OPENFABRICS ALLIANCE

Signature Verbs Extension

10TH ANNUAL INTERNATIONAL DEVELOPER WORKSHOP

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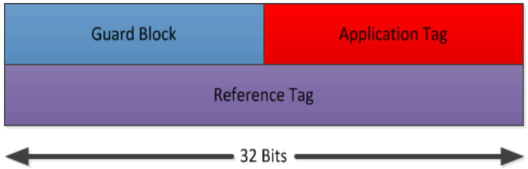
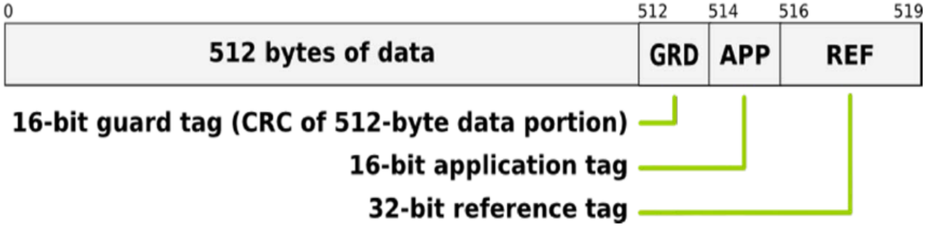
Data Integrity Field (DIF)

- Used to provide data block integrity check capabilities (CRC) for block storage (SCSI)
- Proposed by the T10 committee
- DIX extends the support to main memory
- Motivation:
  - Data integrity checks are included in:
    - memory bus
    - I/O bus (PCI-e)
    - internal chips
    - RAID controller within arrays
    - network packet interfaces
  - Missing data protection: storage controller
    - iSCSI can DMA wrong pages from memory and calculate checksum on these pages
    - Array may receive incorrect data and use it to generate RAID parity blocks
    - Disks may write to the wrong logical block

What is DIF

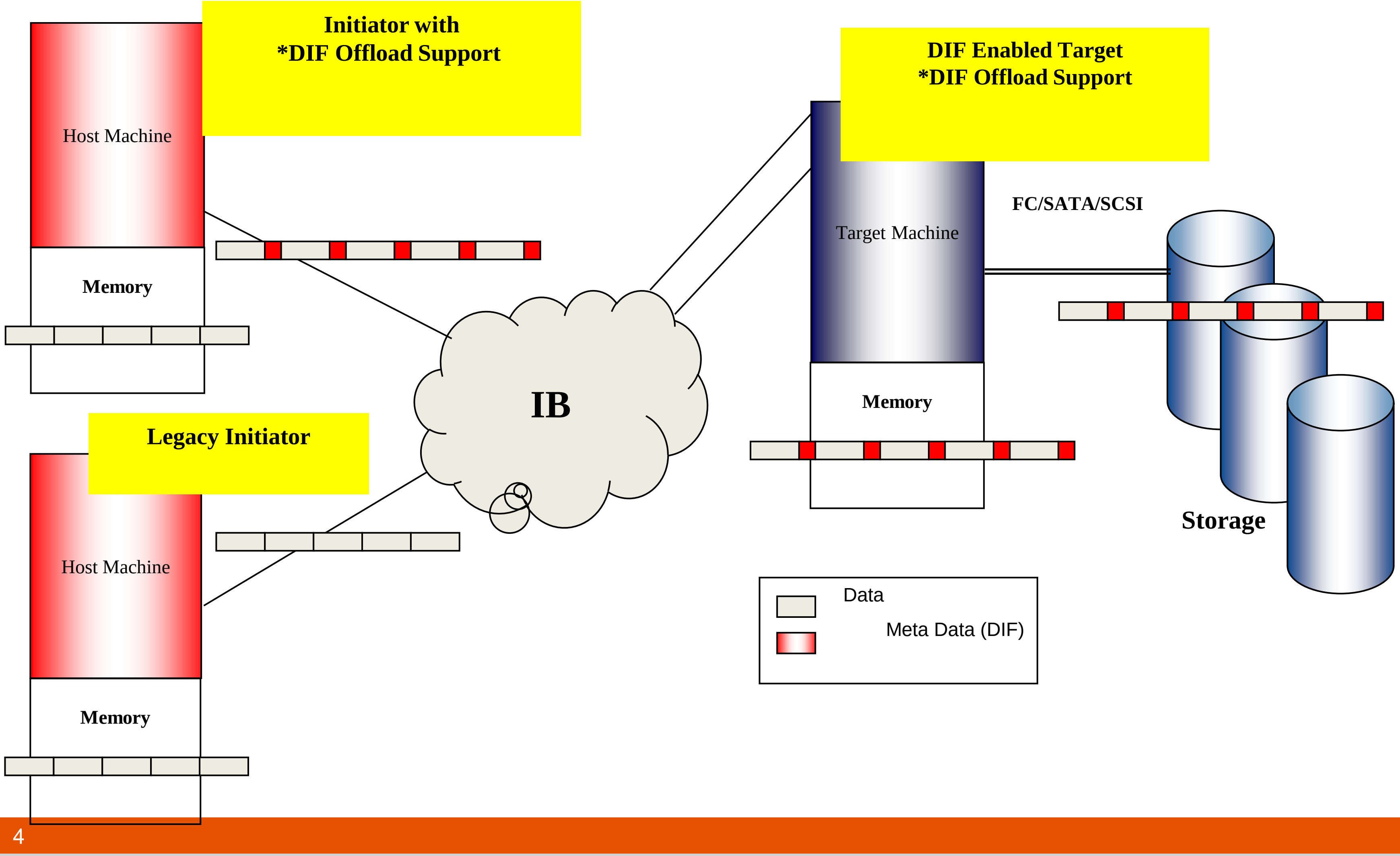
- The standard specify an additional 8 byte field designated for data integrity/protection for each data block (usually of size 512 bytes but not a must).



