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**Workstation Solutions**  
**March 5, 2001**

# NDMP - What is it?

- The Network Data Management Protocol (NDMP) defines a mechanism and protocol for controlling backup, recovery, and other transfers of data between primary and secondary storage.
- The NDMP architecture separates the network attached Data Management Application (DMA), Data Servers and Tape Servers participating in archival, recovery or data migration operations. NDMP also provides low level control of tape devices and SCSI media changers.

# NDMP - What is it? continued

- The TCP/IP and XDR record marking protocols are foundations for NDMP.
- The key goals of NDMP include interoperability, contemporary functionality, and extensibility.
- The NDMP workgroup activities include:
  - protocol definition
  - protocol standardization within IETF & SNIA
  - source code reference implementations (SDKs)
  - protocol conformance mechanisms

# NDMP - Who Supports it?

Partial list of NDMP Vendors at Connectathon 2001

ATL	Quadratec
Auspex	Quantum/ATL
Bakbone	Syncsort
Commvault	Blue Arc (Synaxia)
EMC	Syncsort
Legato	Tivoli
Mirapoint	Traakan
Network Appliance	Veritas
Procom	Workstation Solutions

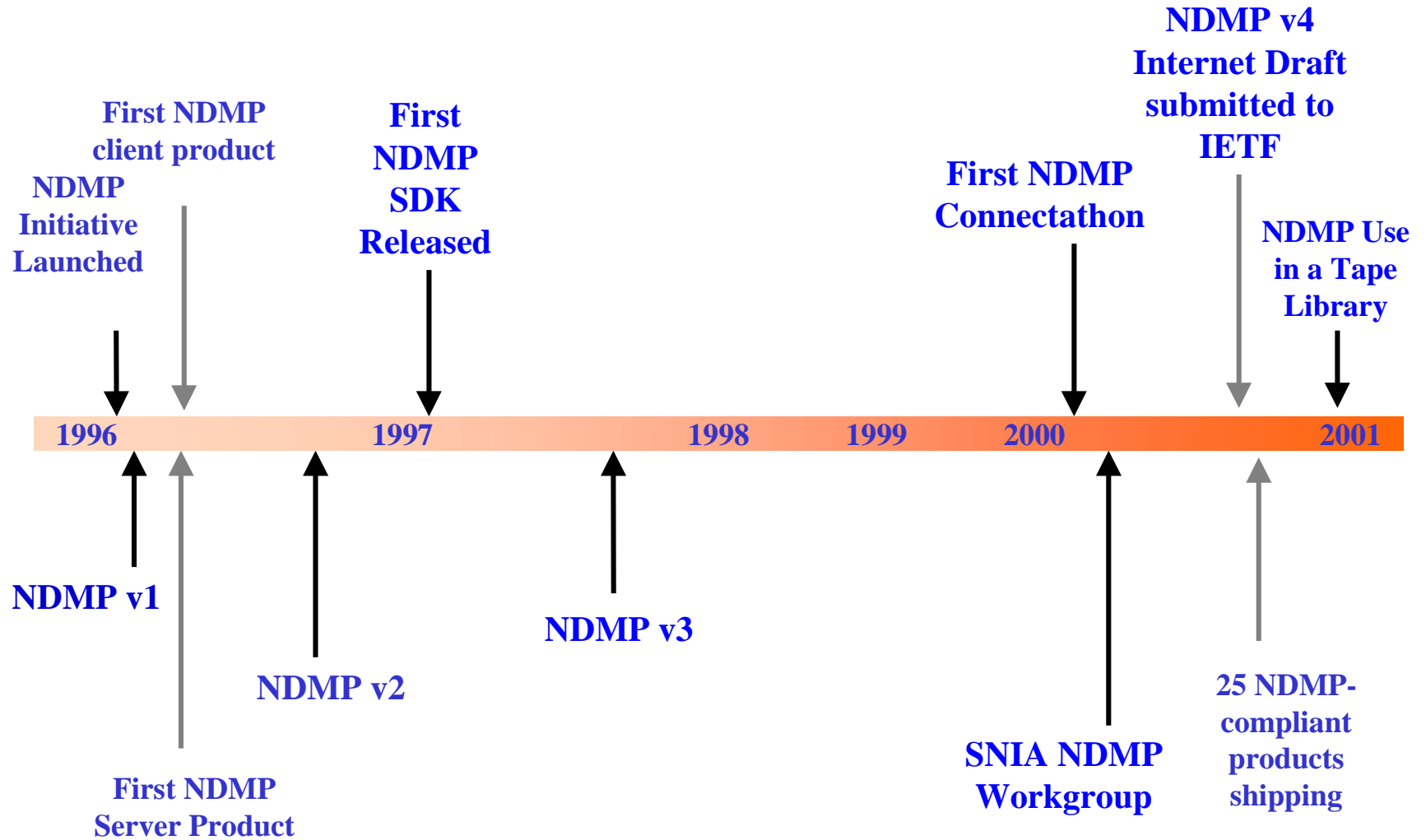
# NDMP - Origin

- NAS appliances are typically closed systems thus not supporting 3rd party management applications.
- Historically backups/recoveries performed with rsh/dump (local) or NFS or CIFS (remote).
- In 1996, Dave Hitz and Roger Stager, founders of Network Appliance and PDC respectively focused on the specific issue of how backup management software supports storage appliances (NDMP v1).

# NDMP - Origin continued

- Backup applications
  - Present a GUI to the system administrator
  - Schedule backups
  - Keep track of what files are in a backup so that the data can later be restored with single file granularity.
- Storage systems
  - Can optimize their own backup and recovery methods since they understand the layout of and provide access to their data/storage
  - Can easily track their own file system or hardware changes.

# NDMP History



# NDMP Key Concepts

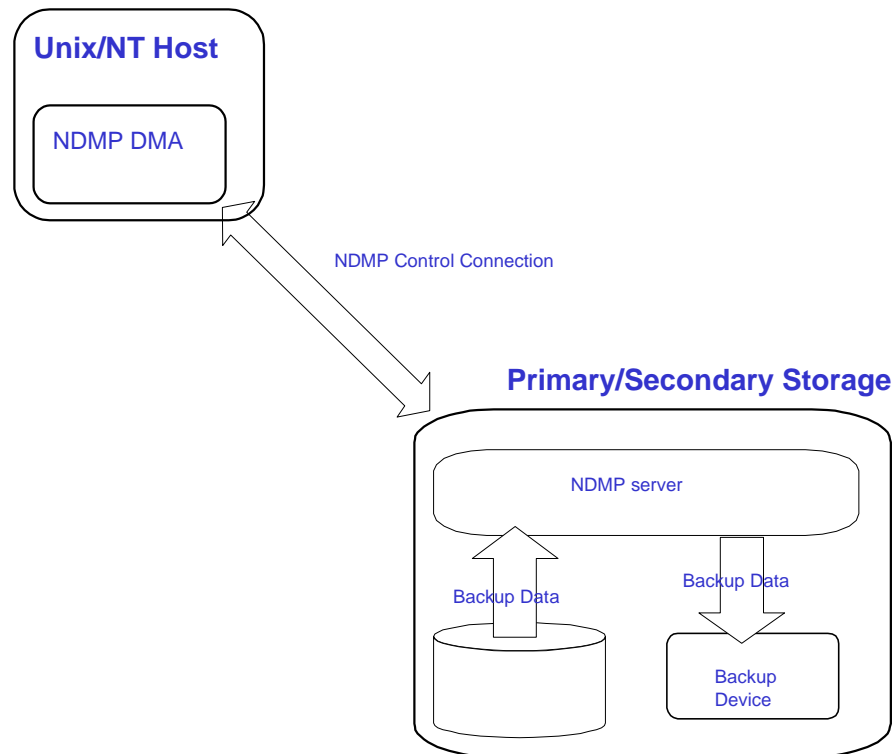
- Standards based
  - TCP/IP transport/network
  - XDR record marking
- Client/Server architecture
  - NDMP Clients:
    - Data Management Applications (DMA)
  - NDMP Servers:
    - Primary storage systems (file system access)
    - Secondary storage systems (tape & media changer devices)



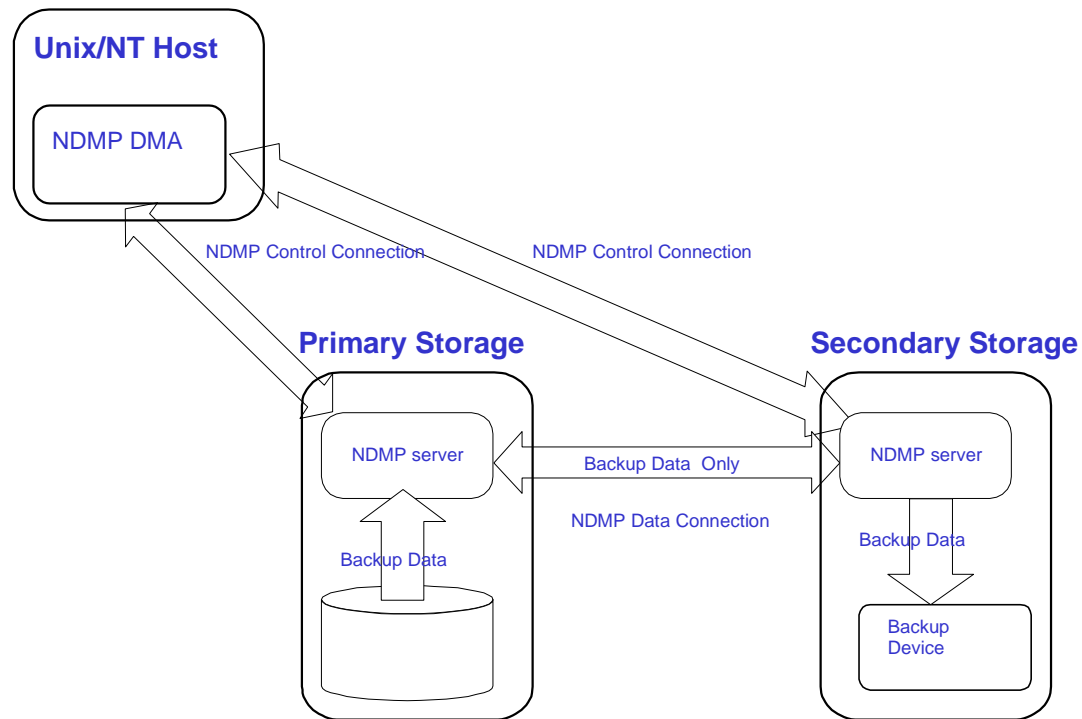
# NDMP Key Features

- Backup Operations
  - Multiple backup methods
  - File history
- Recovery Operations
  - Selective file recovery
  - Direct Access Recovery
- Other Features
  - Independent tape & media changer control
  - Data migration & tape duplication
  - Asynchronous event notification
  - Dynamic server configuration discovery

# NDMP Local configuration



# NDMP 3 way configuration



# NDMP - The V4 Effort

- Bias towards specification improvements
  - minimize impact to existing implementations
  - improve interoperability ‘out of the chute’
  - create a solid base for future enhancements
  - allow structured extensibility
  
- Converge on single protocol version
  - deprecate previous protocol versions
  - promote interoperability testing
  - provide conformance test tools
  - provide v4 compliant SDK

# NDMP - Evolution

- NDMP V4 Protocol extensions
  - Proprietary extensions developed for individual implementations
  - Standard extensions developed/ratified by the NDMP community
  - Unique name spaces for extension messages & error codes
  - Extension versioning & negotiation
  - Documented in separate specification (no core protocol impact)
  - Shortest time to market with backwards compatibility
- NDMP V5 Core enhancements
  - Mechanism for significant protocol architecture changes
  - Also allows promotion generally accepted v4 extensions
  - Standardized through IETF Internet Draft & RFC process

