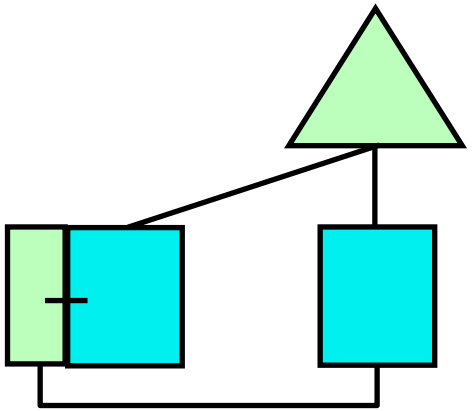


CF Partition Options - what are the differences?

- Standalone CF
  - dedicated processor(s)
    - best for production
  - shared processor(s)
    - test or non-data-sharing production
    - dynamic CF dispatching
    - competition from other partitions

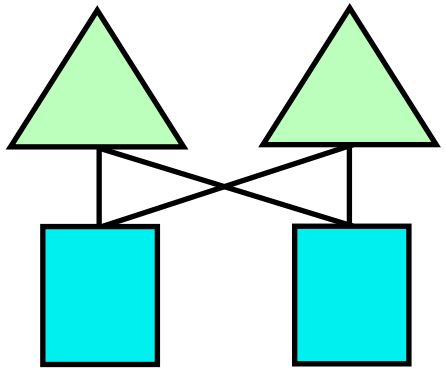


- ICF (Internal Coupling Facility)
  - dedicated or shared processor(s)
    - see above
  - availability considerations
    - addressed by CF duplexing

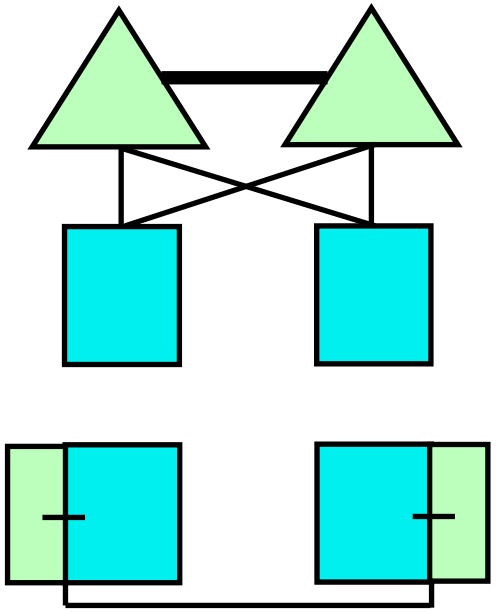


What is CF duplexing?

- User Managed CF structure duplexing
  - Available only for DB2 GBPs and VSO
  - User (DB2 or IMS shared VSO)
    - asks for primary/secondary structures
    - writes updates to both
    - synchronizes via already held locks



- System Managed CF structure duplexing
  - Installation selects duplexing option
    - for specific exploiters/structures
  - System
    - creates primary/secondary structures
    - writes updates to both
    - synchronizes via 2 CF-to-CF ops

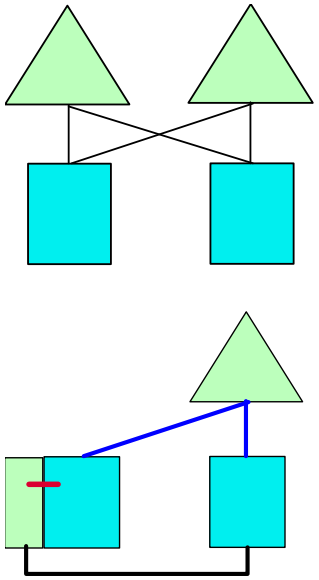


CF duplexing: value vs. cost

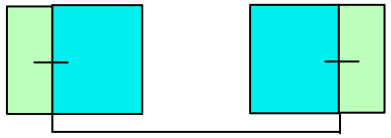
- Value
  - Faster recovery from CF failures
    - much, much faster compared to log recovery (40x)
    - faster compared to rebuild (4x)
  - Provides failure isolation
    - fully exploit ICFs
- Cost
  - Increased resource requirements: host CPU, CF CPU, CF links
  - User Managed (DB2 GBP and VSO structures)
    - 2x times 1% to 100% (typically 20%) of simplex cost
  - System Managed (list and lock structures)
    - 3x to 5x times near 100% of simplex cost
- Selectively enable when value > cost

CF Partition Options – Pros and Cons

- Standalone or “logical” standalone CF in the configuration
  - Inherently provides failure isolation
  - Easier maintenance
  - More connectivity
  - Most commonly used for …
    - Large sysplexes
    - Intensive data sharing workloads



- All ICF (Internal Coupling Facility) configuration
  - Less costly than separate footprints
  - Technology upgrades simultaneously with host
  - Take advantage of internal coupling links
  - Needs SM duplexing to provide failure isolation
    - MIPS cost can be prohibitive to intensive data sharing workloads
  - Most commonly used for …
    - Smaller sysplexes
    - Resource sharing or low-intensity data sharing workloads