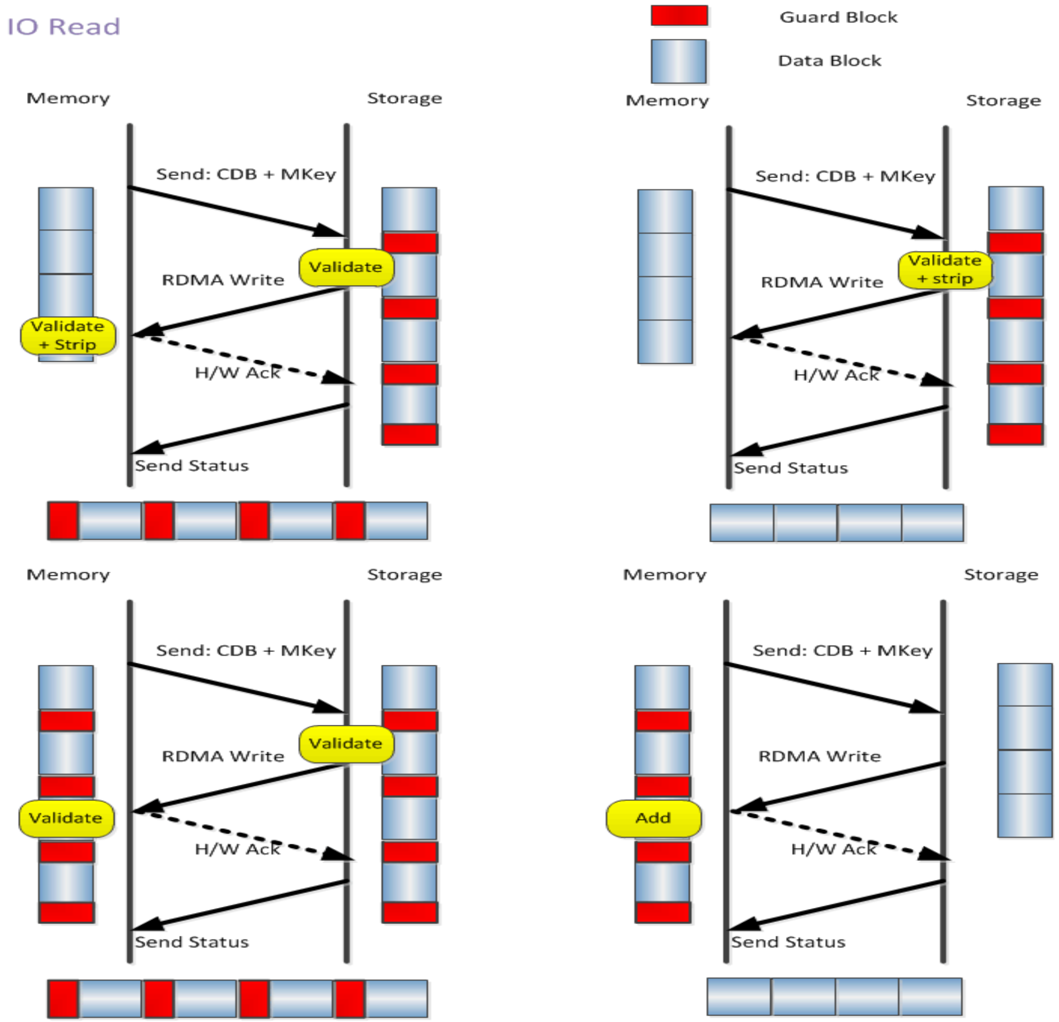


- GUARD tag (Logical Block Guarding):
  - 16-bit CRC covering the hardware sector
  - Regardless of sector size
  - 4096 KB sectors appear only to gain momentum in lower end
- REFERENCE tag (Misdirected writes):
  - 4 bytes – depend on protection type
  - For Type 1 protection, REF tag contains lower 32 bits of LBA
  - For Type 2 protection, REF tag has to match LBA in CDB + N
  - Wraps at 2TB with 512 byte sectors, 16TB with 4KB
- APPLICATION tag (Up for grabs):
  - 2 bytes per sector
  - Ownership negotiated with target