# NDMP - Evolution continued

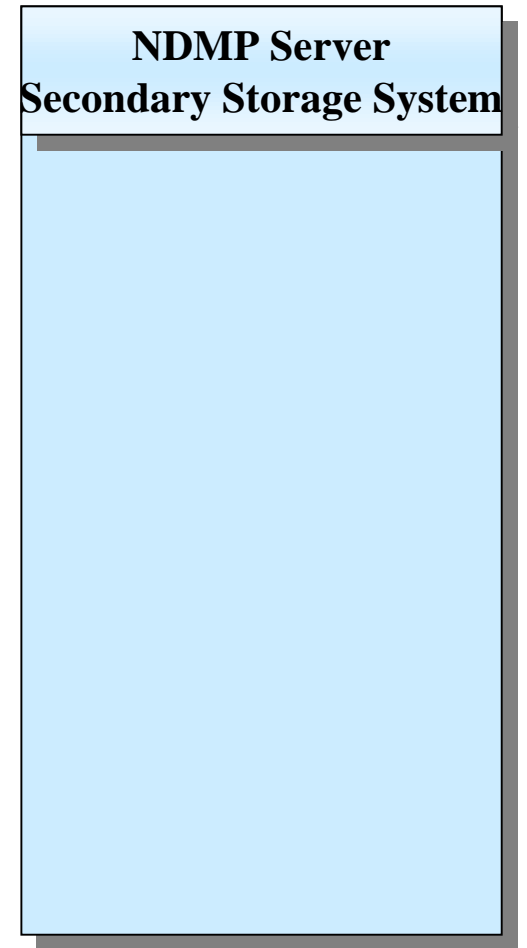
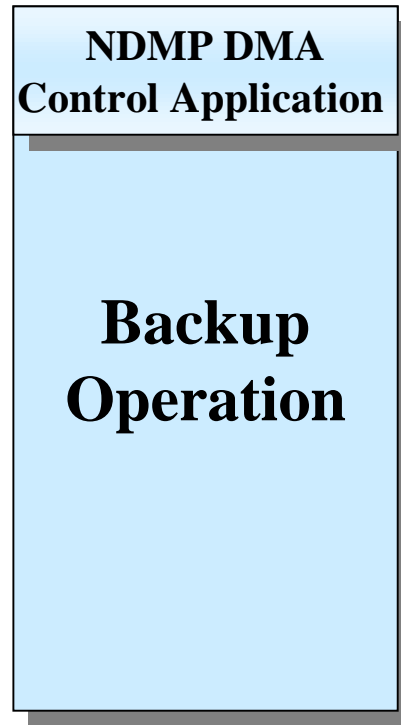
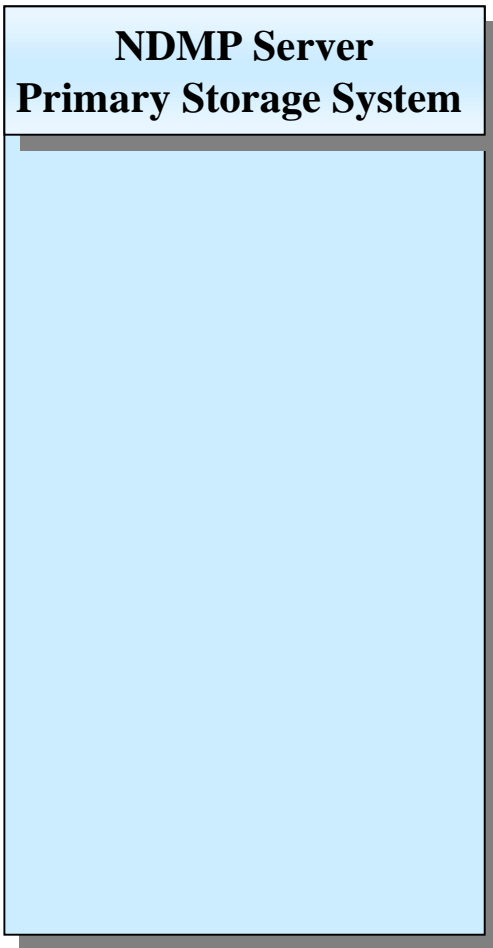
- Future NDMP development areas include:
  - backup & recovery checkpoints (failed op restartability)
  - snapshot management (creating, deleting, recovery from)
  - improved authentication
  - translate objects (multiplexing, encryption, virus scanning)
  - improved firewall & NAT compatibility
  - server instantiated operations
  - recovery operation exception list
- NDMP futures to be discussed at Cthon Tuesday 3/6
  - NDMP V4 Extensions @ 10:00 AM,
  - NDMP V5 Core Protocol @ 12:30 PM

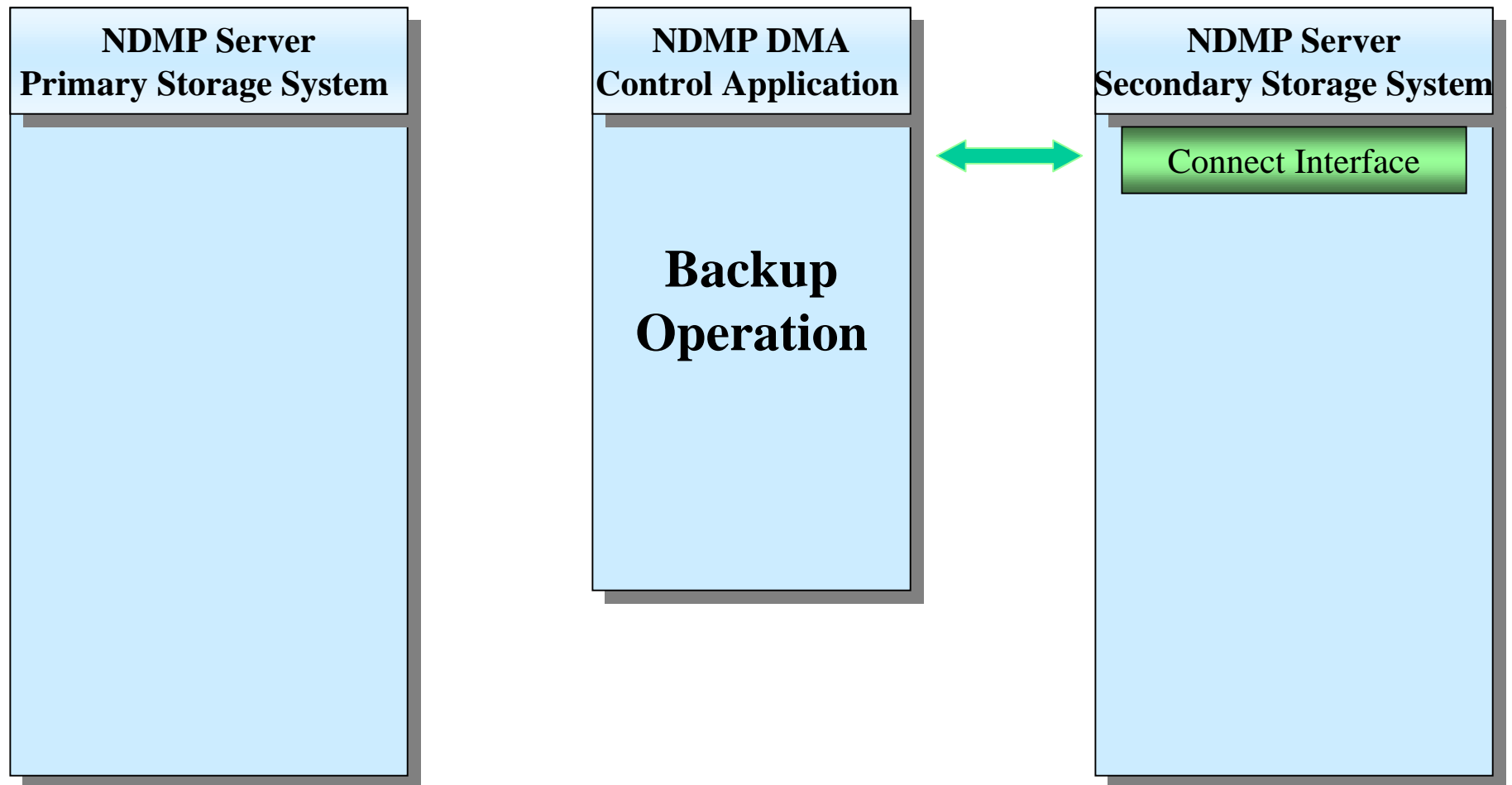
# NDMP - Information sources

- NDMP web site
  - [www.ndmp.org](http://www.ndmp.org)
  - contains both technical and marketing information
- NDMP mail reflector
  - [ndmp-tech@ndmp.org](mailto:ndmp-tech@ndmp.org)
  - to subscribe send email to [majordomo@netapp.com](mailto:majordomo@netapp.com) with
  - “subscribe dl-ndmp-tech [your email address]” in text body
- Current NDMP v4 IETF Internet Draft Specification
  - <http://search.ietf.org/internet-drafts/draft-skardal-ndmpv4-01.txt>