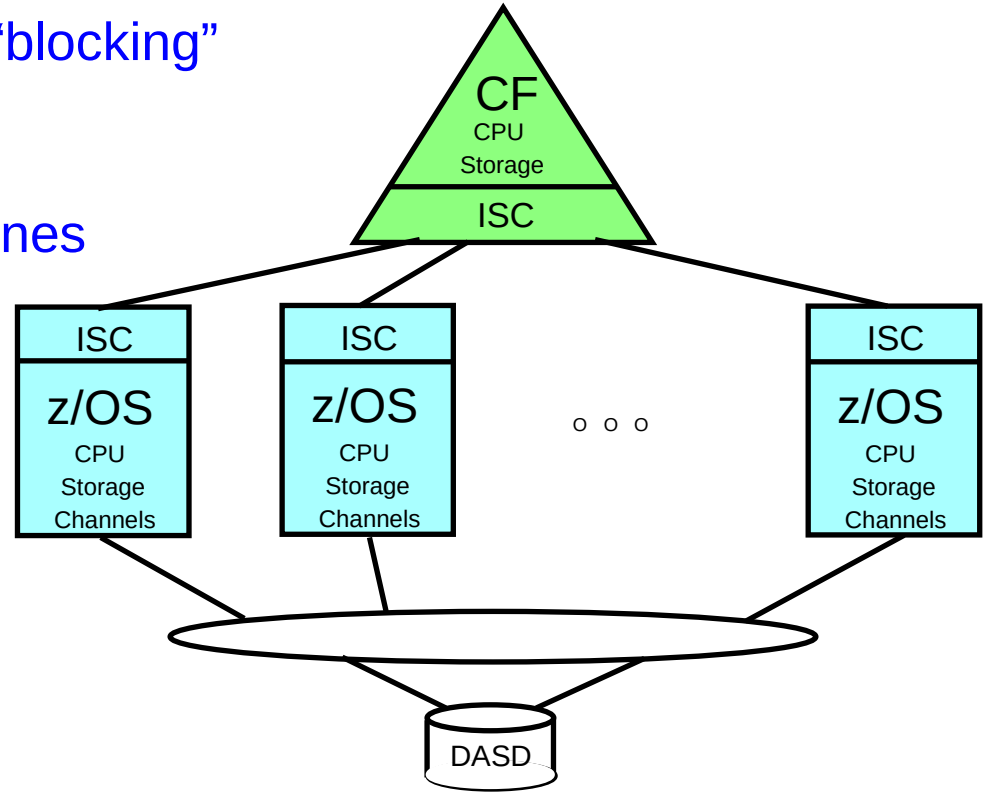


What coupling technology is right for me?

- CF Functionality

- CF Capacity
  - Need enough to handle the request rate (keep utilization < 50%)
    - Note 1way CFs <30% due to
      - Single server queuing
      - Long running commands “blocking” short commands
  - Add engines or move to faster engines