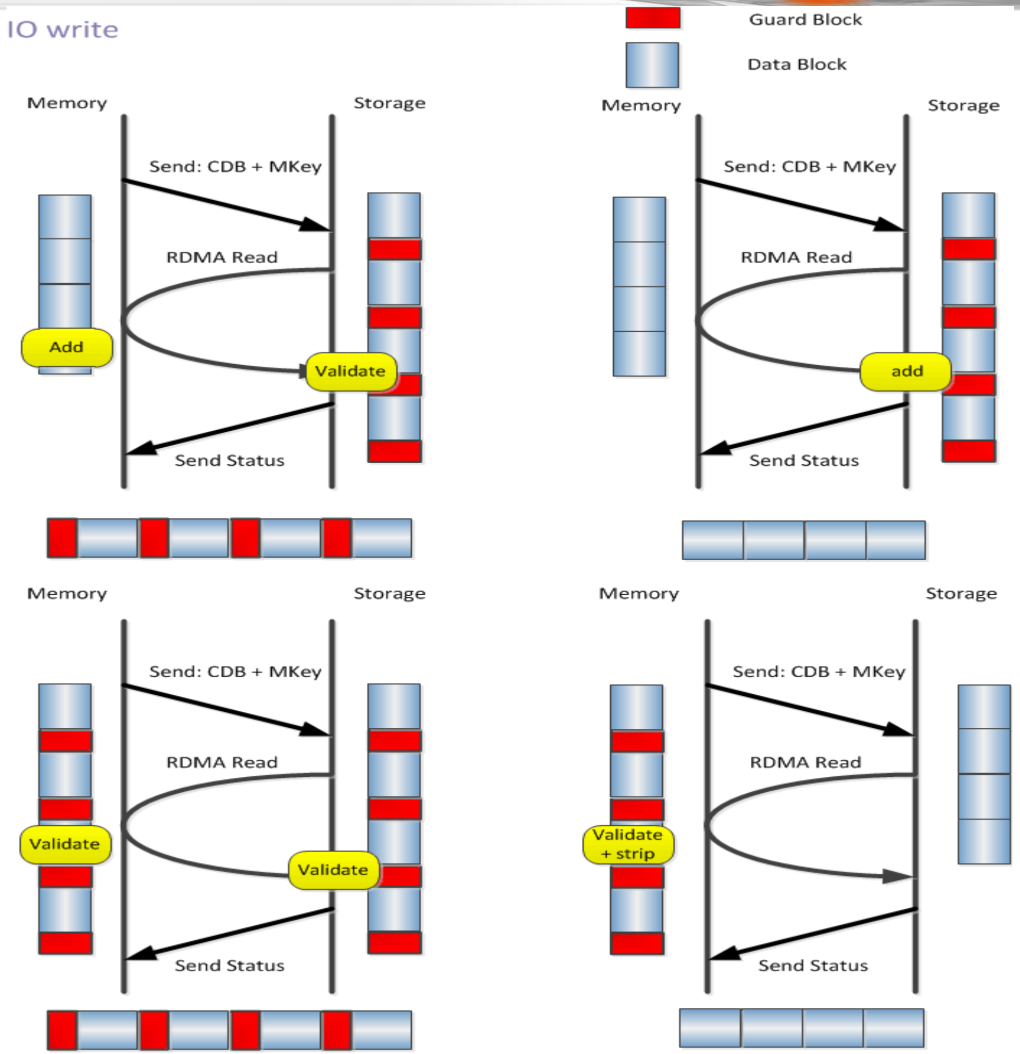
System Architecture



System Architecture



System Architecture



Signature Verbs - Actions

1. Allocate Signature enabled memory regions

```
mr_init_attr.flags |= IB_MR_SIGNATURE_EN;
sig_mr = ib_create_mr(pd, &mr_init_attr);
```

2. Set QP as Signature enabled

```
qp_init_attr.create_flags |= IB_QP_CREATE_SIGNATURE_EN;
sig_qp = ib_create_qp(pd, &qp_init_attr);
```

3. Register Signature MR (send work request `IB_WR_REG_SIG_MR`)

```
sig_wr.opcode = IB_WR_REG_SIG_MR;
sig_wr.sg_list = data_sge;              /* Data buffer */
sig_wr.wr.sig_handover.prot = prot_sge;           /* protection buffer */
sig_wr.wr.sig_handover.sig_attrs = &sig_attrs;    /* signature attributes struct */
sig_wr.wr.sig_handover.sig_mr = pi_ctx->sig_mr;   /* Signature enabled MR */
ret = ib_post_send(qp, sig_wr, &bad_wr);
```