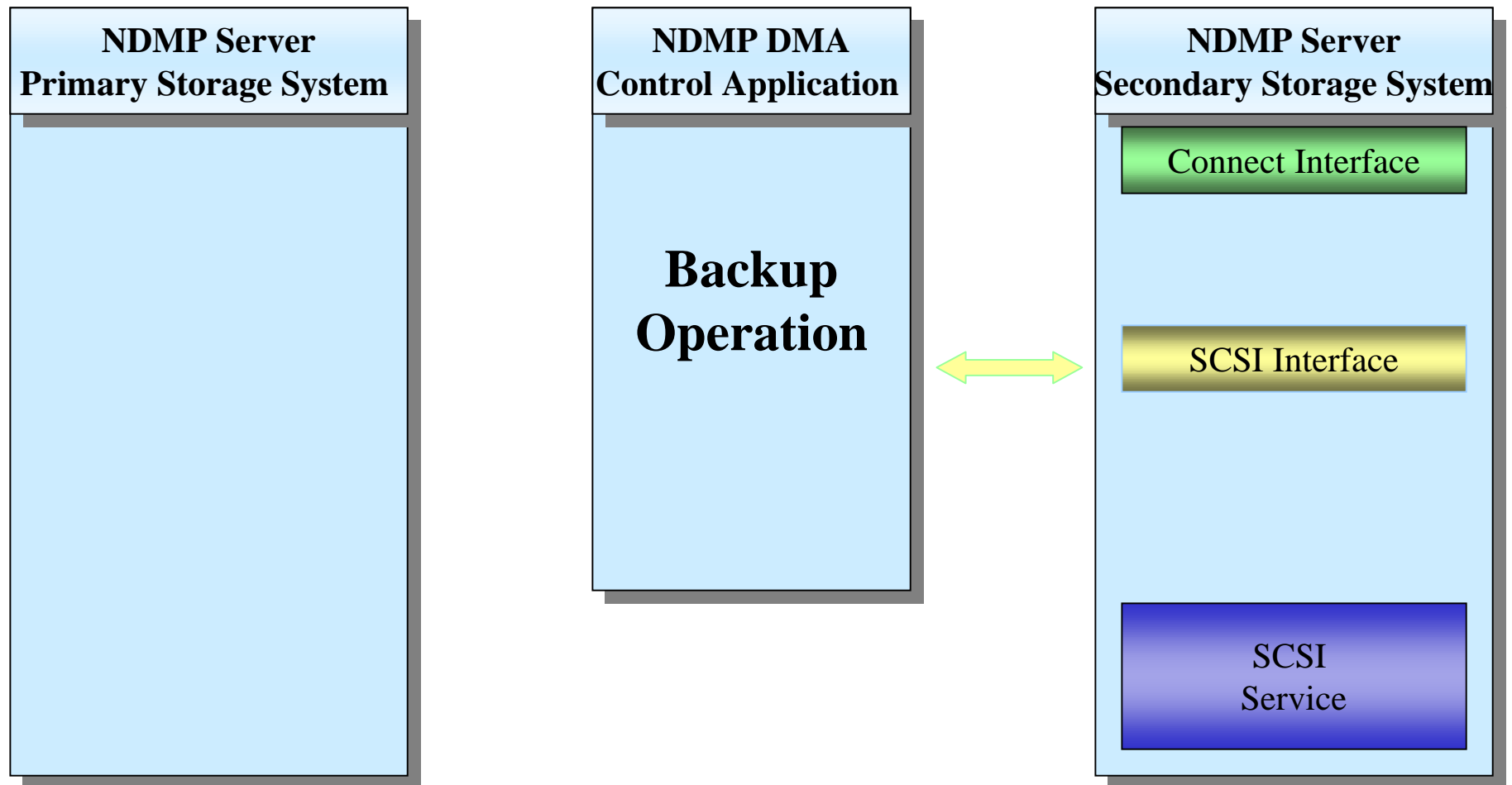
# NDMP Backup Operation Workflow



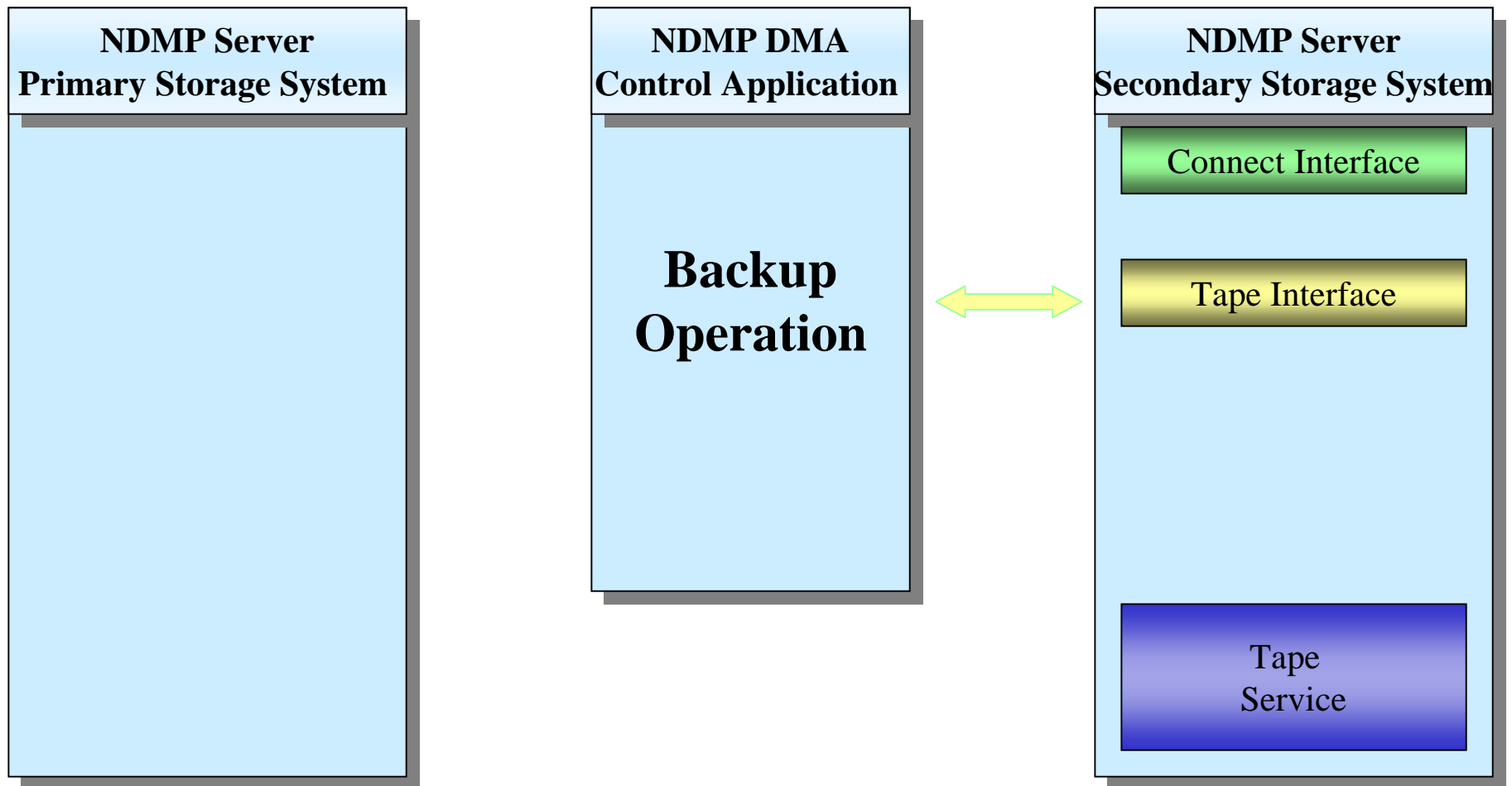




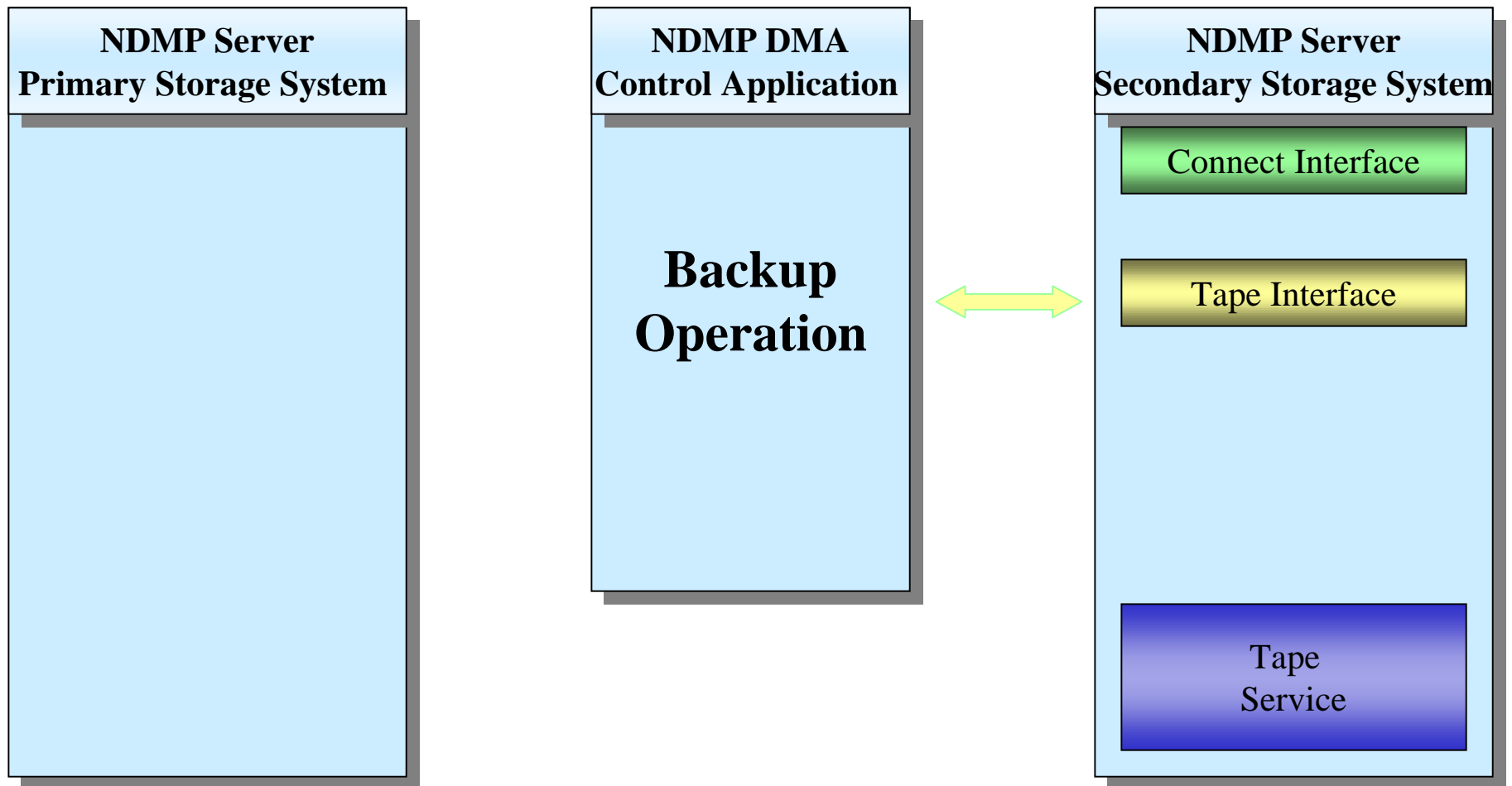
- **DMA creates a control connection to the secondary storage System**
  - Connect using TCP port 10,000
  - NDMP\_CONNECT\_OPEN (to negotiate version)
  - NDMP\_CONNECT\_CLIENT\_AUTH (to authenticate DMA to Server)



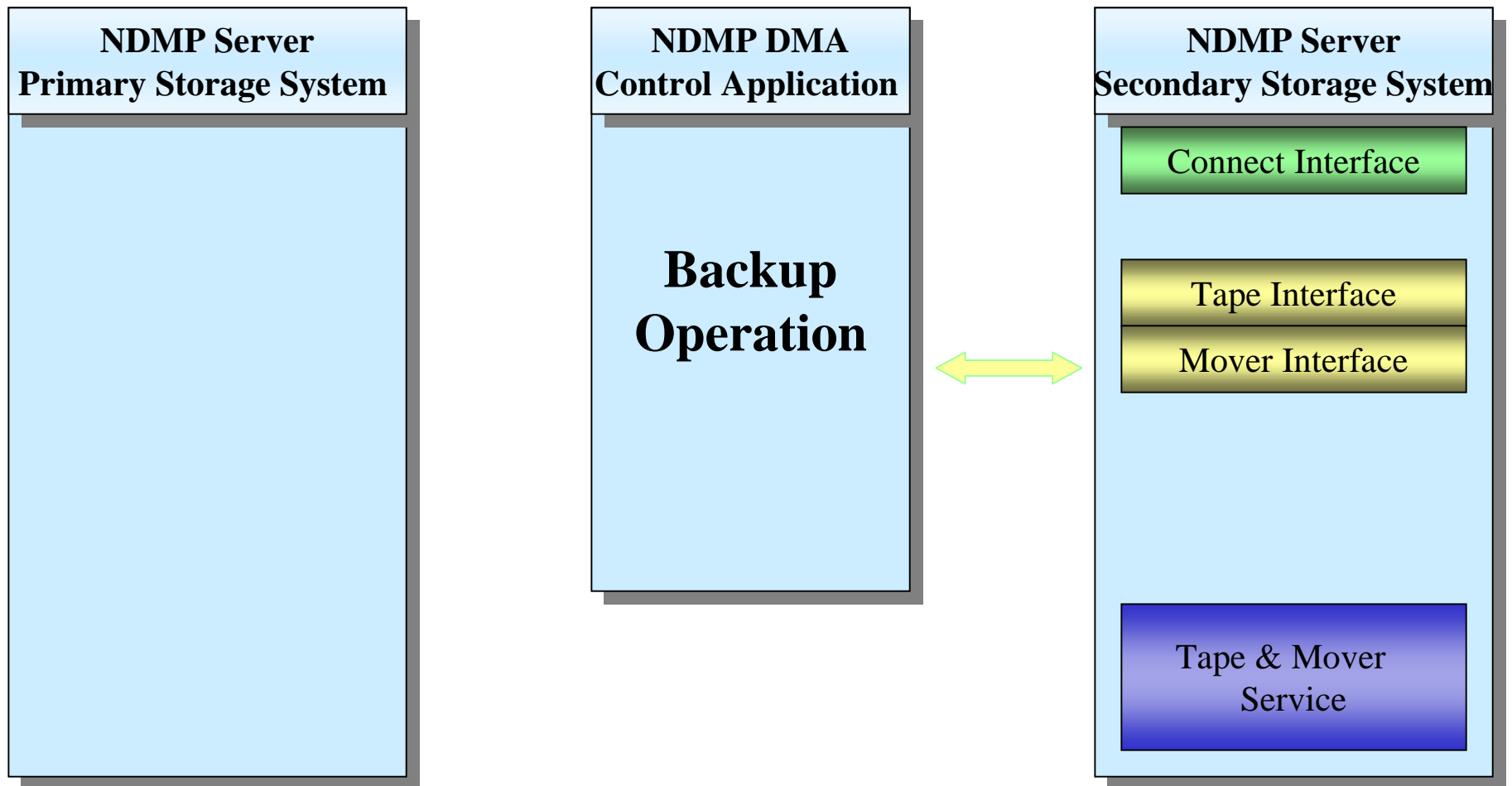
- **DMA uses the tape library media changer to load the required tape (optional)**
  - The SCSI service is invoked
  - NDMP\_SCISI\_OPEN
  - NDMP\_SCISI\_EXECUTE\_CDB - to manipulate media changer
  - NDMP\_SCISI\_CLOSE



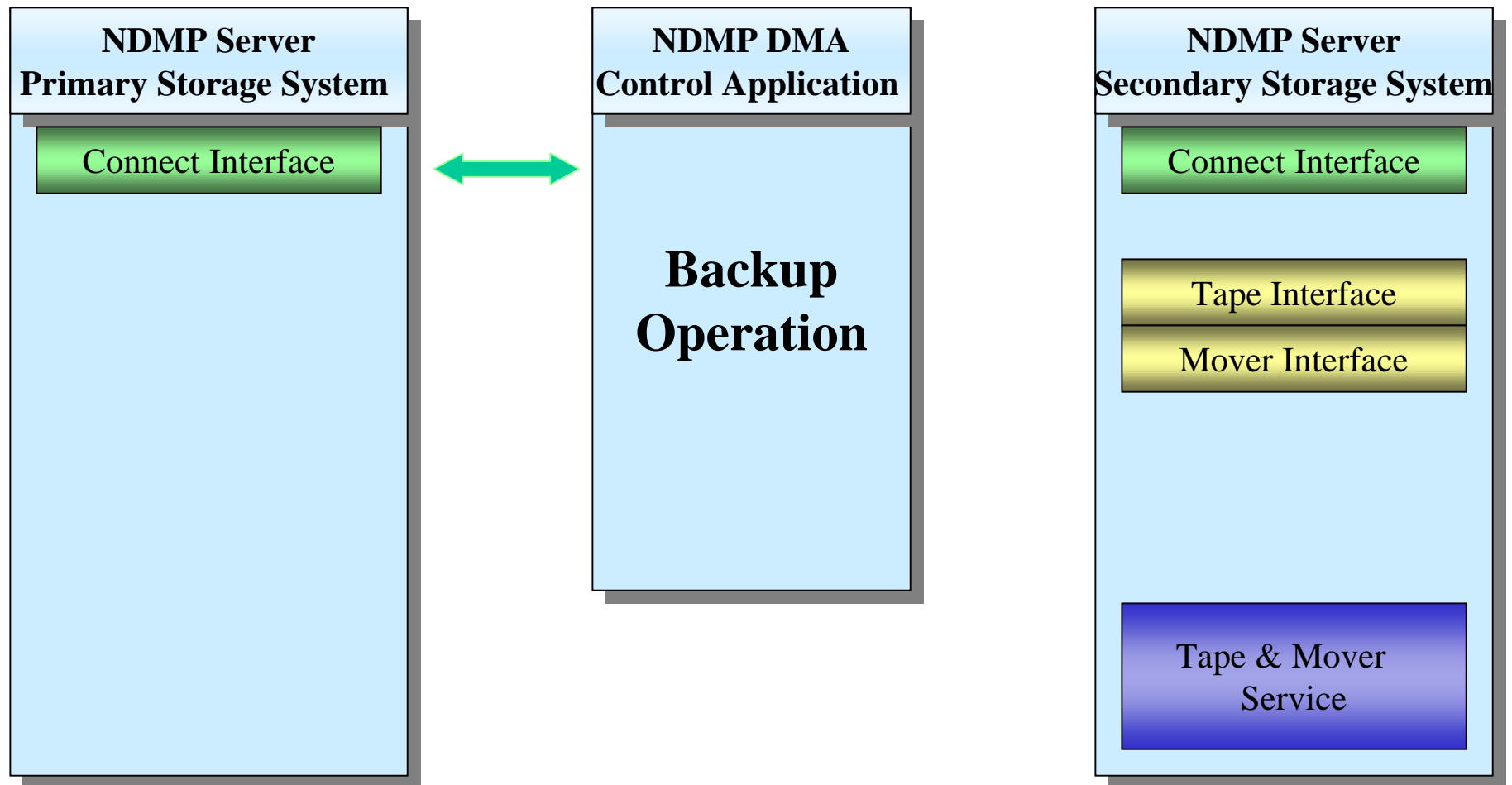
- **DMA prepares the tape service for a backup operation**
  - The tape service is invoked
  - NDMP\_TAPE\_OPEN
  - NDMP\_TAPE\_READ - to validate volume label



