

DDR SDRAM Application notes 2 ; Basic DDR SDRAM operations

1. DDR SDRAM application notes available from Samsung

- App. note 1 : Key features and points for memory controller designers
; Explains key features of DDR SDRAM and points which users need to pay attention onto.
- App. Note 2 : Basic DDR SDRAM operations
; Examples of consecutive commands such as read-read, read-write and write-read.
Explain when we can do gapless operation and when we need to put a dead cycle or cycles.

2. Contents

This note is intended to explain what happens in case of consecutive DDR SDRAM accesses.

- **Read** followed by a **read**
- **Read** followed by a **write**
- **Write** followed by a **write**
- **Write** followed by a **read**

For all the above four patterns, the following three cases are explained.

- Page Hit to the same page
- Row Empty to the same Row, but a different Bank
- Row Empty to a different Row

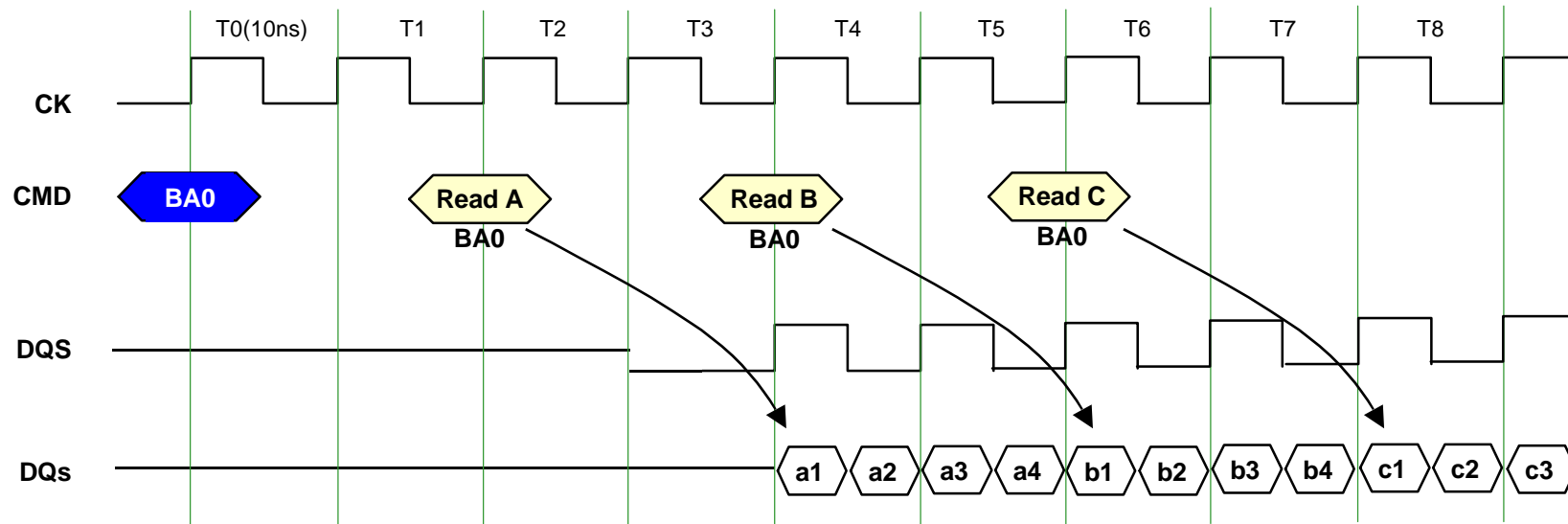
Terminology

- **The following terms are used in this material.**
To avoid confusion, please refer to the following definitions for each term
- **Page Hit:** Access to an already opened page
Target page is already activated before access.
- **Row Empty:** Access to a closed page
Target page is in precharge.
- **Row:** Means external bank
Controlled by CS# in system. One DIMM can have more than one Row
- **Bank:** Means internal bank inside DDR SDRAM.
Controlled by Bank Address. DDR SDRAM has four internal banks
- **Row Address:** Row address for DDR SDRAM

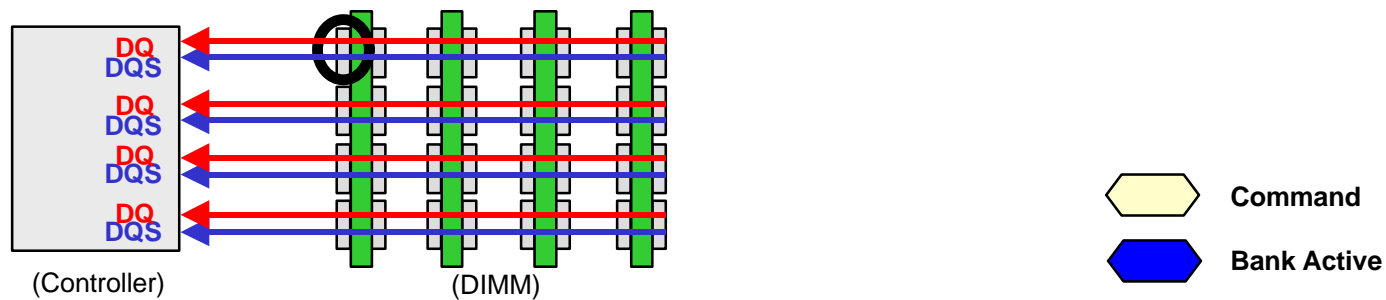
Read-to-Read (1/3)