3.5. do RDMA (data-transfer) – Leverage existing verbs support

4. Check Signature status

```
ret = ib_check_mr_status(sig_mr, IB_MR_CHECK_SIG_STATUS, &mr_status);
```

Leverage Extended User Mode Memory Registration

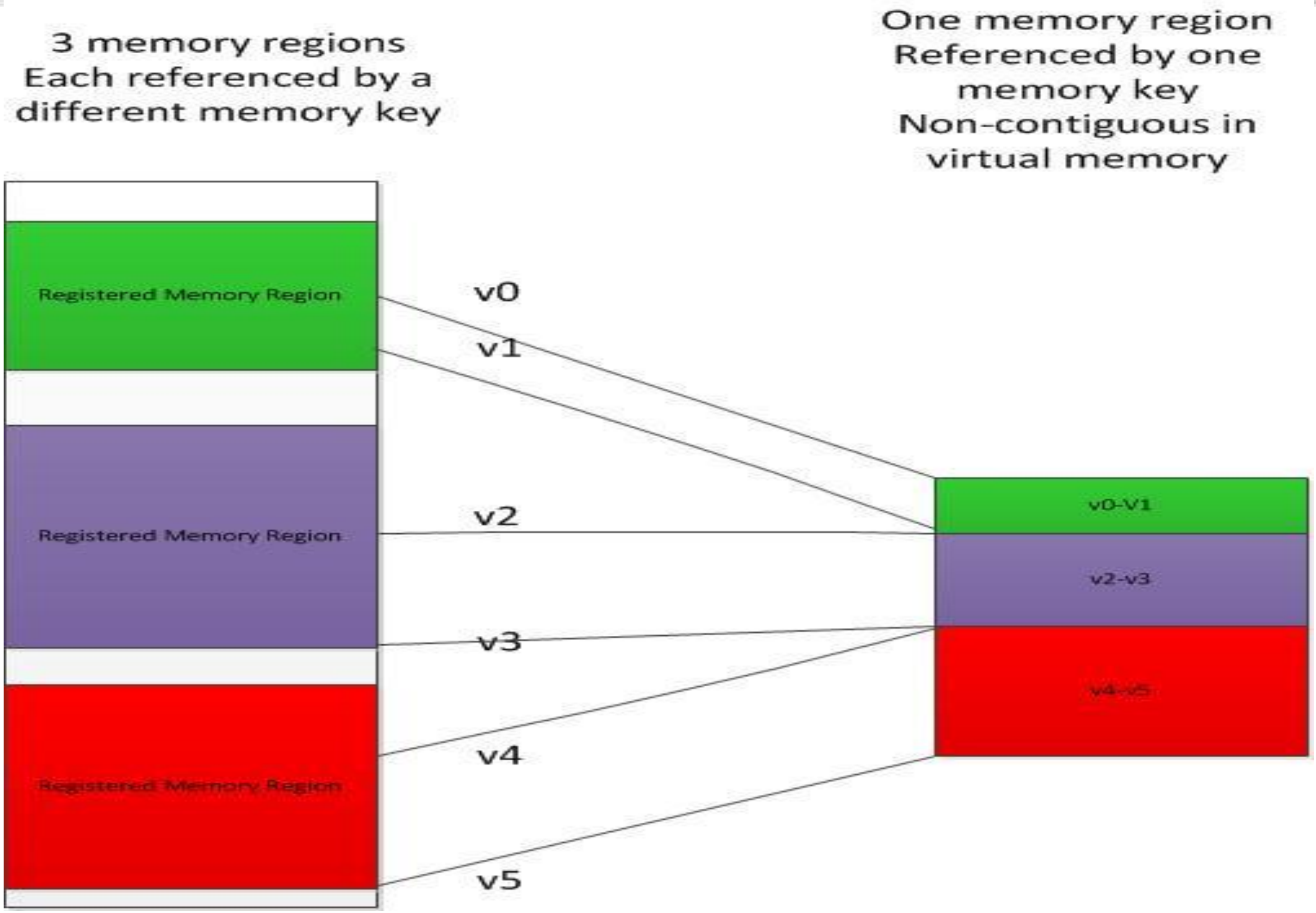
- Memory Key Creation: Support combining contiguous registered memory regions into a single memory region. H/W treats them as a single contiguous region (and handles the non-contiguous regions)

- For a given memory region, supports non-contiguous access to memory, using a regular structure representation – base pointer, element length, stride, repeat count.
  - Can combine these from multiple different memory keys

- Memory descriptors are created by posting WQE's to fill in the memory key

- Supports local and remote non-contiguous memory access
  - Eliminates the need for some memory copies