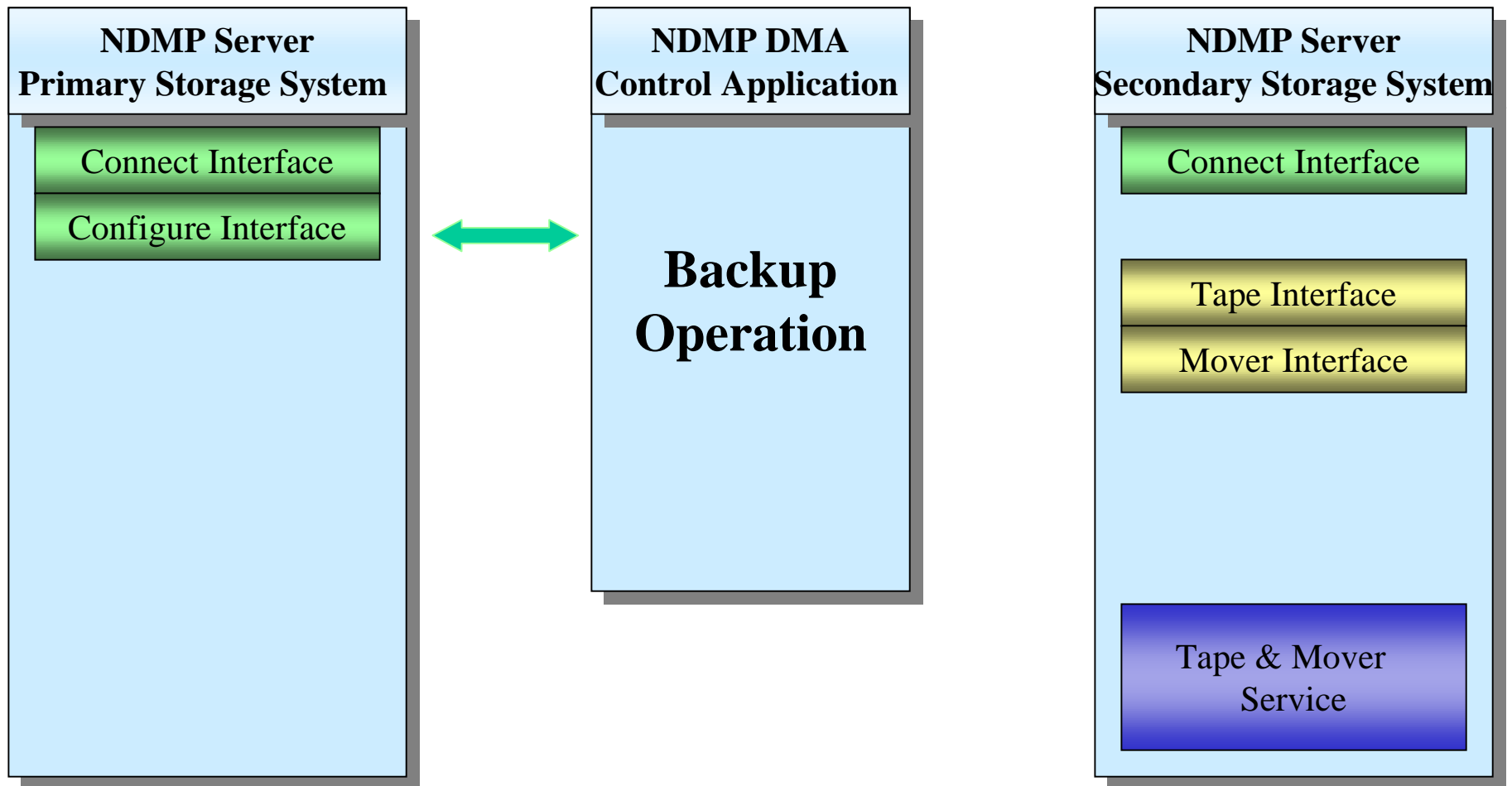
- **DMA initializes the backup tape**
  - NDMP\_TAPE\_MTIO - to position tape
  - NDMP\_TAPE\_WRITE - to write new tape volume label



- **DMA prepares the mover for a backup operation**
  - NDMP\_MOVER\_SET\_RECORD\_SIZE
  - NDMP\_MOVER\_SET\_WINDOW

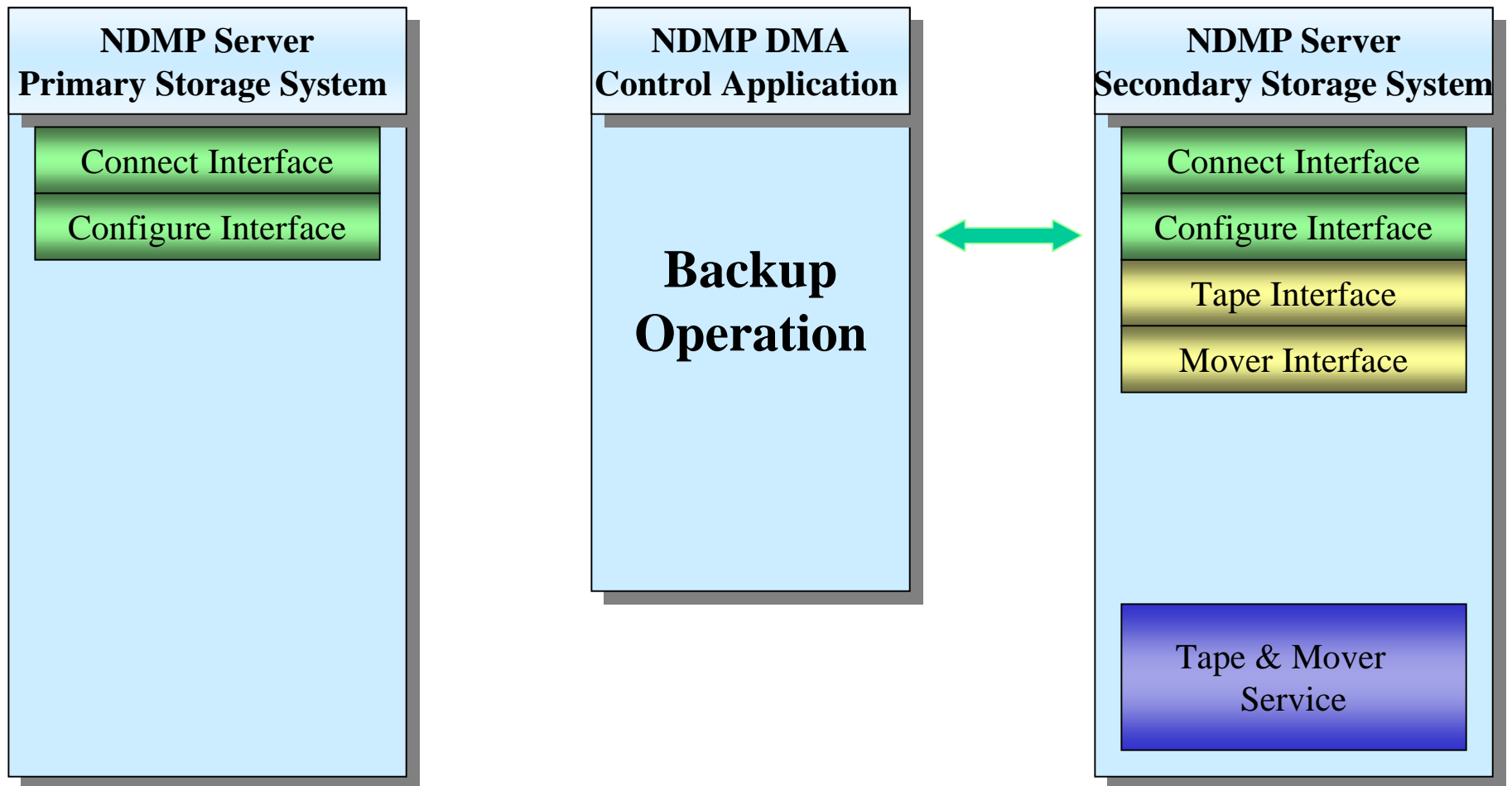


- **DMA opens control connection to the primary storage System**
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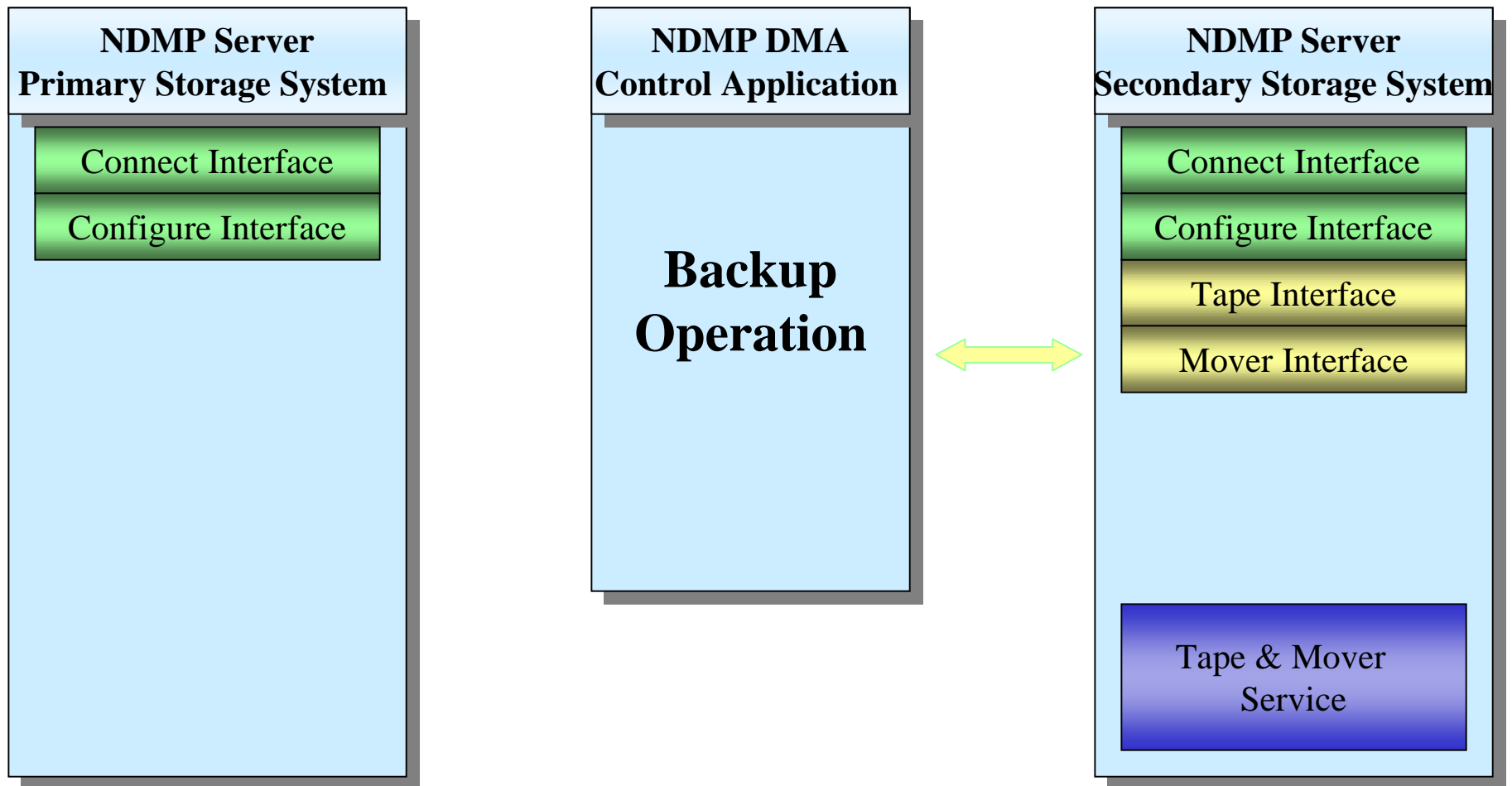


- **DMA queries primary storage System for capabilities**
  - NDMP\_CONFIG\_GET\_BUTYPE\_INFO
  - NDMP\_CONFIG\_GET\_CONNECTION\_TYPE
  - NDMP\_CONFIG\_GET\_FS\_INFO