- CF Service Time



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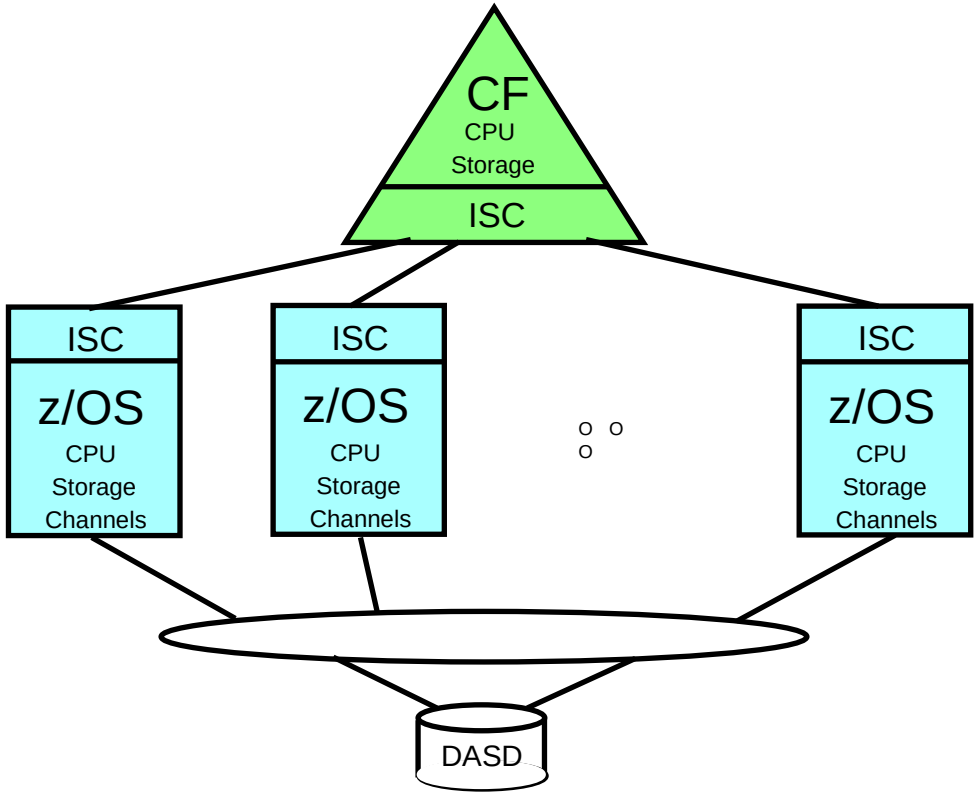
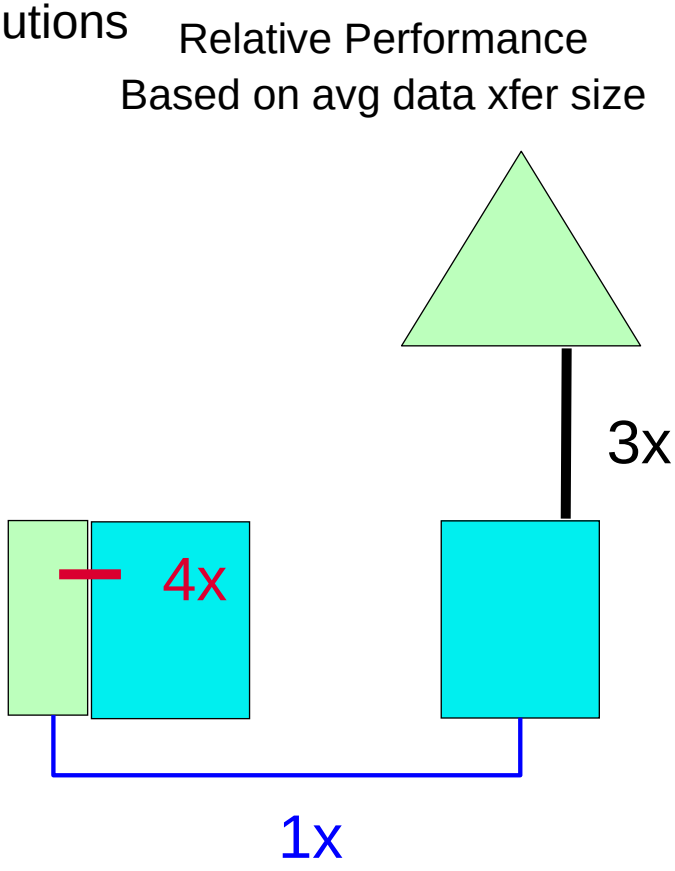


Coupling Link Choices - Overview

- ISC (Inter-System Channel)
  - Fiber optics
  - I/O Adapter card
  - 10km and longer distances with qualified WDM solutions
- ICB (Integrated Cluster Bus)
  - Copper cable plugs close to memory bus
  - 10 meter max length
  - Not available on z196 and later
- IC (Internal Coupling Channel)
  - Millicode - no external connection
  - Only between partitions on same processor



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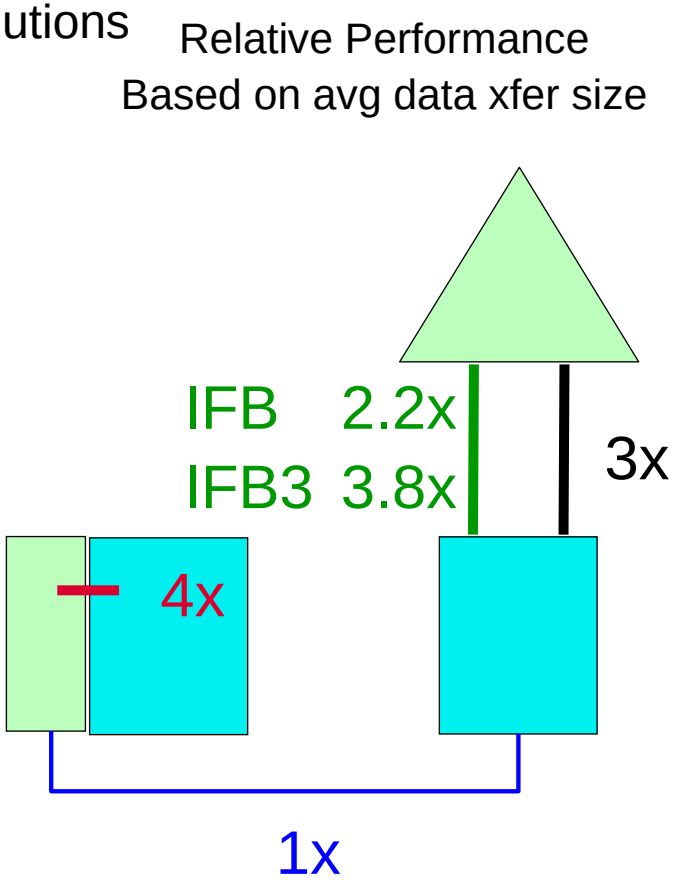
- 12X IFB and 12X IFB3 (intro z196 GA2)
  - 150 meter max distance optical cabling
  - Supports multiple CHPIDs per physical link
  - Multiple CF partitions can share physical link