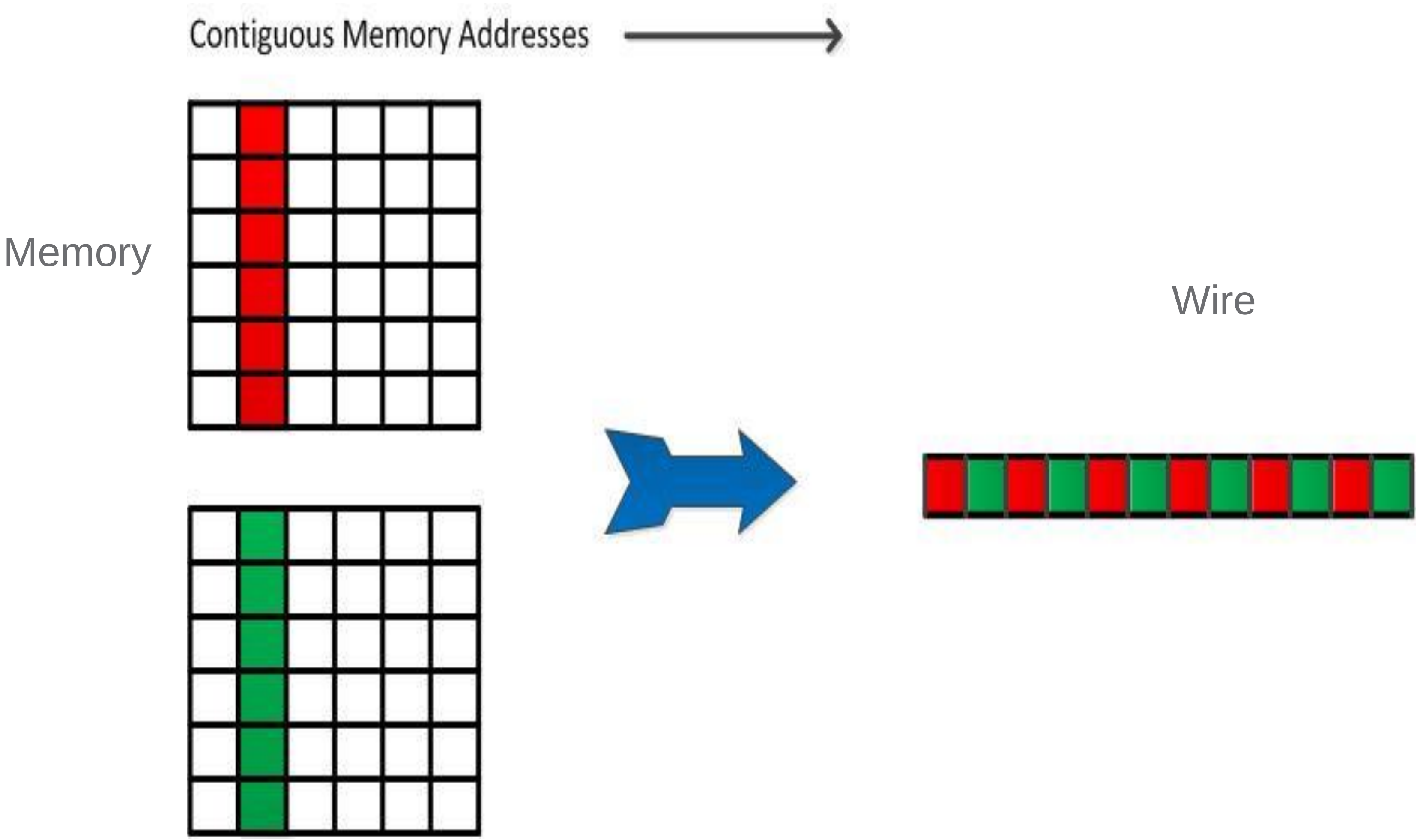
Combining Contiguous Memory Regions



3 memory regions
Each referenced by a
different memory key

One memory region
Referenced by one
memory key
Non-contiguous in
virtual memory