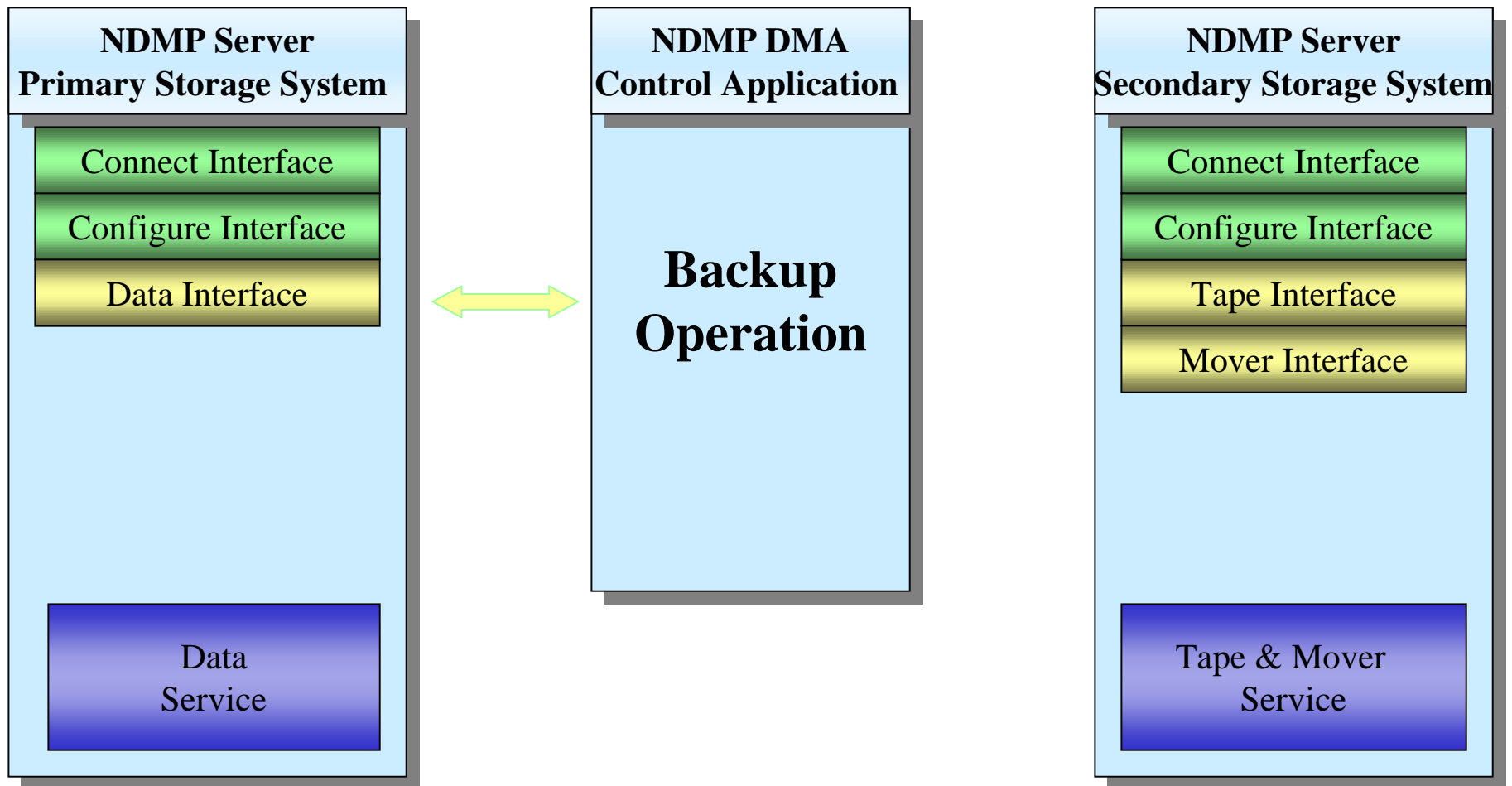




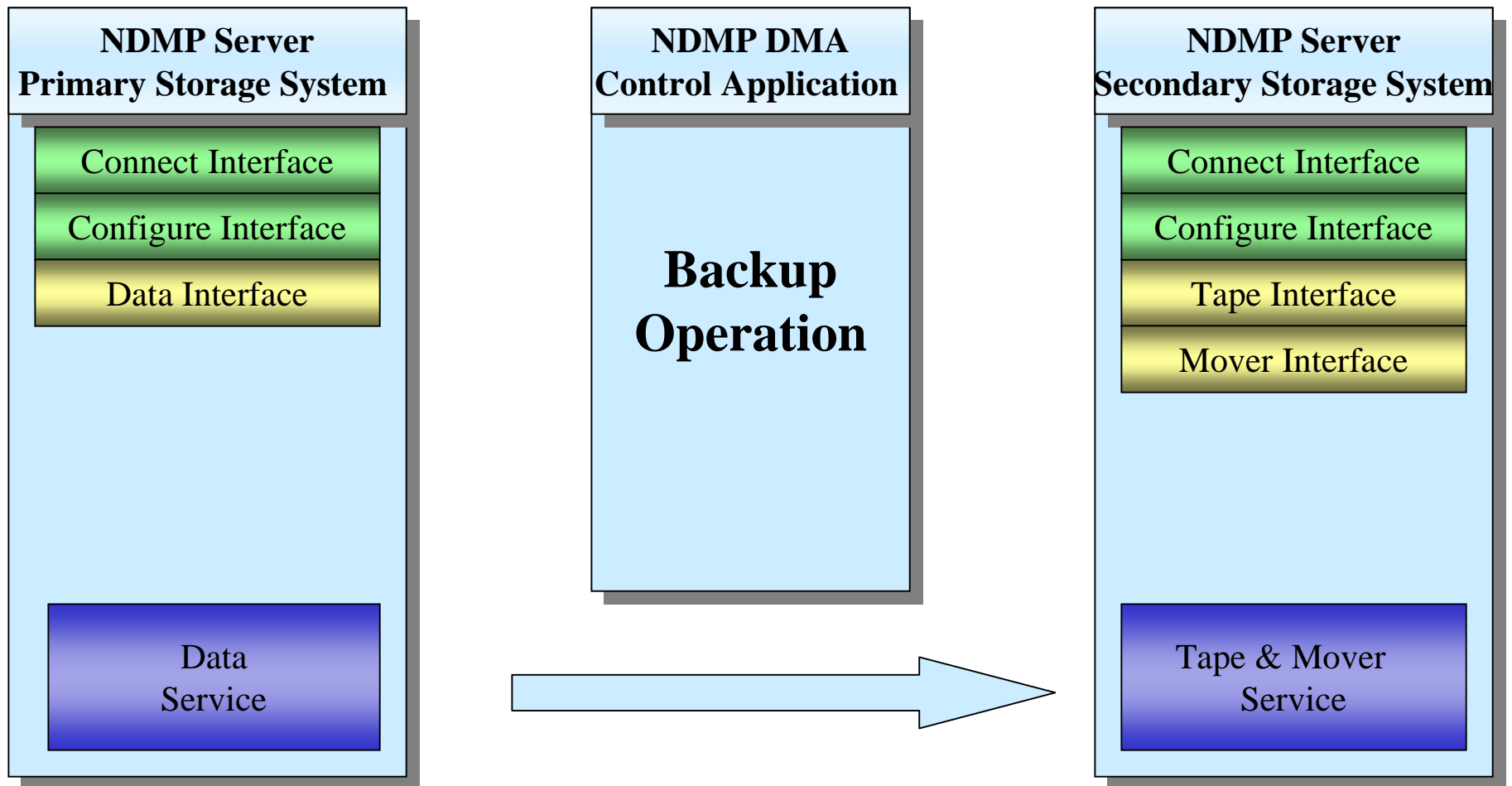
- **DMA queries secondary storage System for supported connection types**
  - `NDMP_CONFIG_GET_CONNECTION_TYPE`



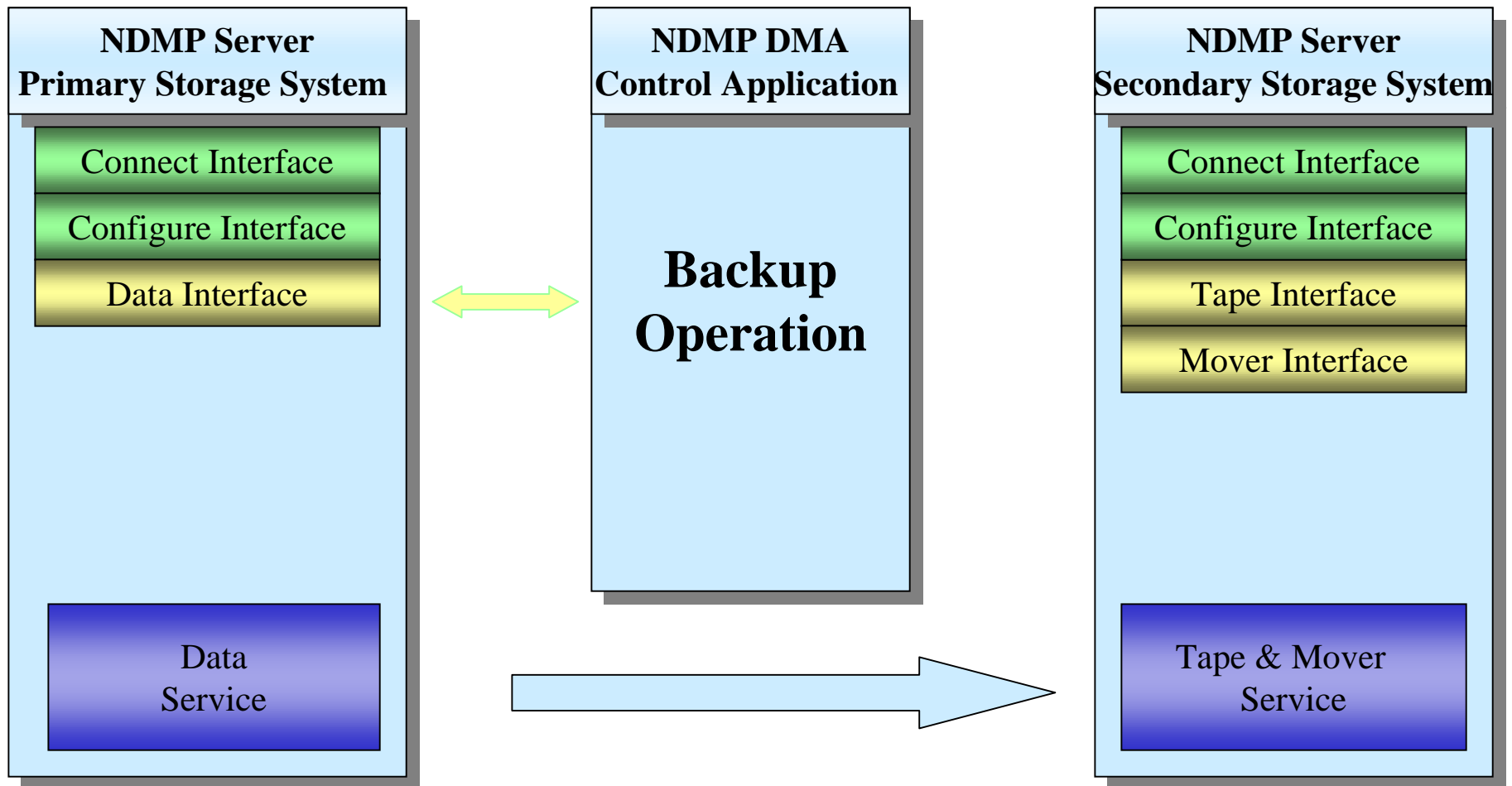
- **DMA requests a data connection between the NDMP servers**
  - `NDMP_MOVER_LISTEN`



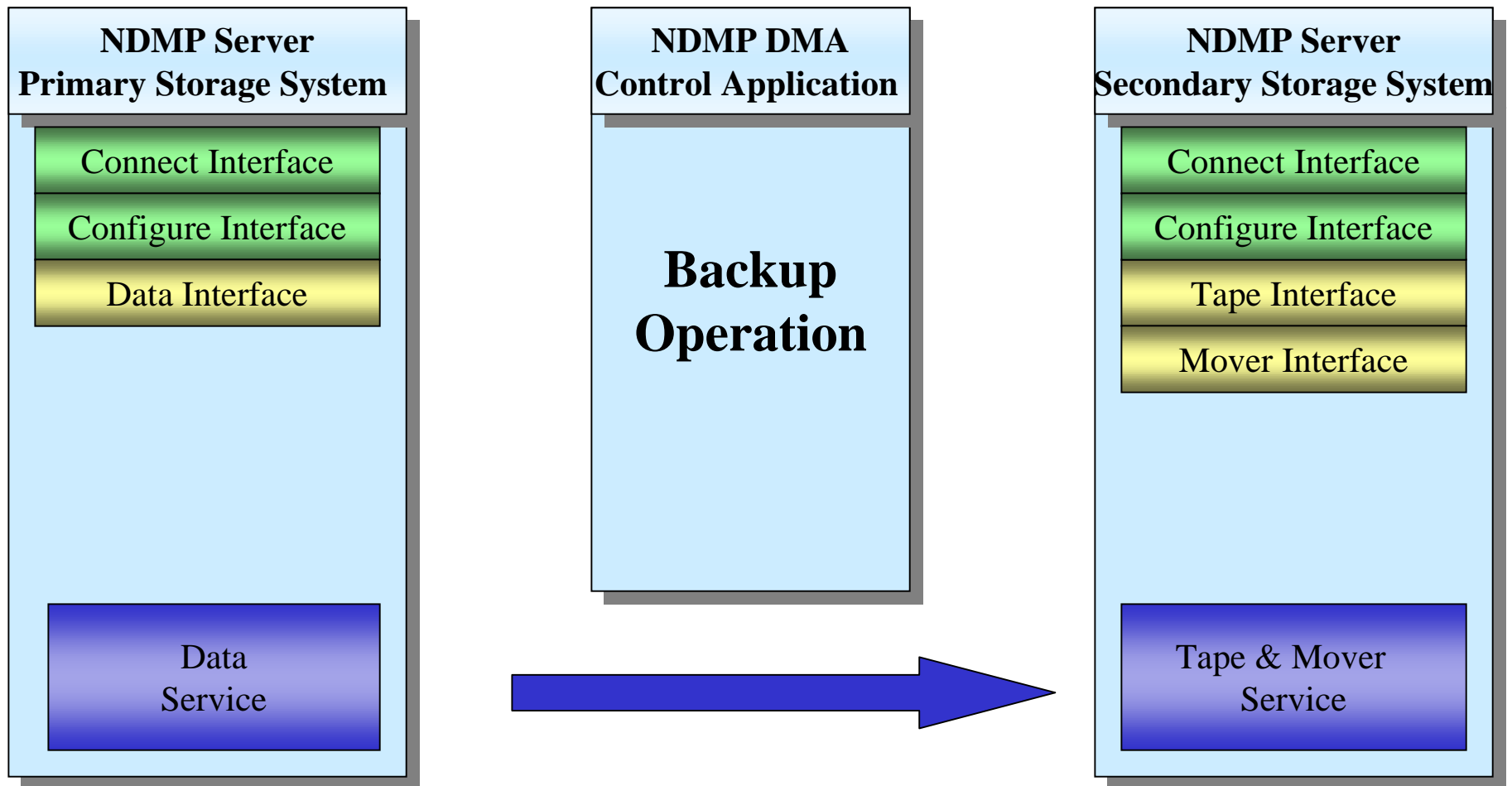
- **DMA creates a data connection connection between NDMP servers**
  - The data service is invoked
  - NDMP\_DATA\_CONNECT