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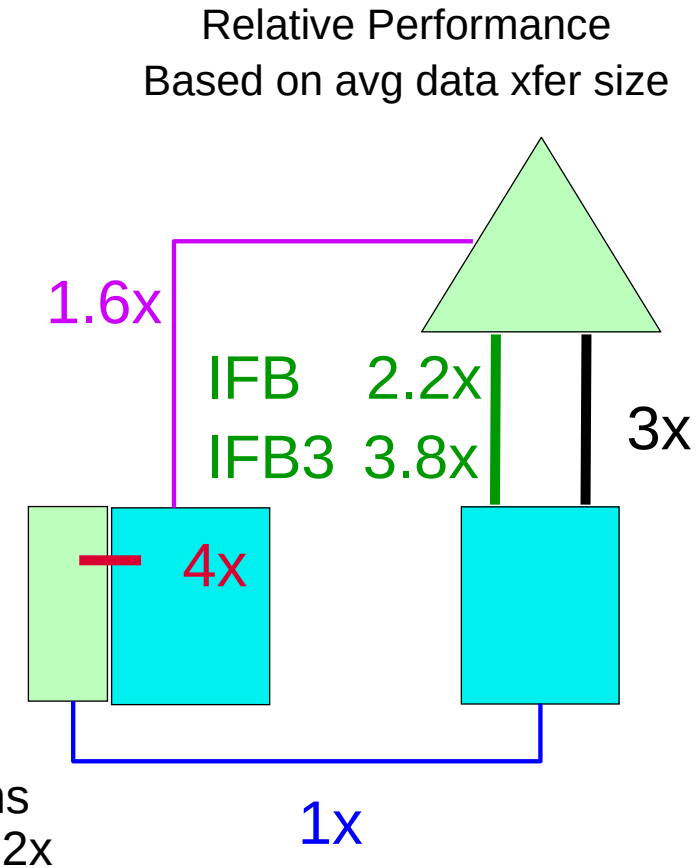
- 1x IFB

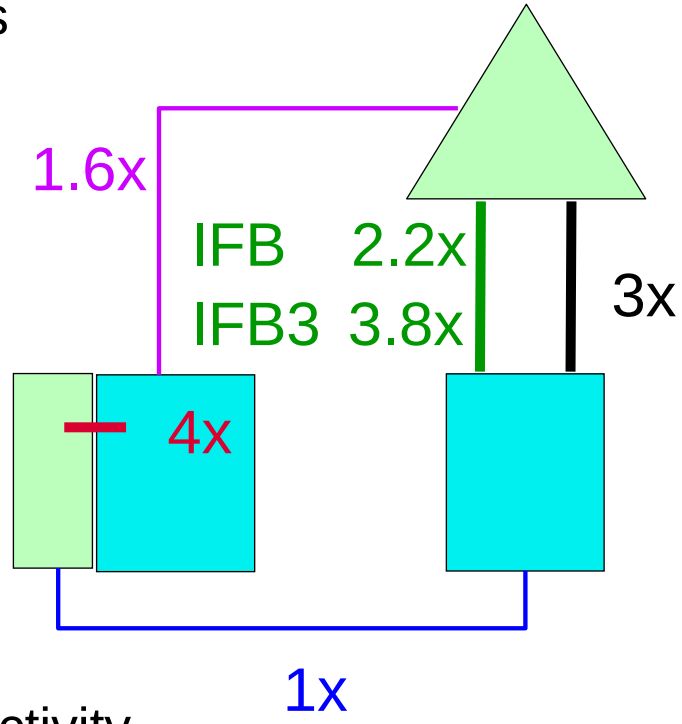
10km and longer distances with qualified WDM solutions

  - Same multiple CHPIDs and sharing flexibility as 12x
  - 32 subchannels (up from 7) per CHPID (intro z196 GA2)



IFB Configuration Advantages

- Pure Capacity
  - 1 12x IFB(3) replaces 1 ICB4
  - 1 12x IFB(3) replaces 4 ISC3s
- Eliminating subchannel and path delays
  - Often >2 ICB4s configured not for capacity but for extra subchannels/paths to eliminate delays
  - 2 12x IFB(3) links with multiple CHPIDs can replace >2 ICB4s in this case
- Multiple sysplexes sharing hardware
  - Production, development, test sysplexes may share hardware – each needs own ICB4 or ISC3 links
  - 2 IFB(3) links with multiple CHPIDs can replace >2 ICB4s or ISC3s in this case
- Multiple CHPID recommendations
  - Max 16 per HCA (2 ports per HCA)
    - Can use up to all 16 for lightly loaded connectivity
    - Limit to use up to 8 per HCA for heavy loads
    - Limit 4 per port for IFB3 performance



What coupling technology is right for me?