- Page Hit to the same page

CL=2, BL=4



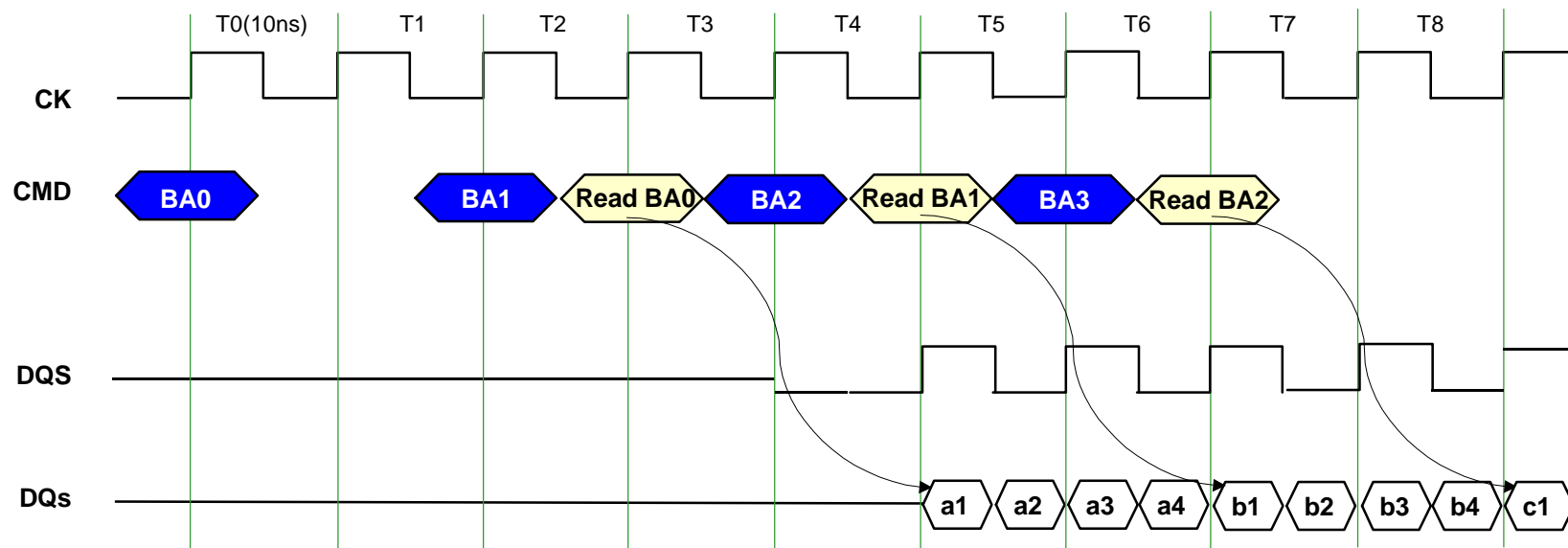
Read from one row address, then Read from the same page



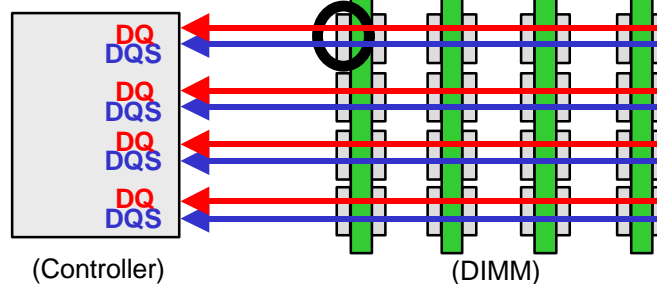
Read-to-Read (2/3)

- Row Empty to the same Row, but a different Bank

CL=2, BL=4



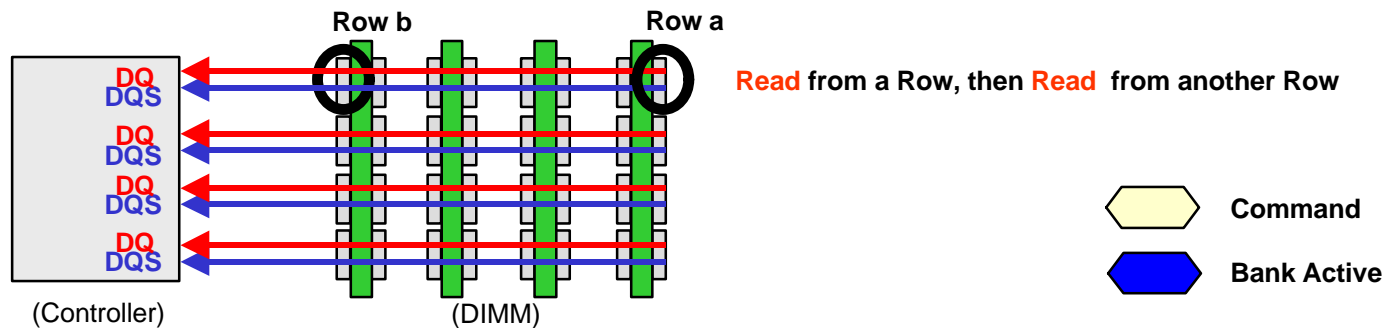
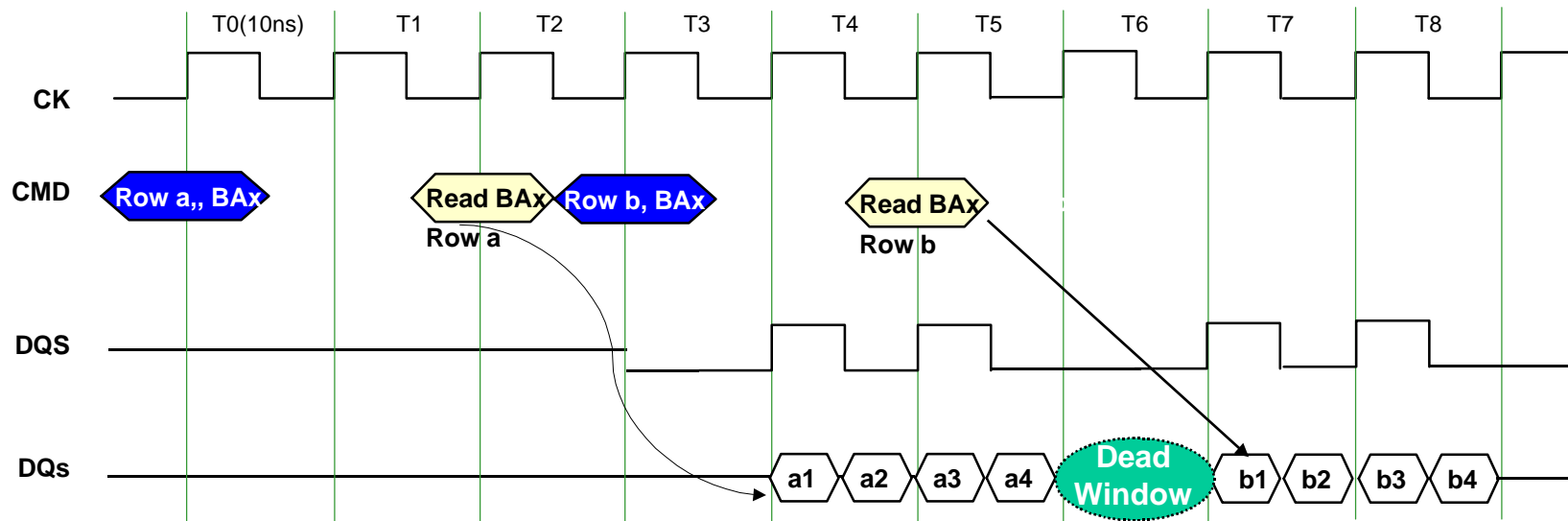
Read from a Bank, then Read from another bank in the same row