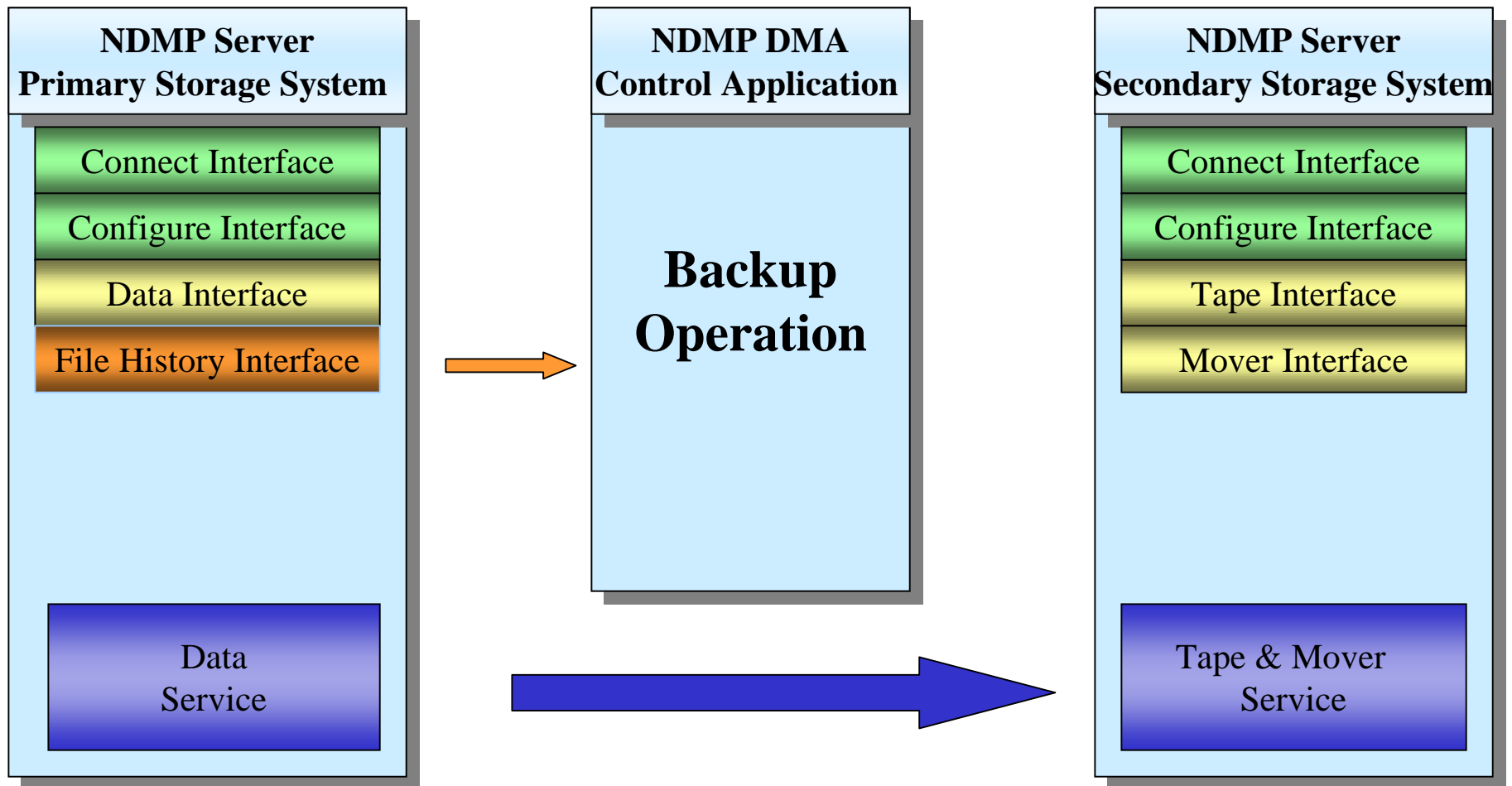
- **DMA creates a data connection connection between NDMP servers**
  - Data service connects to the specified IP address & port



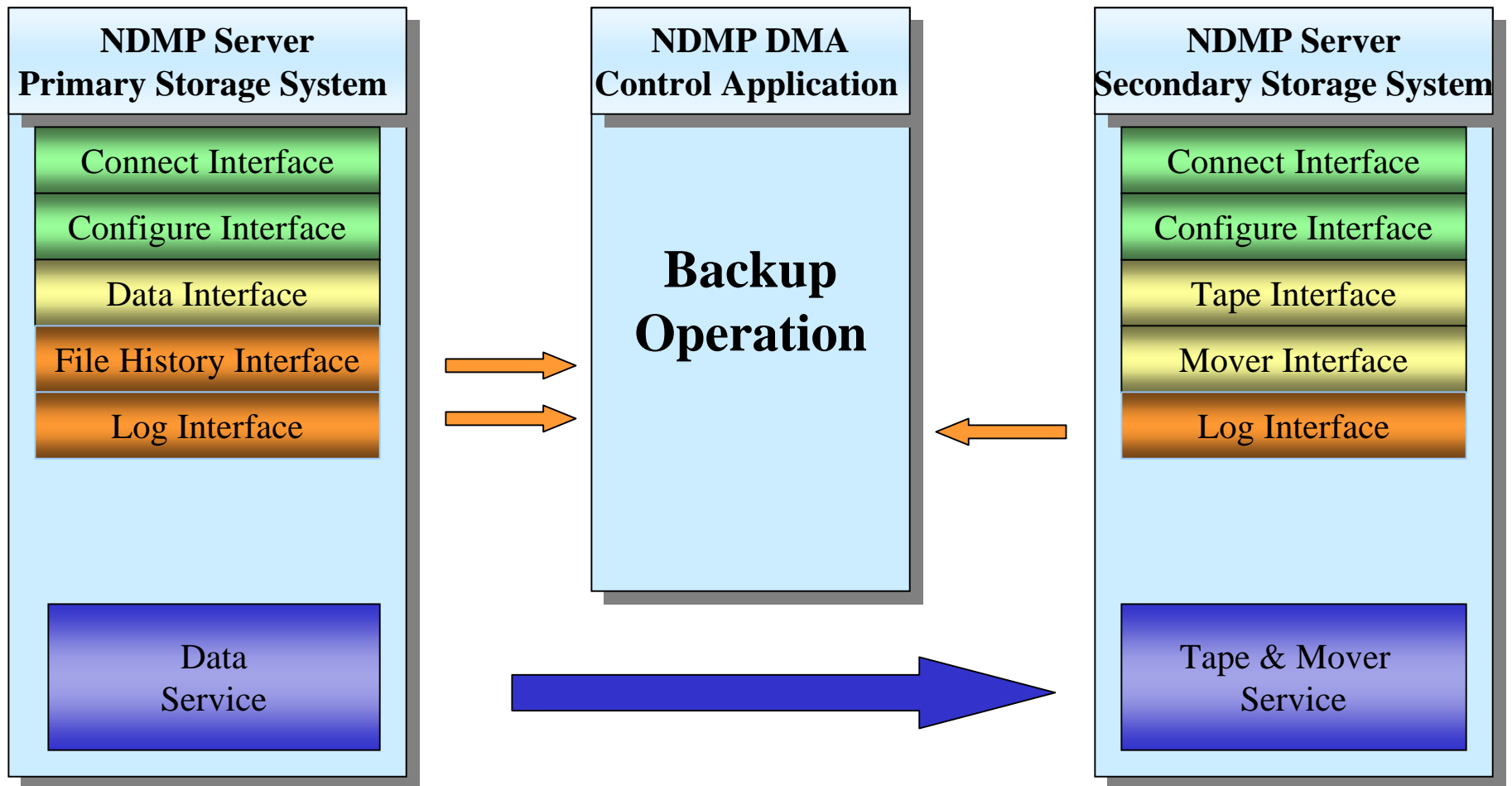
- **DMA initiates the transfer of backup data**
  - `NDMP_DATA_START_BACKUP`



- **DMA initiates the transfer of backup data**
  - Data service begins sending backup stream over data connection

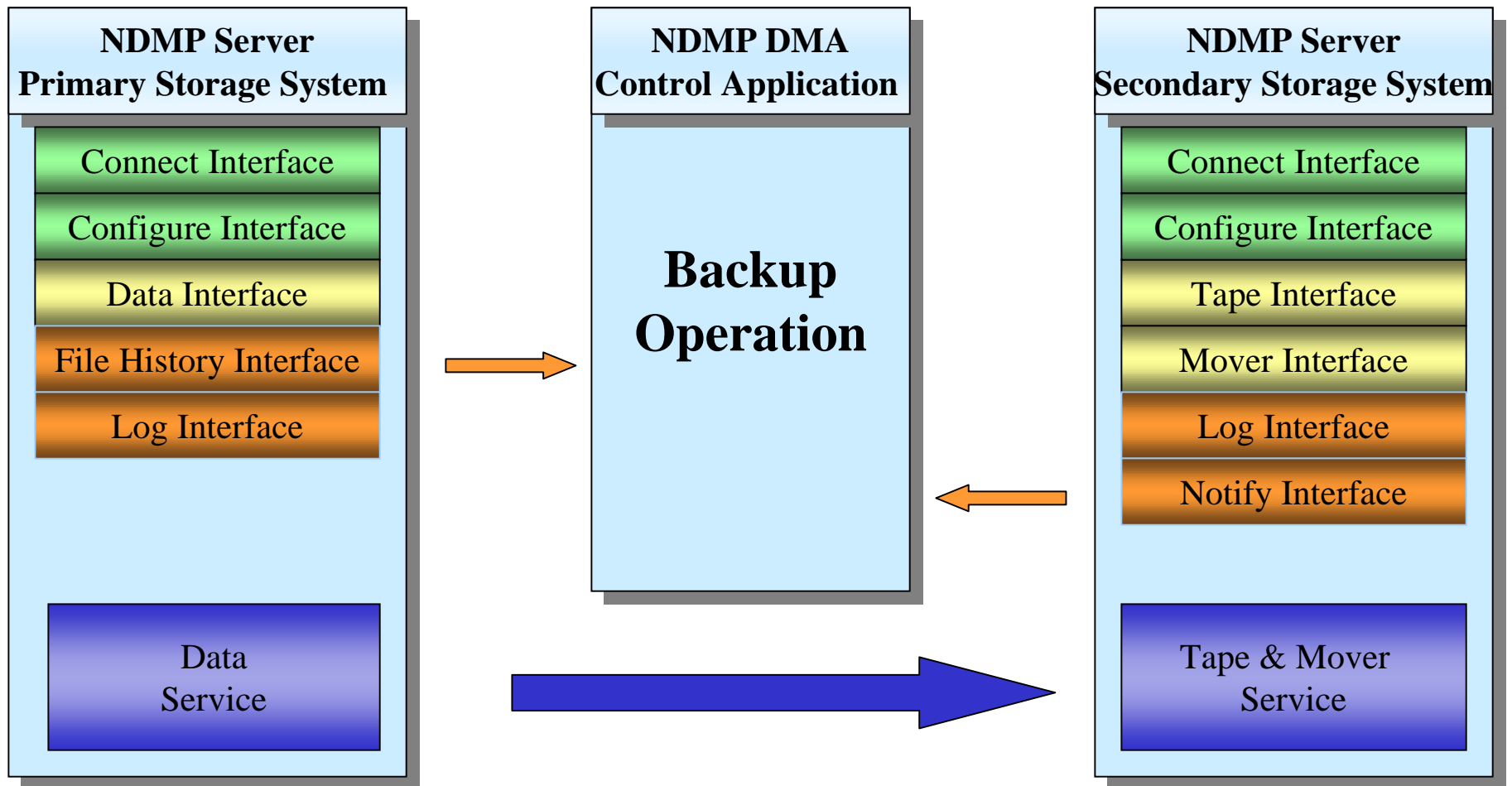


- **NDMP Data service sends stream of file history information to DMA**
  - NDMP\_FH\_ADD\_DIR &
  - NDMP\_FH\_ADD\_NODE - for inode based backups
  - or NDMP\_FH\_ADD\_FILE - file based backups