- CF Functionality
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  - Affected by
    - –speed of CF engine
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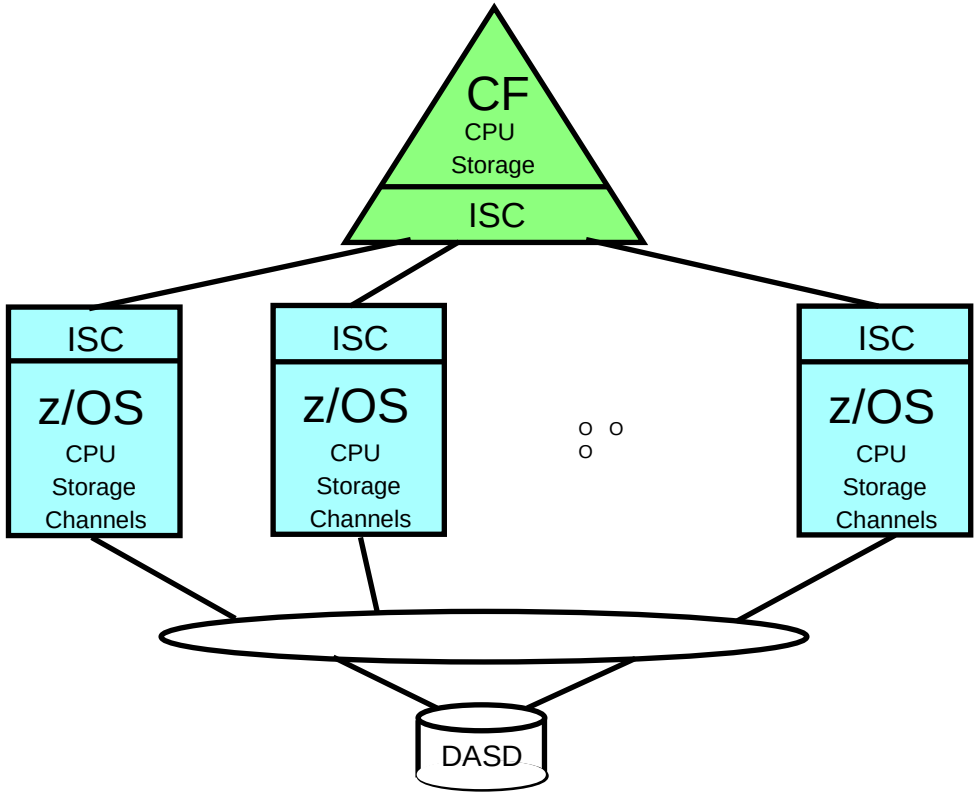
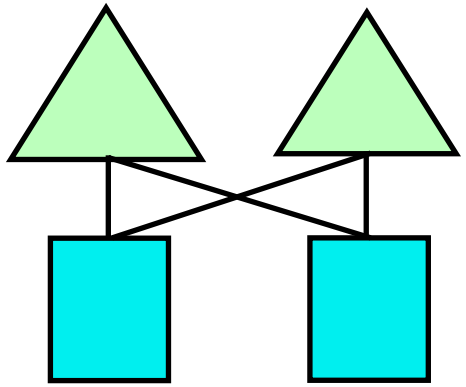
  - Affects cost of data sharing
    - –host processor dwells for synchronous requests



CF Operations: synchronous or asynchronous

- Describes state of host processor engine issuing CF operation

- Synchronous operation
  - SW cost: exploiter+XES
  - HW cost ("dwelling time")



- Asynchronous operation
  - SW cost
    - exploiter+XES+SRBs
    - task switching impact on HW
  - HW cost - virtually none (no dwelling)
  - CF service time elongation
    - added latency for XES to recognize completion of operation

- Which when?
  - Exploiter can specify synch or asynch
  - If synch, XES heuristic can override and issue it asynch
    - based on measured synch service time versus "breakeven" cost of asynch
  - If issued synch and encounter subchannel busy, will change to asynch