Non-Contiguous Memory Access – Regular Access



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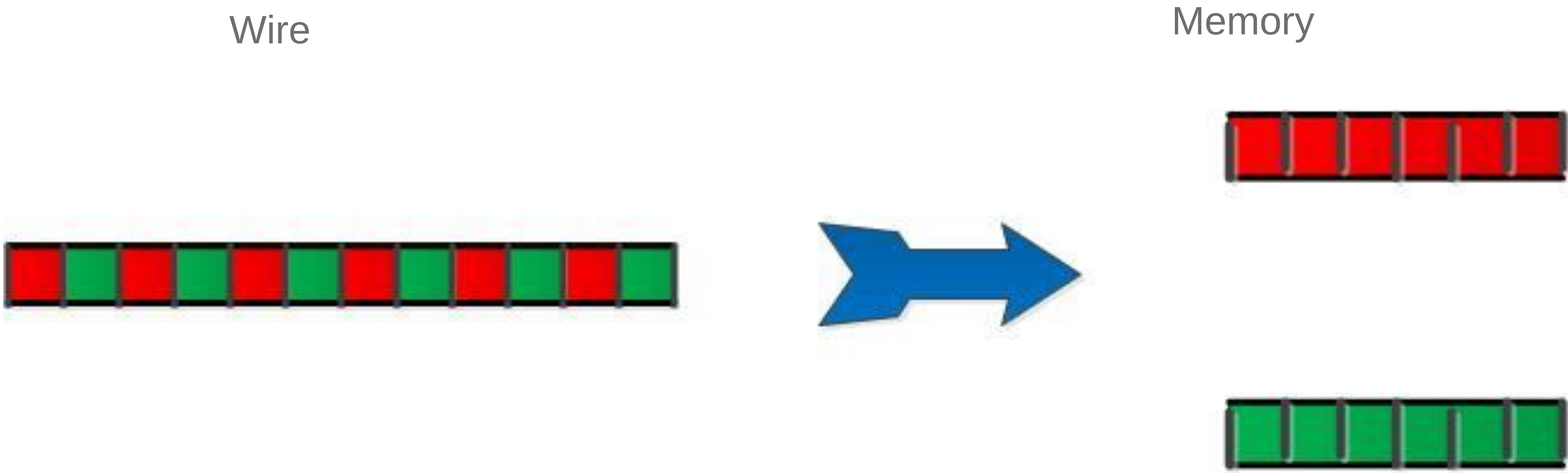
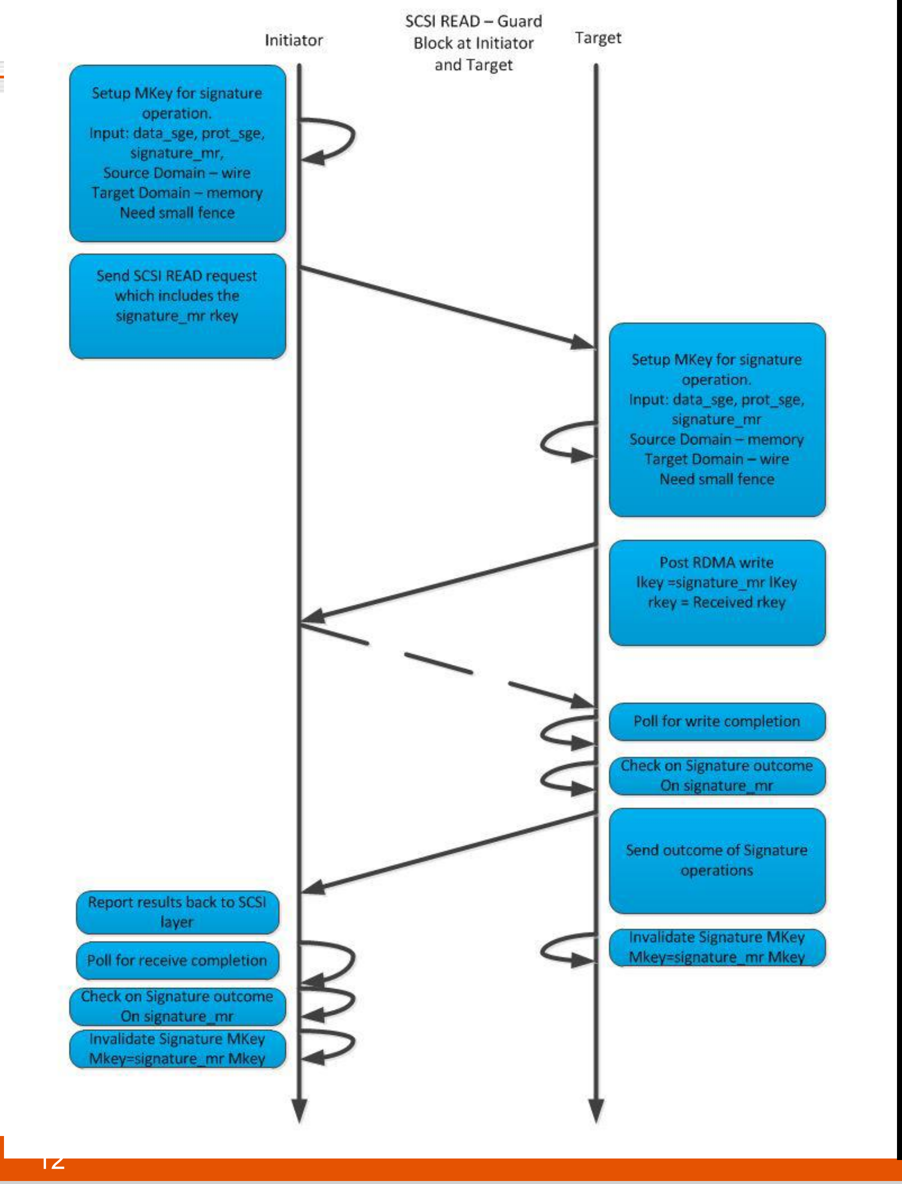


Example in SCSI transport



SCSI READ – Guard Block at Initiator and Target

Initiator

Target

Setup MKey for signature operation.
Input: data_sge, prot_sge, signature_mr,
Source Domain – wire
Target Domain – memory
Need small fence