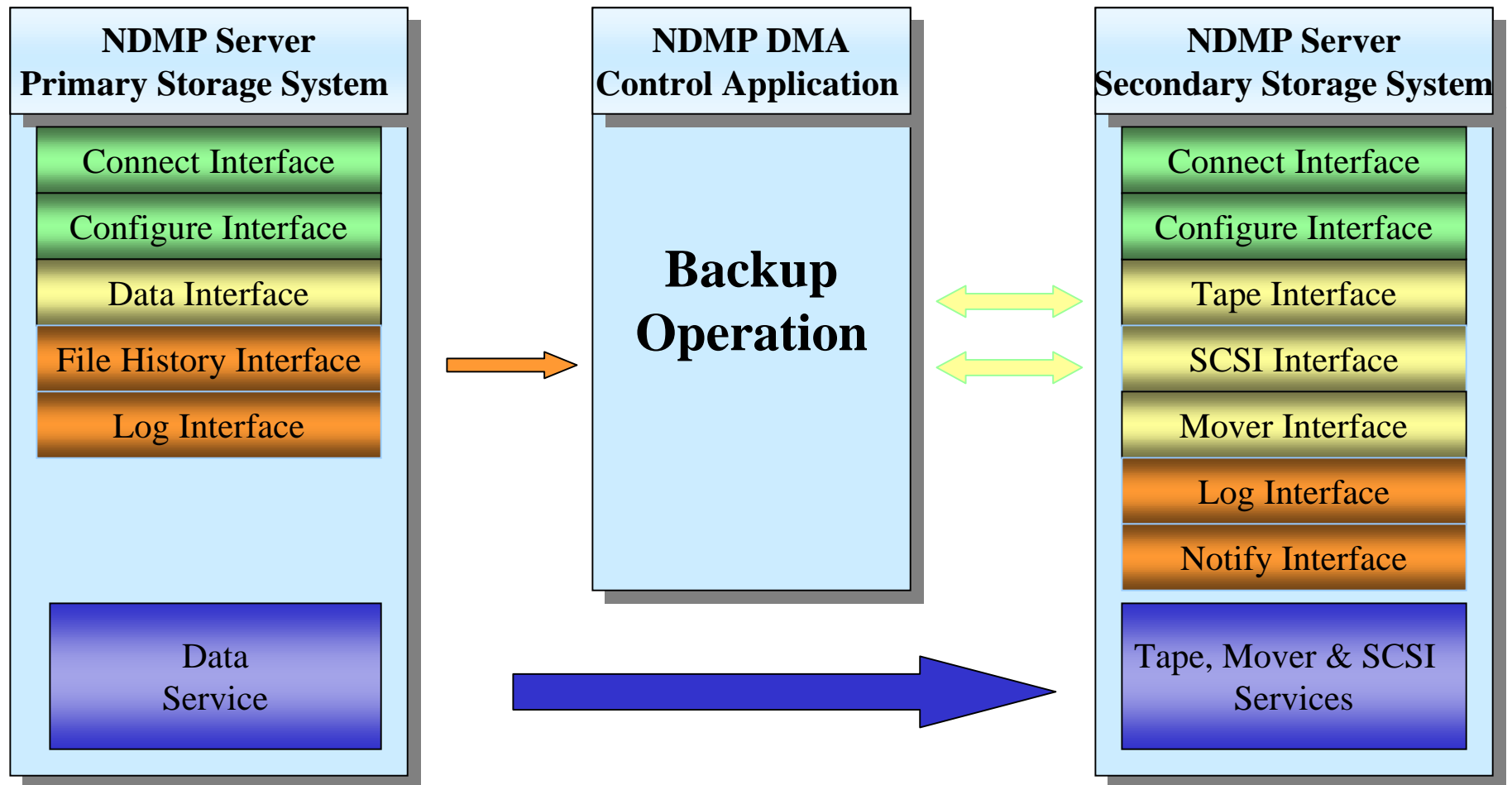


- **NDMP Data & Tape services send periodic log messages to DMA**
  - `NDMP_LOG_MESSAGE`

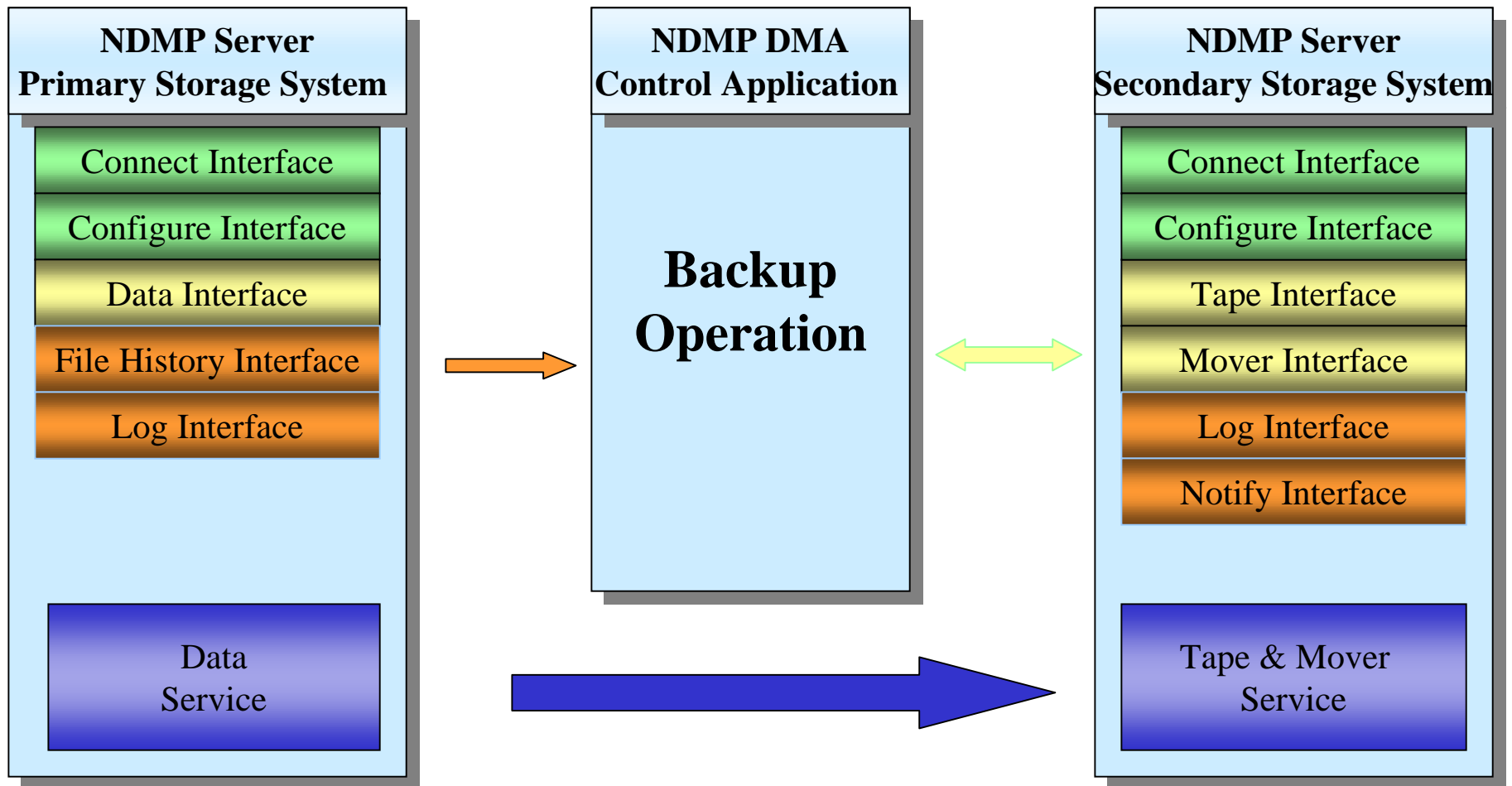




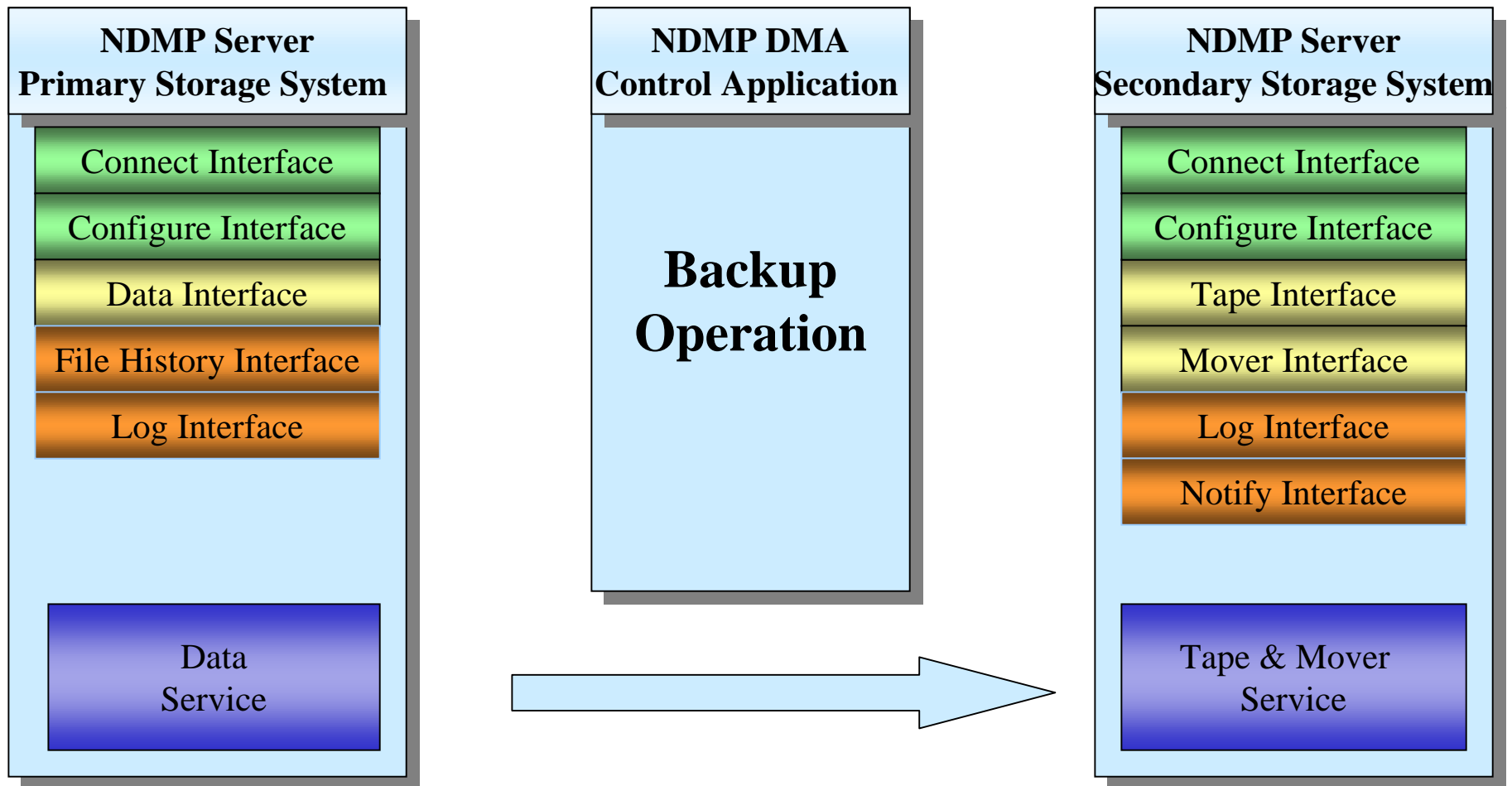
- **NDMP Tape service sends notification when DMA intervention is required**
  - example: end of mover window or tape medium encountered
  - NDMP\_NOTIFY\_MOVER\_PAUSED



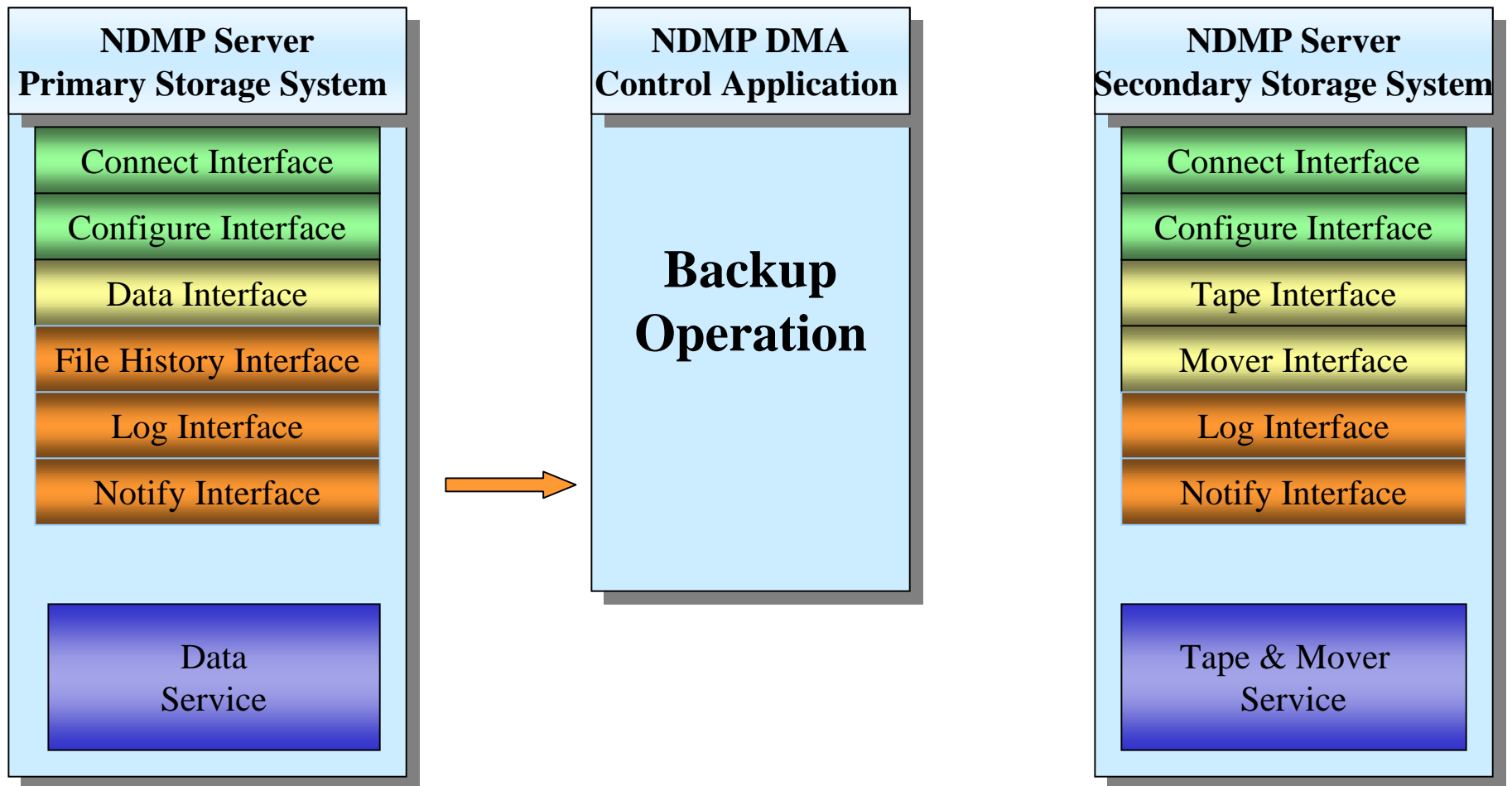
- **DMA initiates tape swap possibly utilizing media changer support**
  - NMDP\_TAPE\_WRITE - to output tape trailer information
  - NDMP\_TAPE\_MTIO - to rewind/unload tape
  - NDMP\_SCSI\_EXECUTE\_CDB - to manipulate media changer
  - NDMP\_TAPE\_MTIO - to position new tape
  - NDMP\_TAPE\_WRITE - to output new tape header