Read-to-Read (3/3)

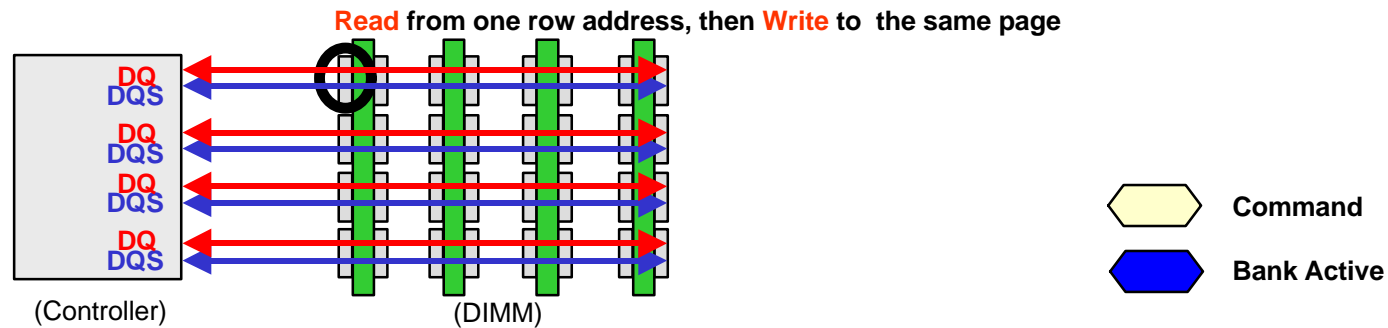
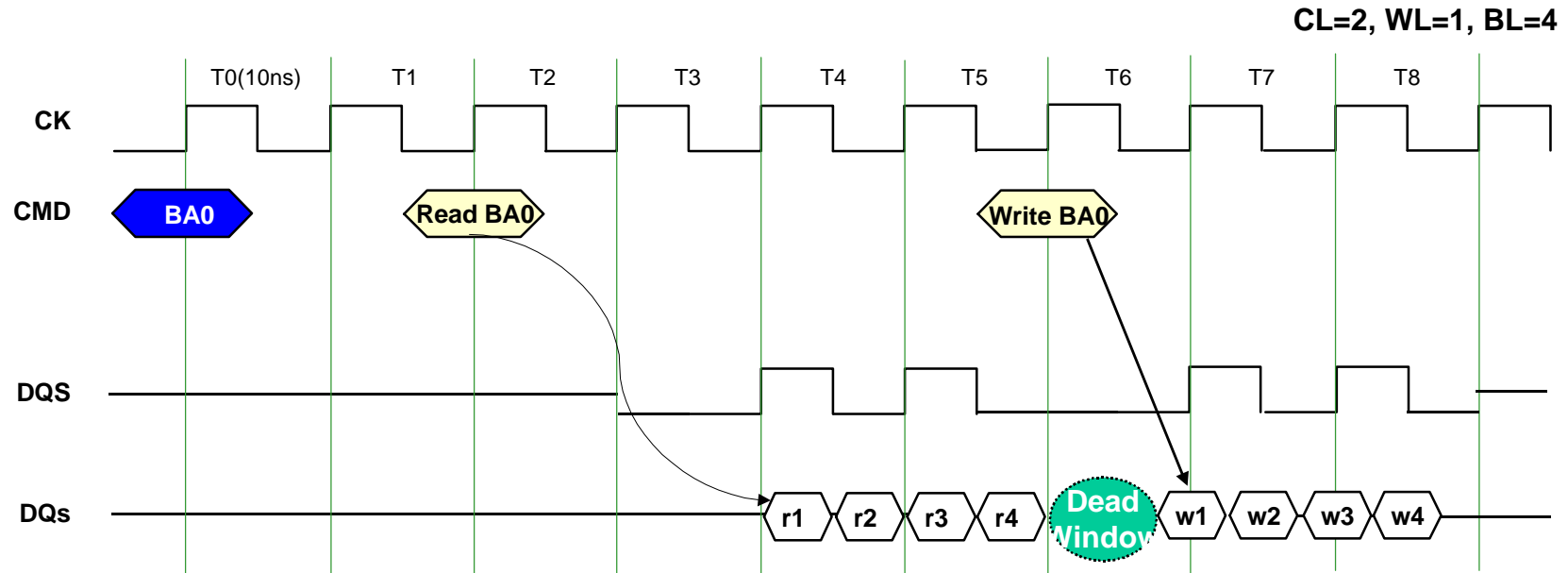
- Row Empty to a different Row

CL=2, BL=4



Read-to-Write (1/3)