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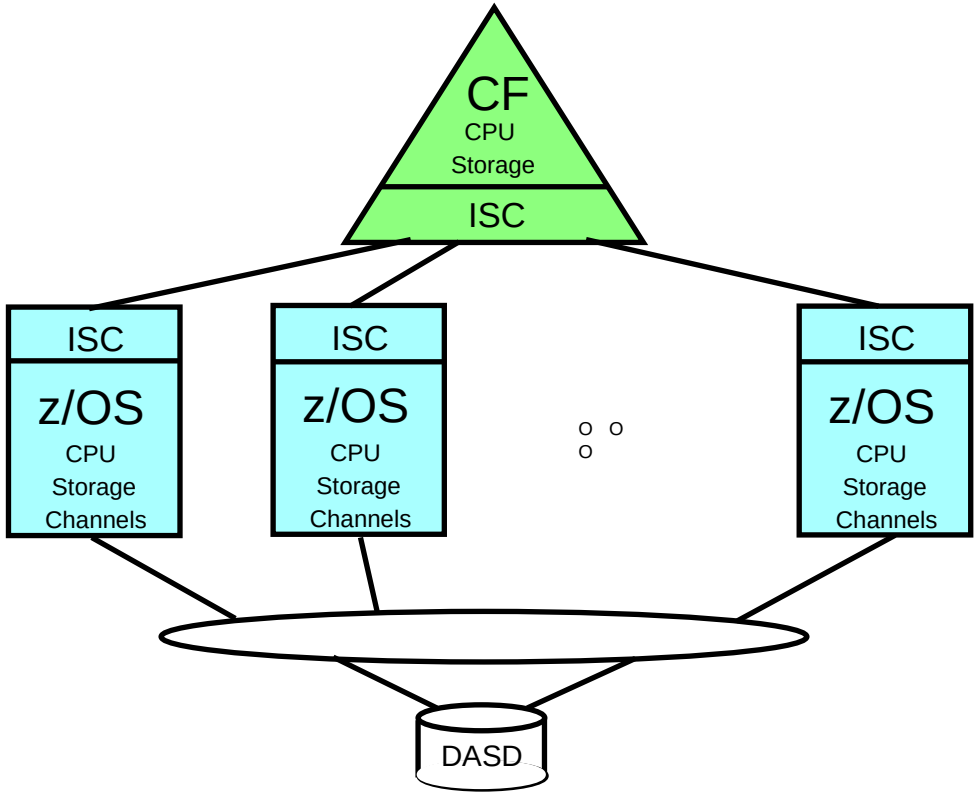
  - Impact relative to ...
    - –Rate of requests to the CF
    - –Speed of the host processor



Host Capacity Effect

- Directly related to activity to CF
  - CF request rate x SW+HW cost
- Varies based on
  - Portion of workload involved in data sharing
  - Access rate to shared data
  - Type of hardware for Host, CF and CF links
- Typical system-level effects
  - Resource Sharing: 2-3% versus single image
  - Data sharing primary production application: 5-10%
- Individual Transaction/Job effects - can have wide variation

Production Examples

Host Effect with primary application involved in data sharing

Industry	Trx Mgr / DB Mgr	z/OS Images	CF access per Mi	% of used capacity
Banking	CICS/IMS	4	9	11%
Banking	CICS/IMS	8	8	9%
Banking	IMS/IMS	2	5	7%
Pharmacy	CICS/DB2	3	8	10%
Insurance	CICS/IMS+DB2	9	9	10%
Banking	IMS/IMS+DB2	4	8	11%
Transportation	CICS/DB2	3	6	8%
Banking	IMS/IMS+DB2	2	7	9%
Retail	CICS/DB2+IMS	3	4	5%
Shipping	CICS/DB2+IMS	2	8	9%

Coupling Technology versus Host Processor Speed

Host effect with primary application involved in data sharing

Chart below is based on 9 CF ops/Mi - may be scaled linearly for other rates

CF\Host	z10 BC	z10 EC	z114	z196	zEnterprise EC12
z10 BC ISC3	16%	18%	17%	21%	24%
z10 BC 1x IFB	13%	14%	14%	17%	19%
z10 BC 12x IFB	12%	13%	13%	15%	17%
z10 BC ICB4	10%	11%	NA	NA	NA
z10 EC ISC3	16%	17%	17%	21%	24%
z10 EC 1x IFB	13%	14%	14%	17%	19%
z10 EC 12x IFB	11%	12%	12%	14%	16%
z10 EC ICB4	10%	10%	NA	NA	NA
z114 ISC3	16%	18%	17%	21%	24%
z114 1x IFB	13%	14%	14%	17%	19%
z114 12x IFB	12%	13%	12%	15%	17%
z114 12x IFB3	NA	NA	10%	12%	13%
z196 ISC3	16%	17%	17%	21%	24%
z196 1x IFB	13%	14%	13%	16%	18%
z196 12x IFB	11%	12%	11%	14%	15%
z196 12x IFB3	NA	NA	9%	11%	12%
zEnterprise EC12 ISC3	16%	17%	17%	21%	24%
zEnterprise EC12 1x IFB	13%	13%	13%	16%	18%
zEnterprise EC12 12x IFB	11%	11%	11%	13%	15%
zEnterprise EC12 12x IFB3	9%	9%	9%	10%	11%

With z/OS 1.2 and above, synch->asynch conversion caps values in table at about 18%
IC links scale with speed of host technology and would provide an 8% effect in each case

What coupling technology is right for me?