Send SCSI READ request which includes the signature_mr rkey

Setup MKey for signature operation.
Input: data_sge, prot_sge, signature_mr
Source Domain – memory
Target Domain – wire
Need small fence

Post RDMA write
lkey =signature_mr lKey
rkey = Received rkey

Poll for write completion

Check on Signature outcome On signature_mr

Send outcome of Signature operations

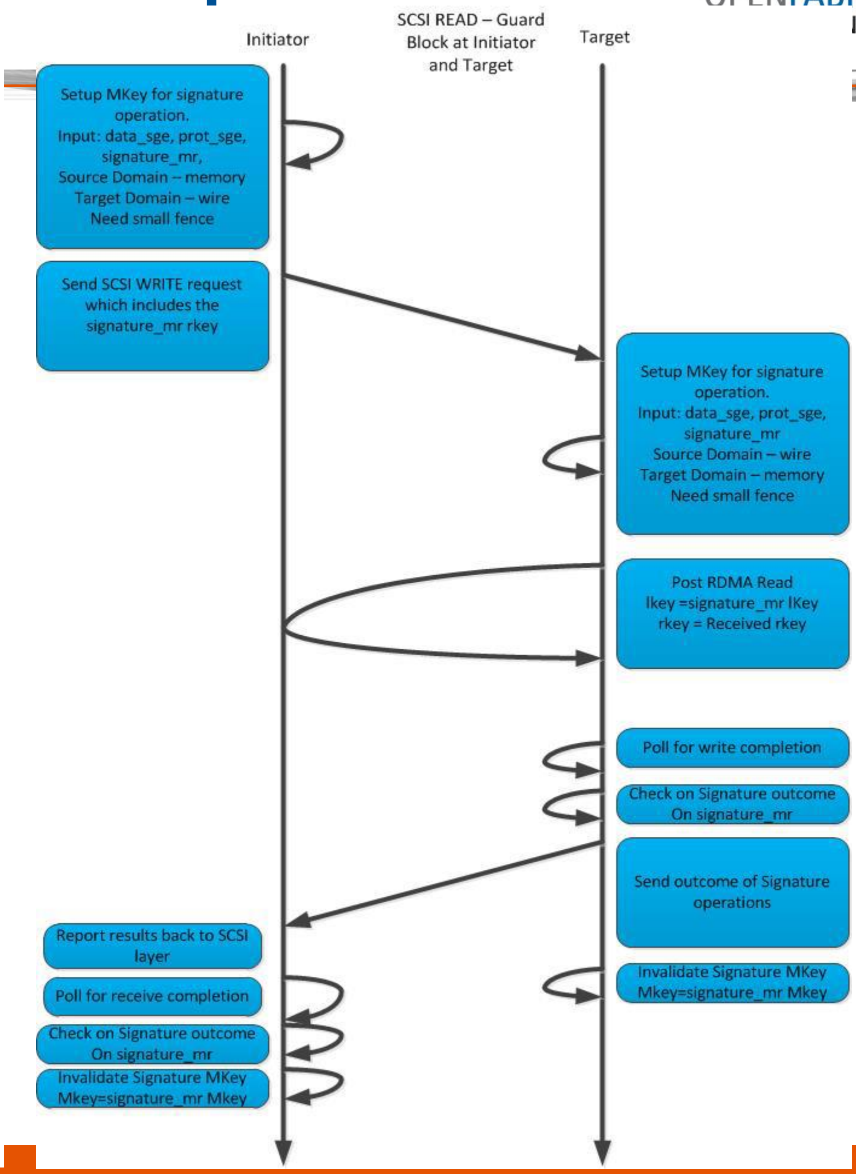
Invalidate Signature MKey Mkey=signature_mr Mkey

Report results back to SCSI layer

Poll for receive completion

Check on Signature outcome On signature_mr

Invalidate Signature MKey Mkey=signature_mr Mkey



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Send SCSI WRITE request which includes the signature_mr rkey

Setup MKey for signature operation.
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lkey =signature_mr lKey
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Poll for write completion

Check on Signature outcome On signature_mr

Send outcome of Signature operations

Invalidate Signature MKey Mkey=signature_mr Mkey

Report results back to SCSI layer

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Thank You

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