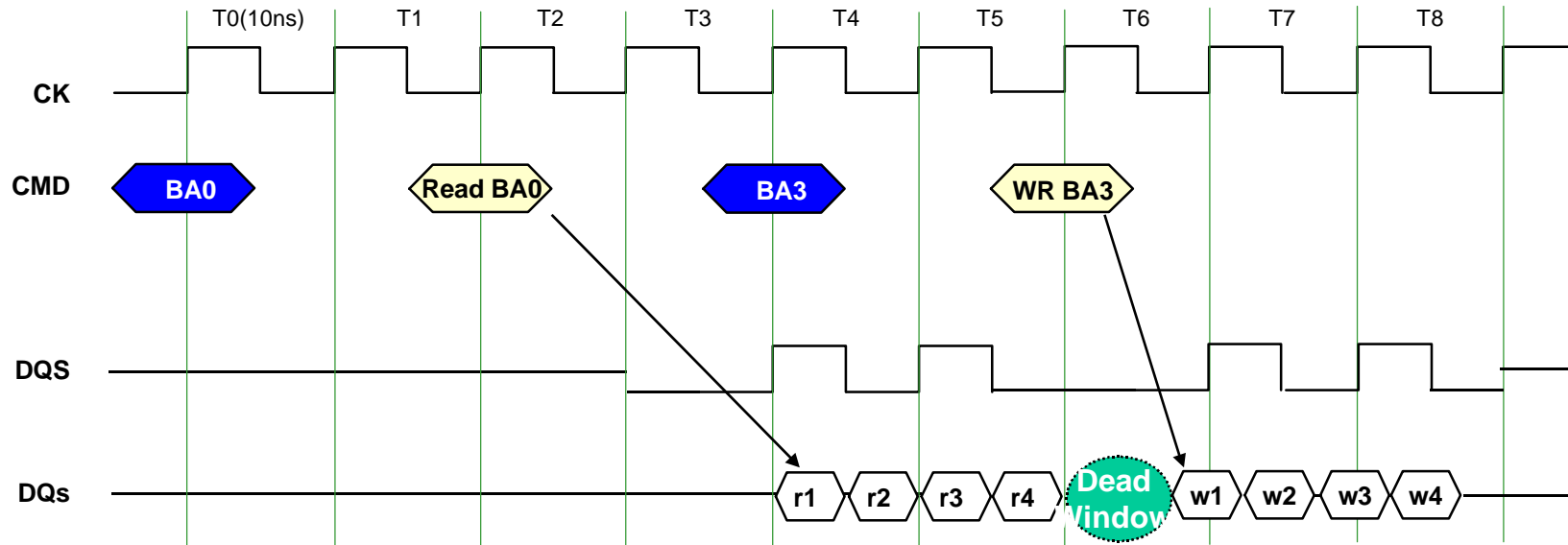
- Page Hit to the same page



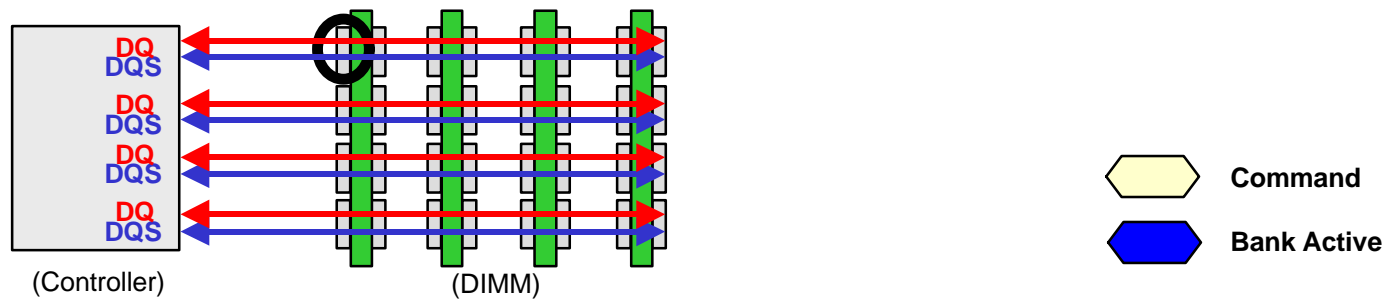
Read-to-Write (2/3)

- Row Empty to the same Row, but a different Bank

CL=2, WL=1, BL=4

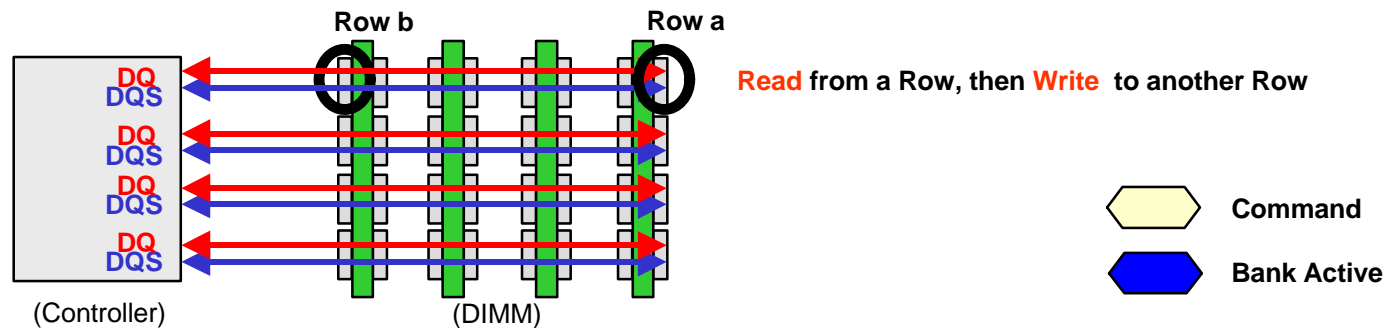
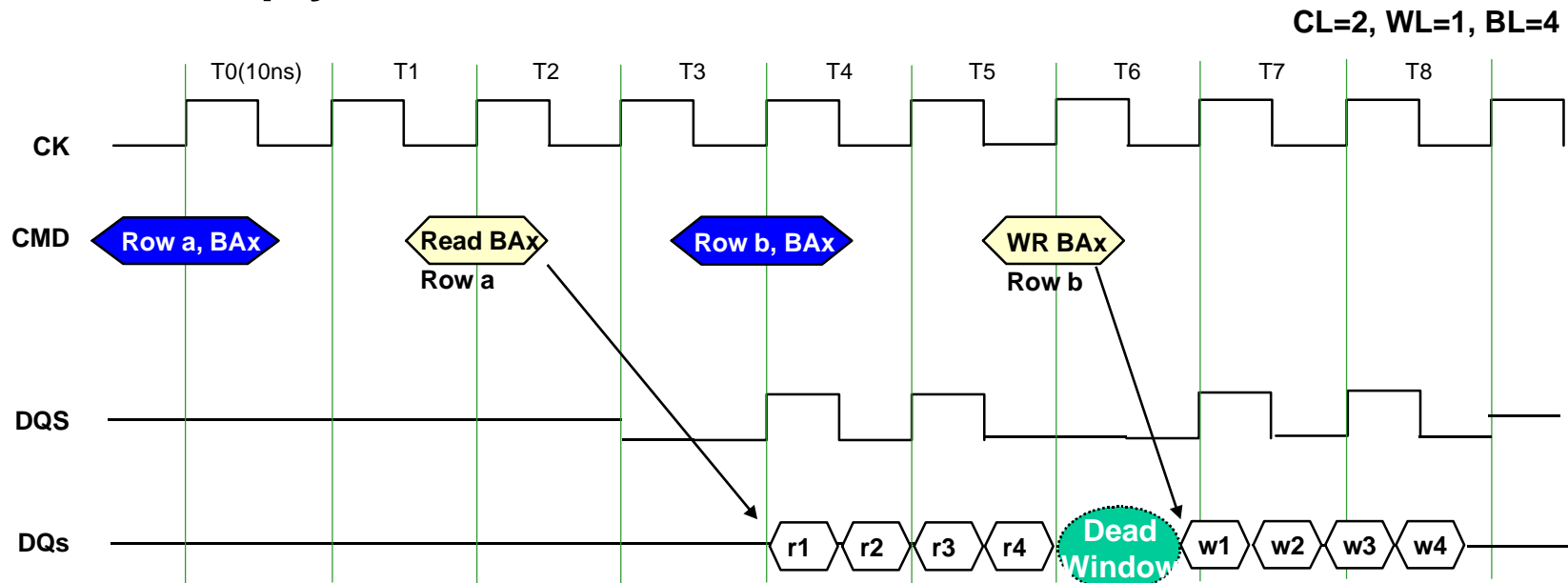