Your Handy Dandy Checklist

- CF Functionality
  - CFCC level, standalone vs internal, dedicated vs shared
- CF Capacity
  - Need enough to handle the request rate (keep utilization < 50%)
  - Add engines or move to faster engines
- CF Service Time
  - Affected by
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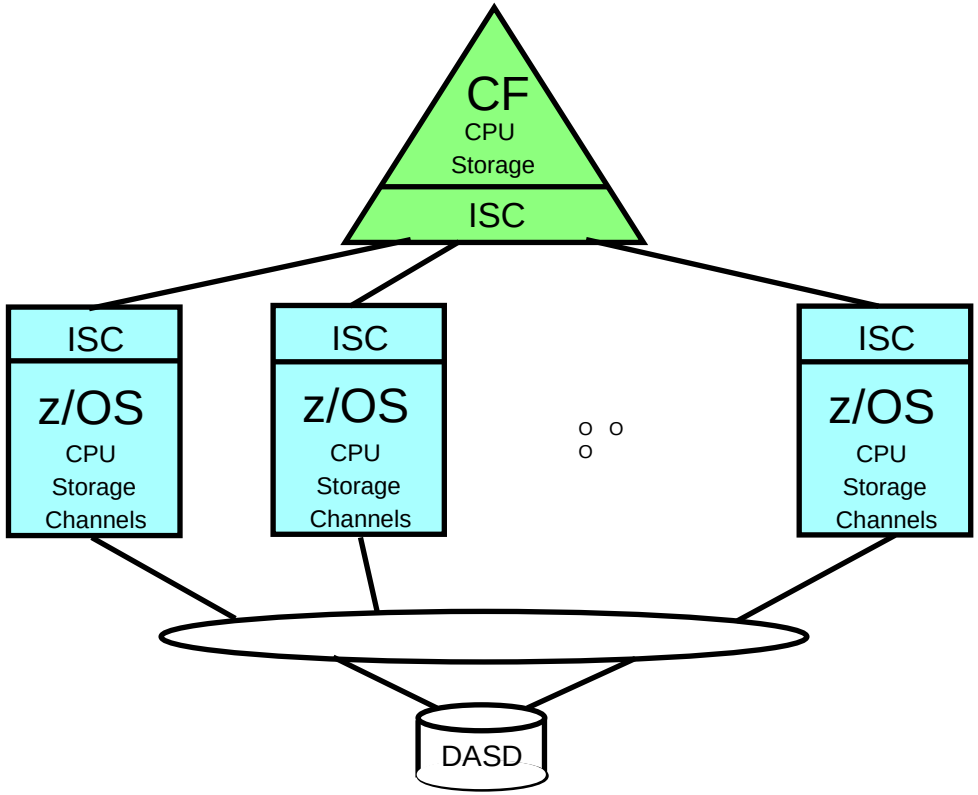
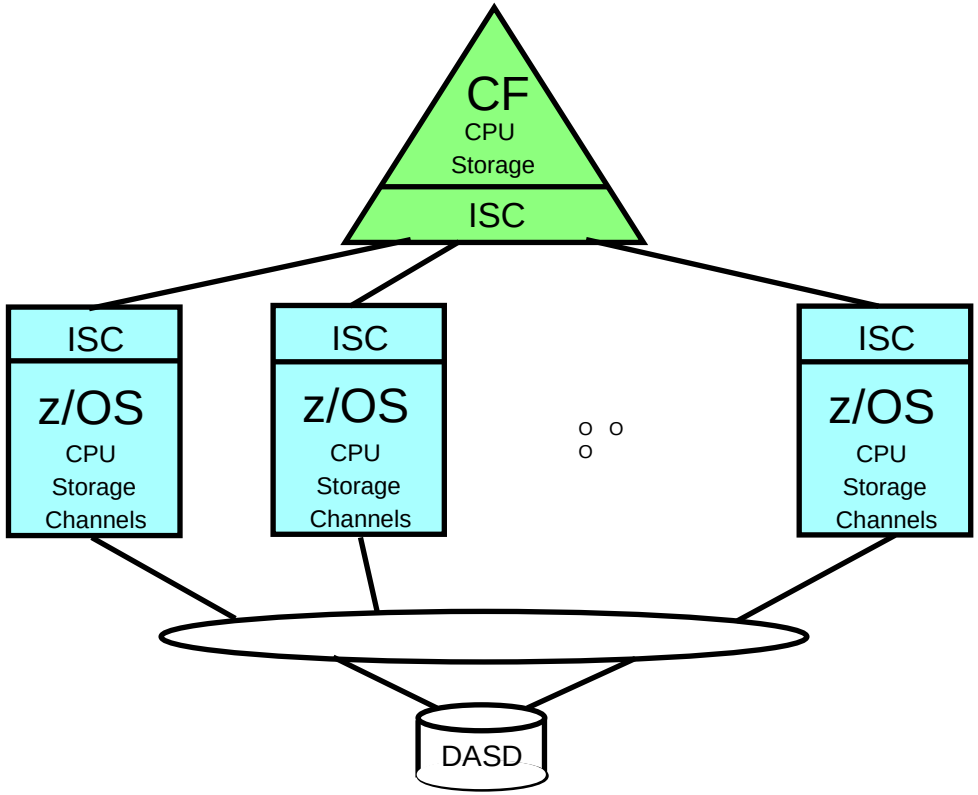


For those considering data sharing over distance ...