Read from a Bank, then Write to another bank in the same row



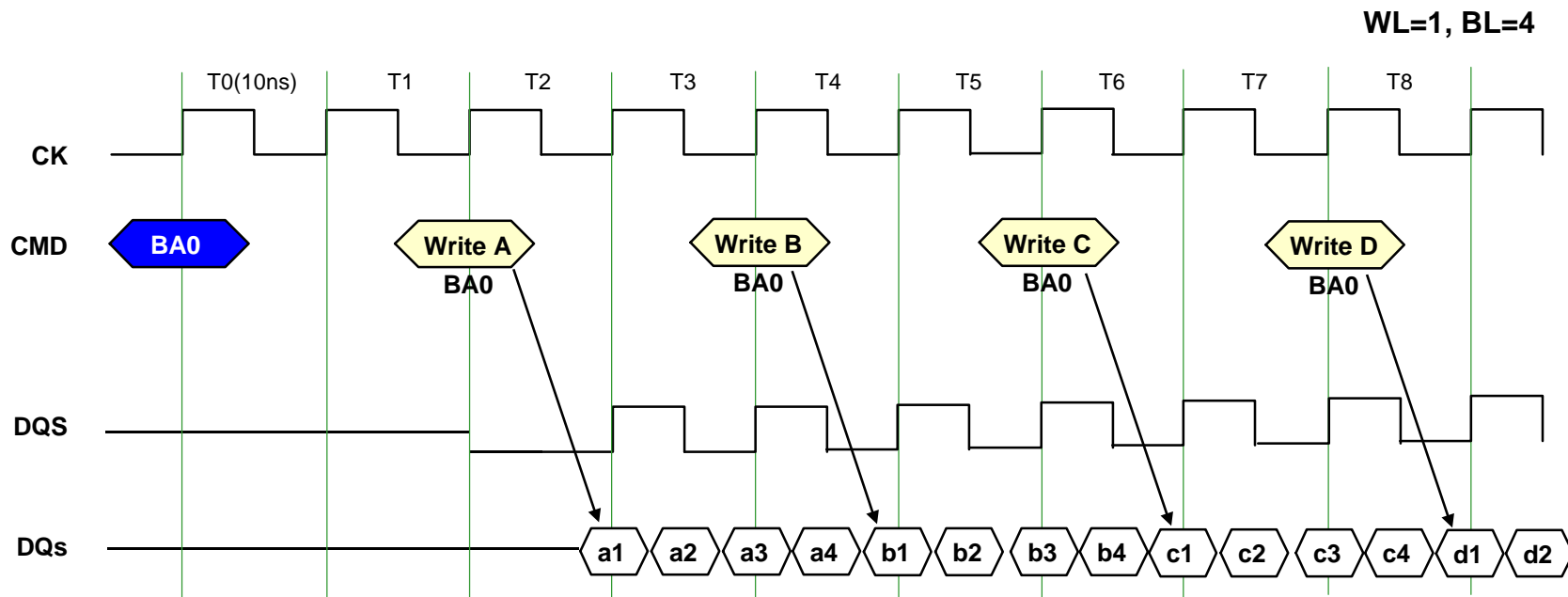
Read-to-Write (3/3)

- Row Empty to a different Row

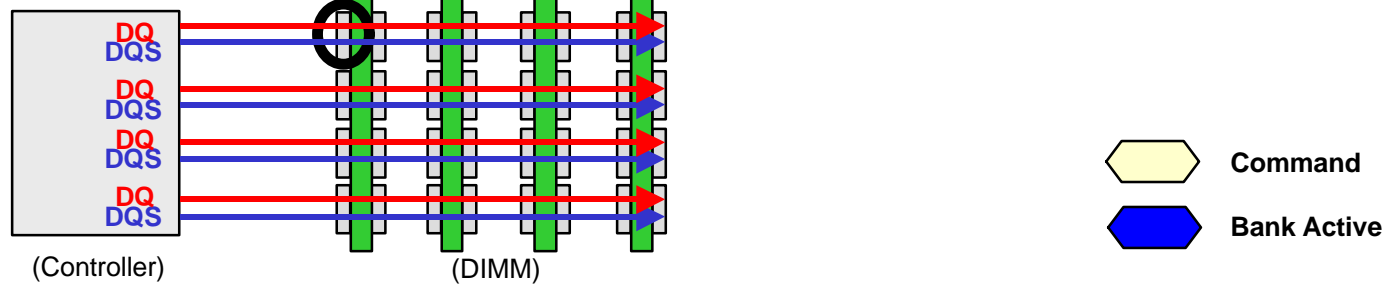


Write-to-Write (1/3)

- Page Hit to the same page

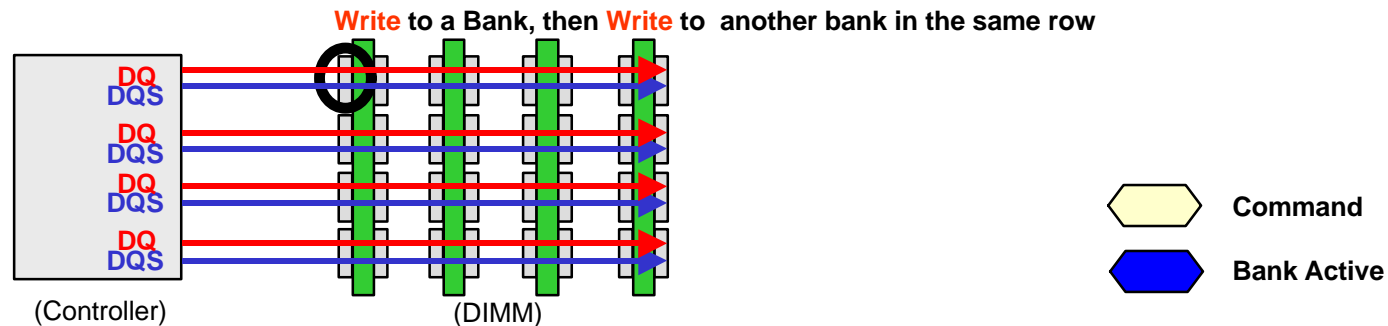
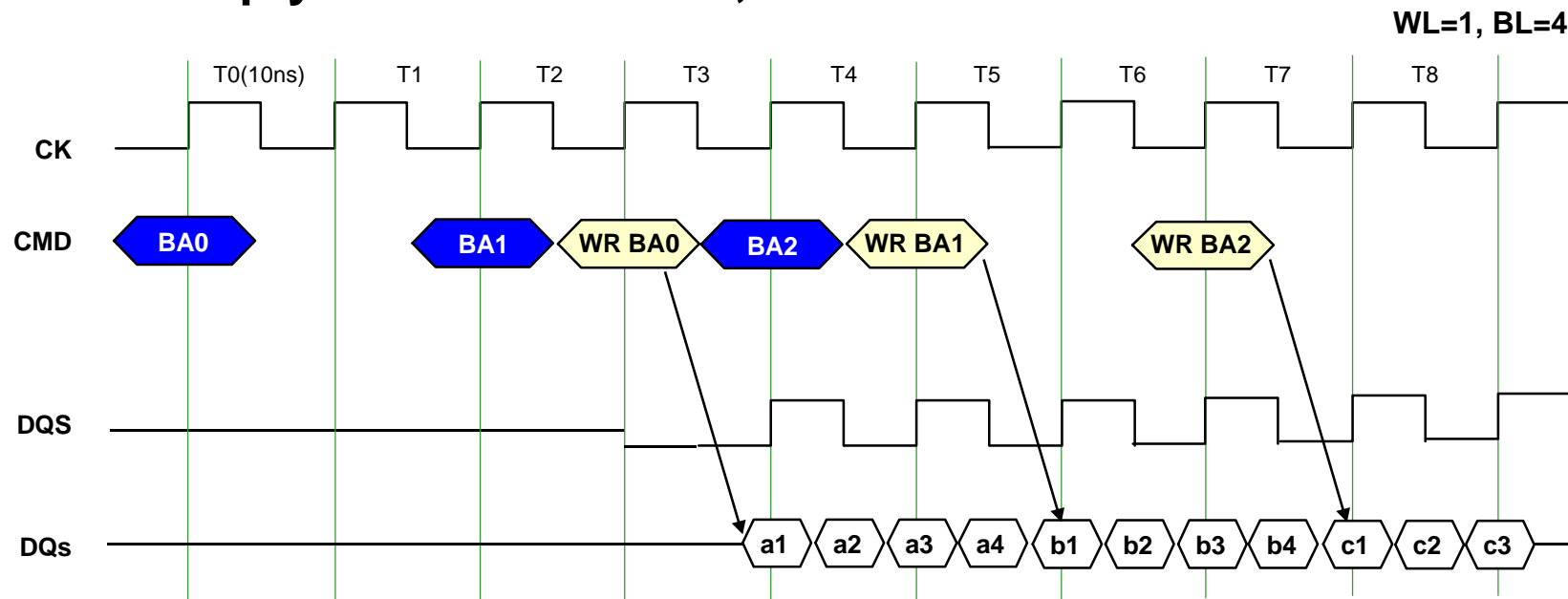


Write to one row address, then Write to the same page



Write-to-Write (2/3)