- CF Functionality
- CF Capacity
- CF Service Time
  - Affected by
    - –speed of CF engine
    - –link technology
    - –distance between host and CF
      - •elongates by 10 mics per km due to speed of light thru fiber
  - Can affect application performance
    - –transaction waits for synch and asynch requests
      - •potential impact on subsystem queues and lock contention

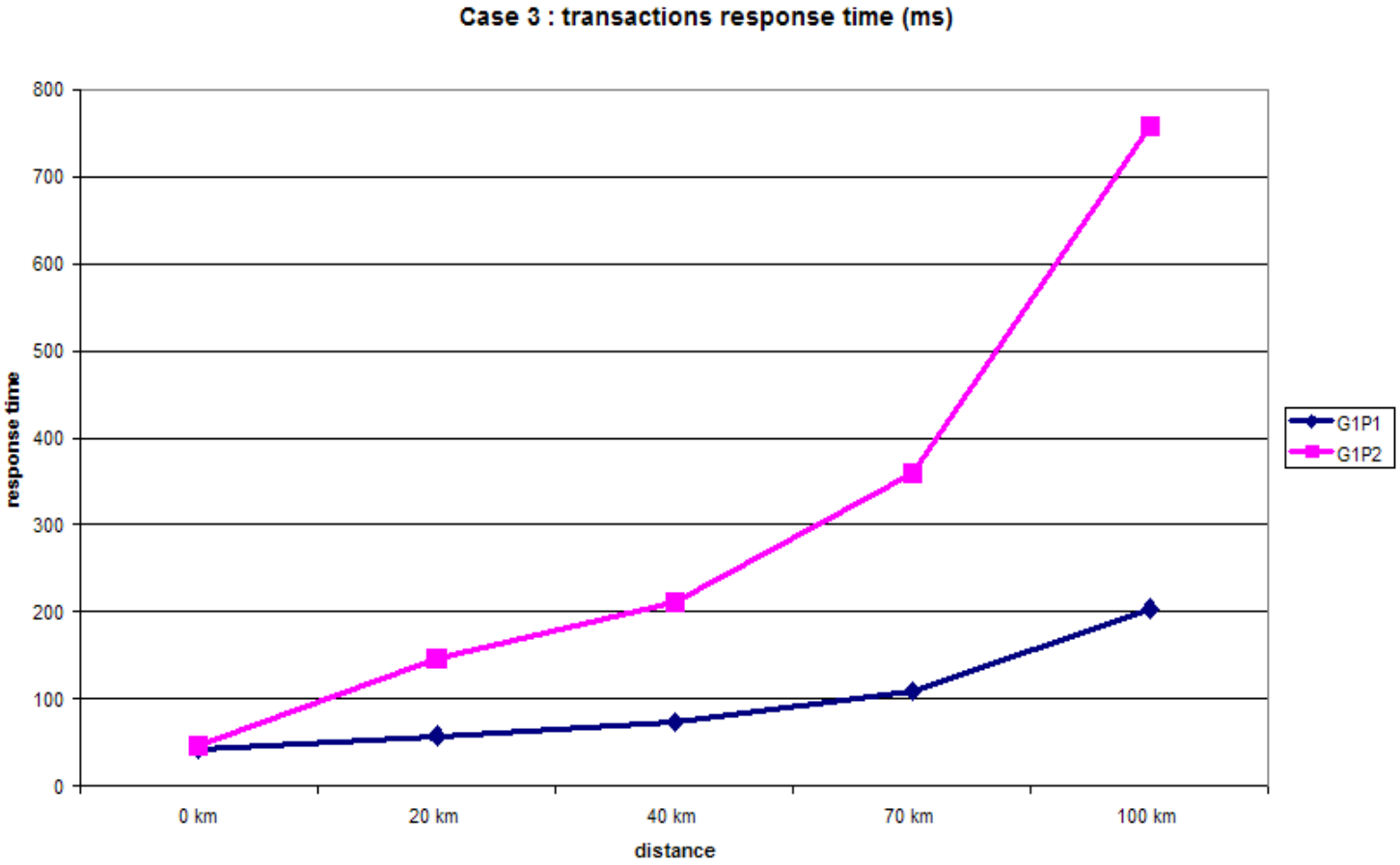


Example Distance Impact

Benchmark CICS/DB2 data sharing application

G1P1 LPAR local to CF with lock structure and primary GBPs

G1P2 LPAR remote to CF with lock structure and primary GBPs



Data sharing over distance summary

- CF service time elongation (versus synch request)
  - +50 mics due to change to asynch
  - +10 mics per km due to speed of light through fiber (round trip to CF)
- Host impact is capped by synch to asynch conversion
- Will likely need more link buffers (subchannels) between host and remote CF
  - link buffer (subchannel) busy grows linearly with elongated service time
  - IFB multiple CHPIDs and 32 subchannels per CHPID support helps here
- Potential application performance impact
  - increased transaction response time
    - increased internal subsystem queues
    - increased lock contention
- Each application will react differently
- Difficult to predict impact
- Suggest application stress testing with simultated distance (e.g., fiber suitcases)

References

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  - CF Structure Sizer Tool