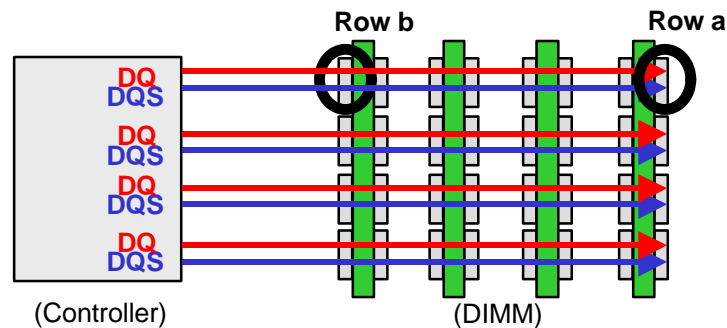
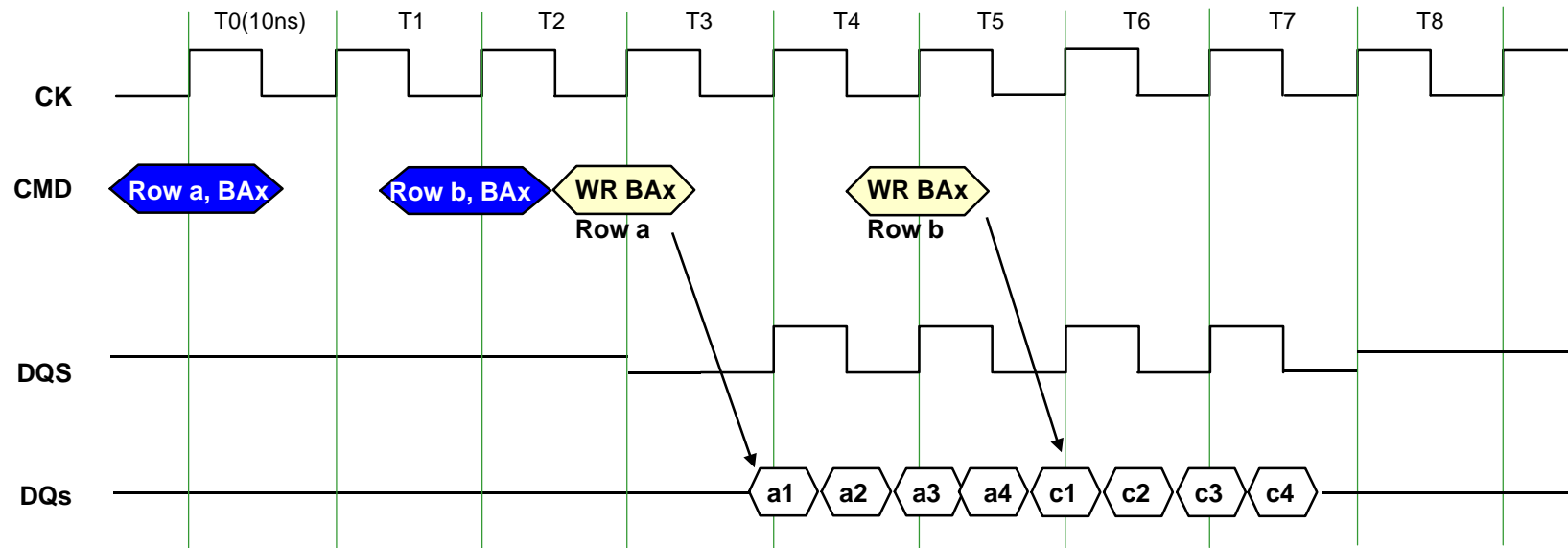
- Row Empty to the same Row, but a different Bank



Write-to-Write (3/3)

- Row Empty to a different Row

WL=1, BL=4

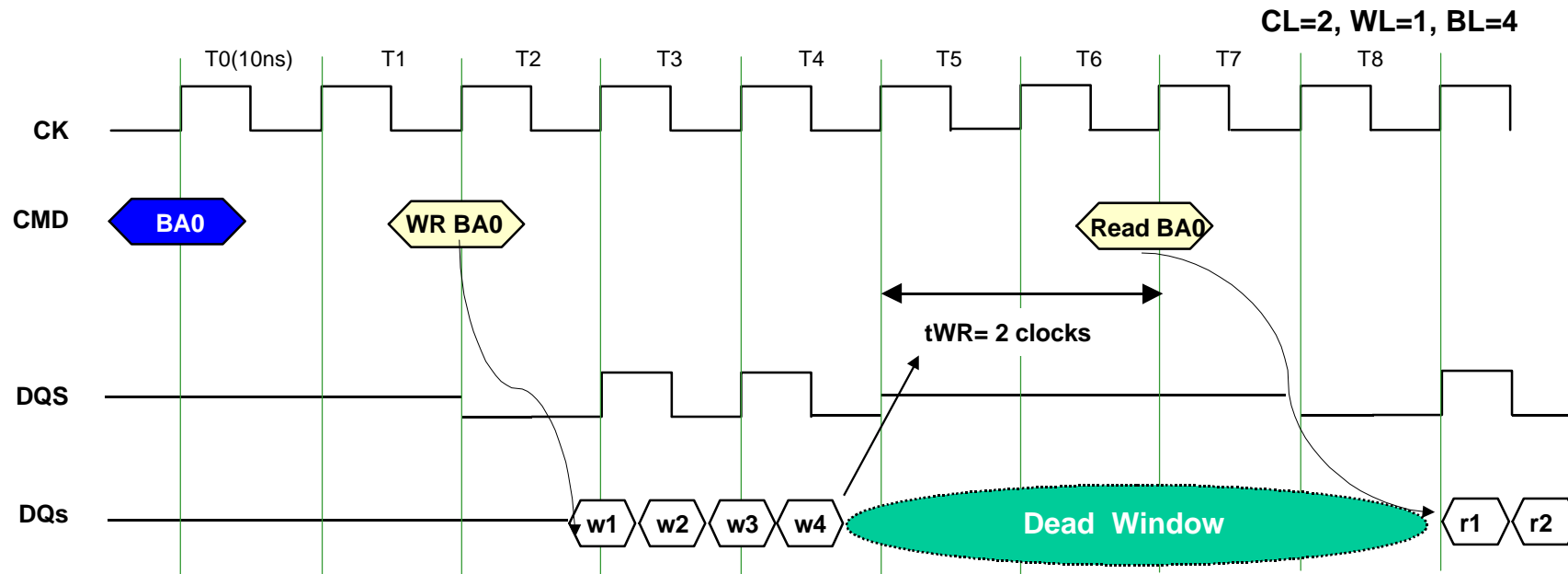


Write to a Row, then Write to another Row

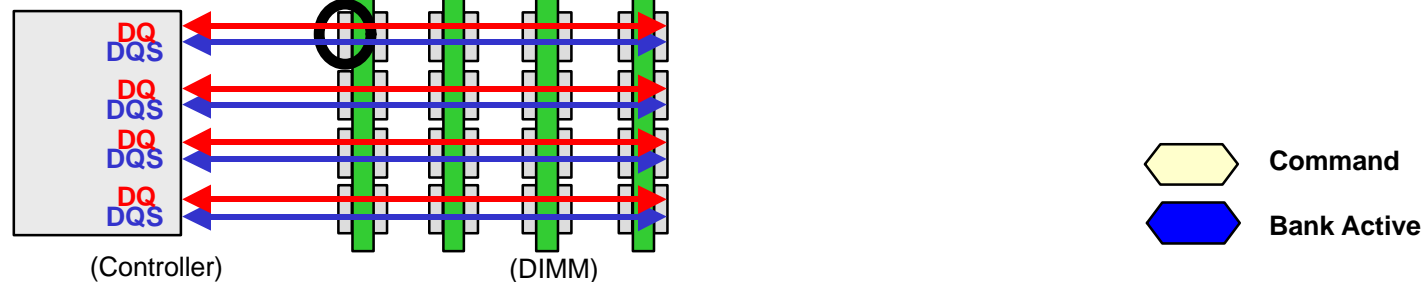


Write-to-Read (1)

- Page Hit to the same page

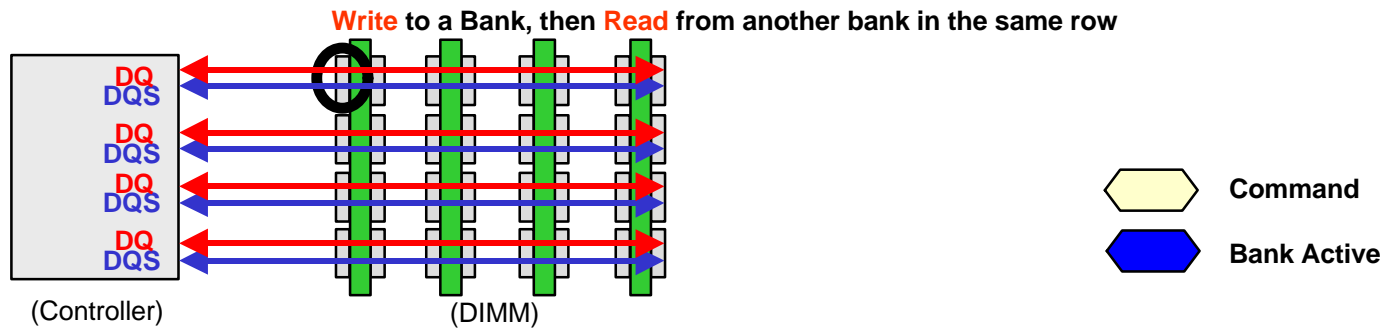
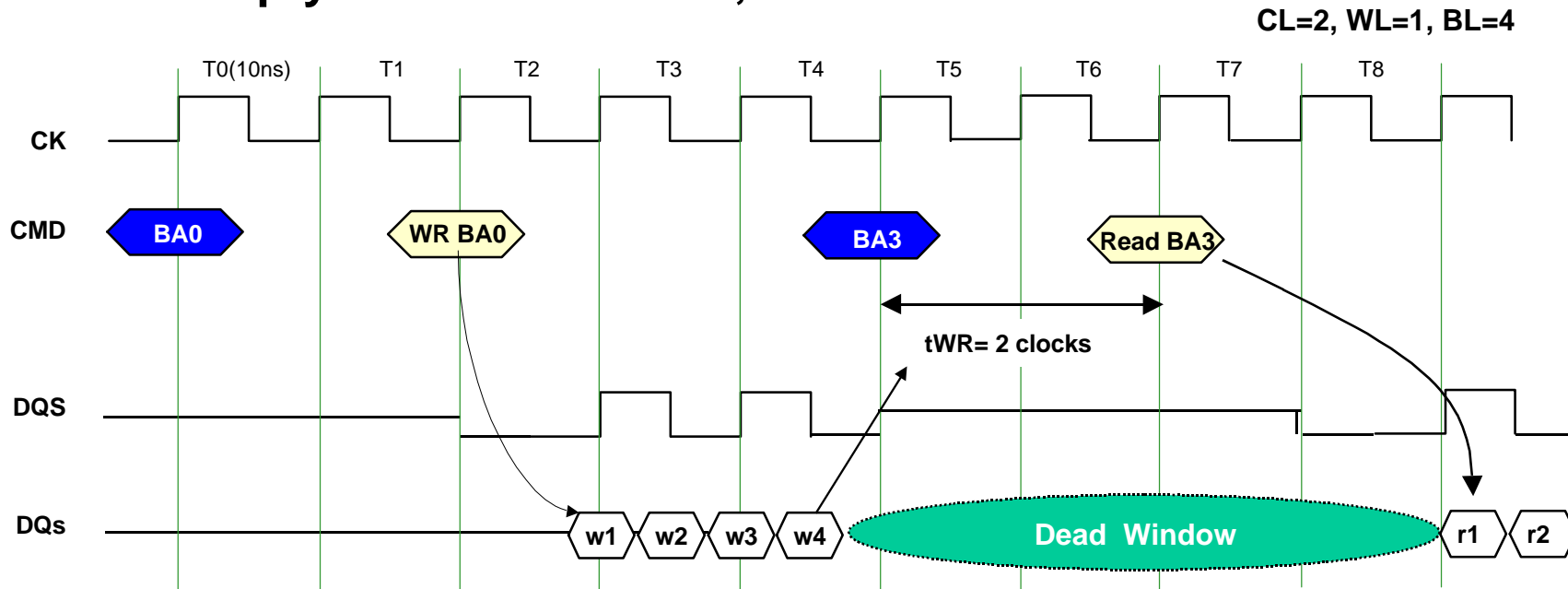


Write to one row address, then Read from the same page



Write-to-Read (2)

- Row Empty to the same Row, but a different Bank



Write-to-Read (3)

- Row Empty to a different Row