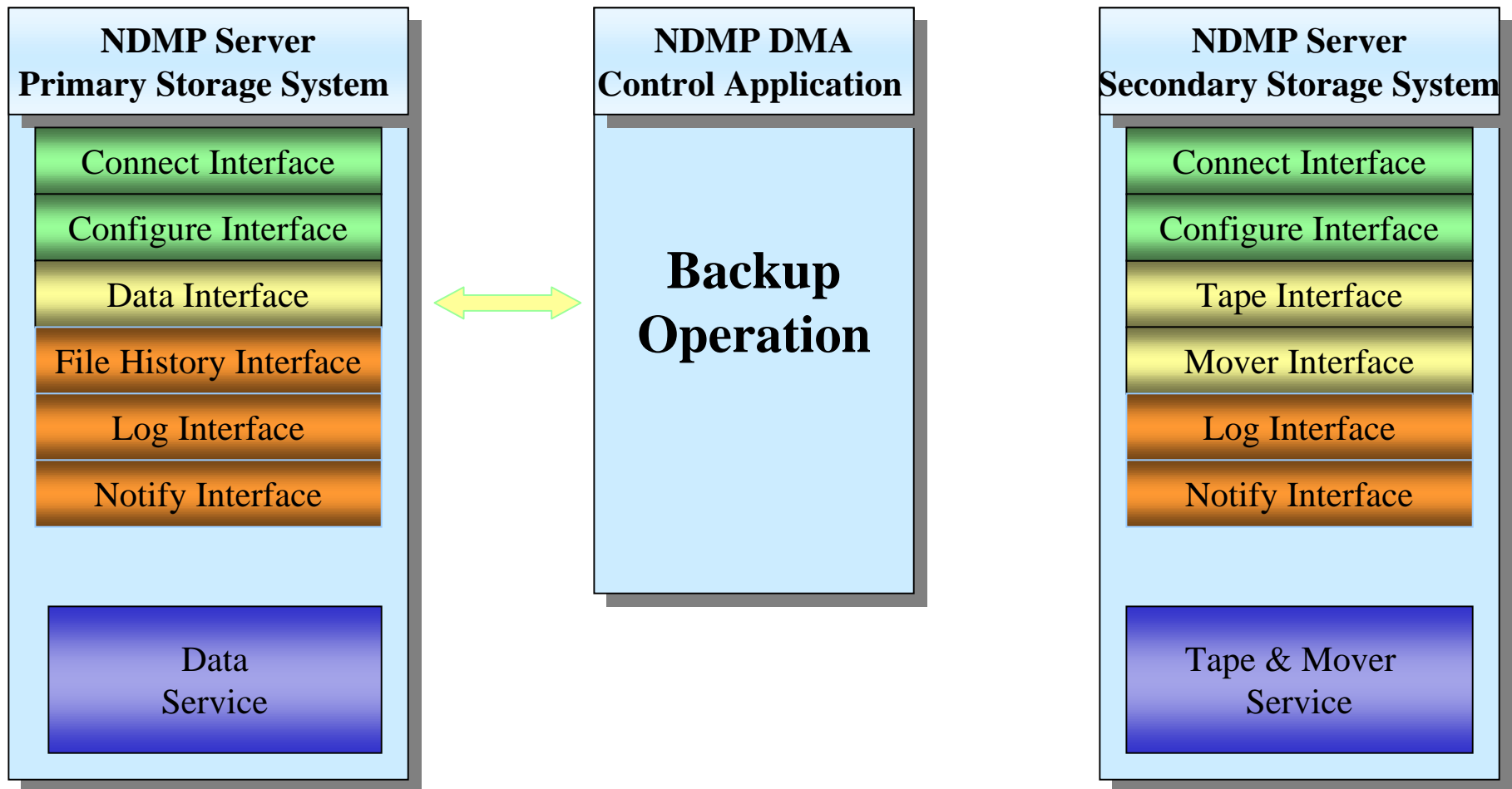
- **DMA prepares the mover to continue the backup operation**
  - NDMP\_MOVER\_SET\_WINDOW
  - NDMP\_MOVER\_CONTINUE



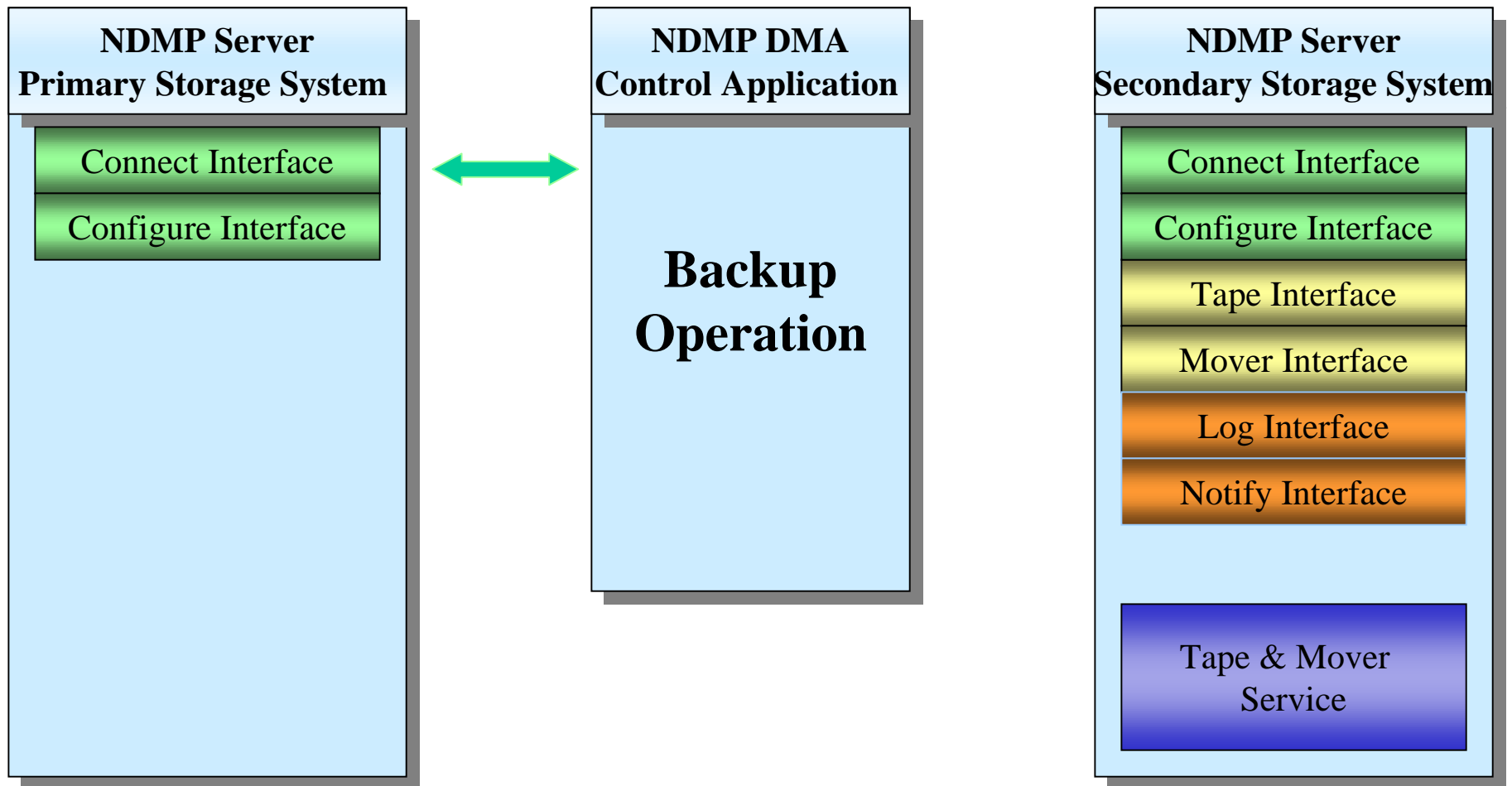
- Data server completes transfer of requested backup data



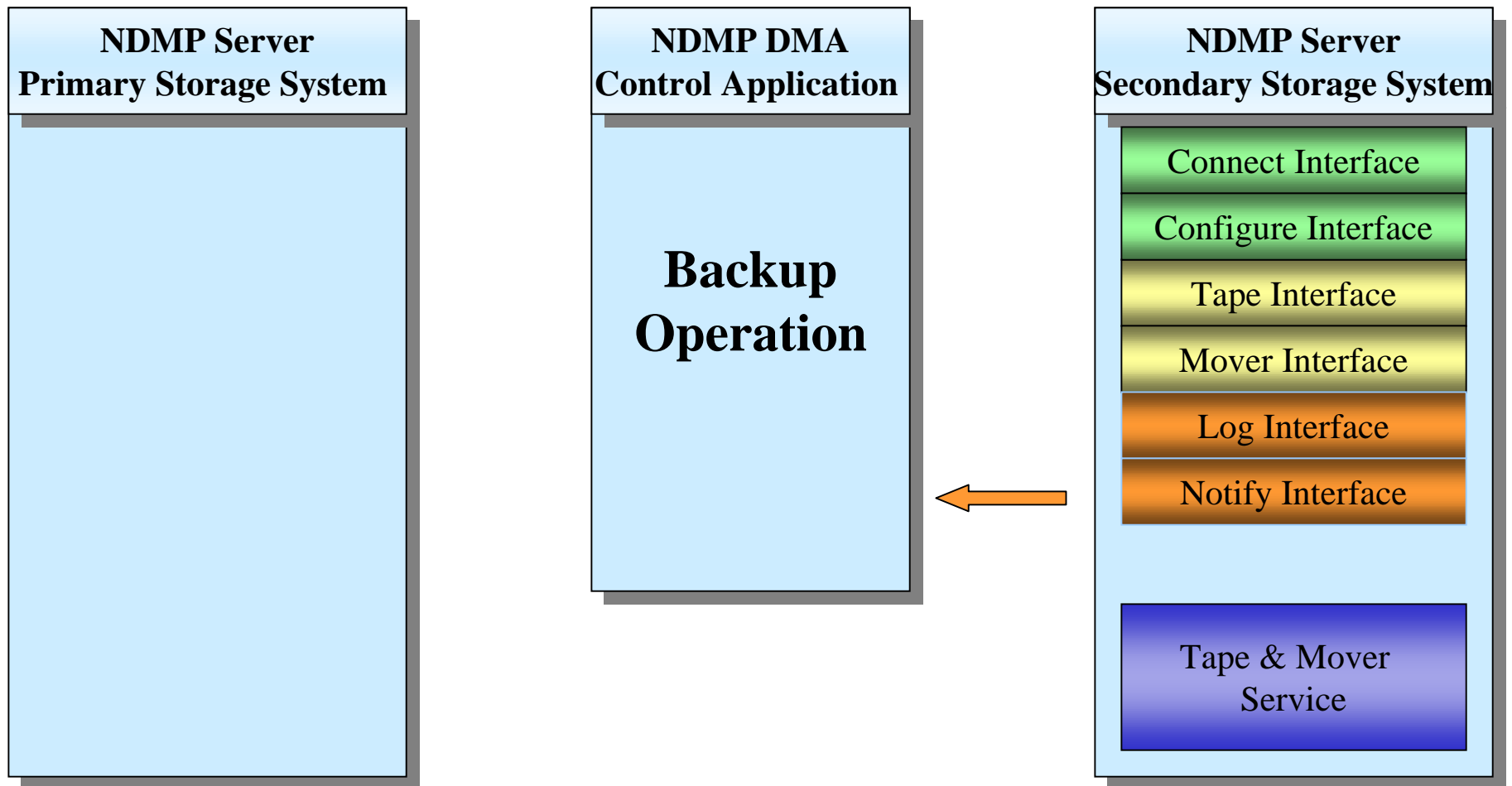
- **Data server notifies DMA of completed backup**
  - NDMP\_NOTIFY\_DATA\_HALTED
  - data server closes data connection to secondary storage System



- **DMA completes post processing with primary storage System**
  - NDMP\_DATA\_GET\_STATE
  - NDMP\_DATA\_GET\_ENV
  - NDMP\_DATA\_STOP

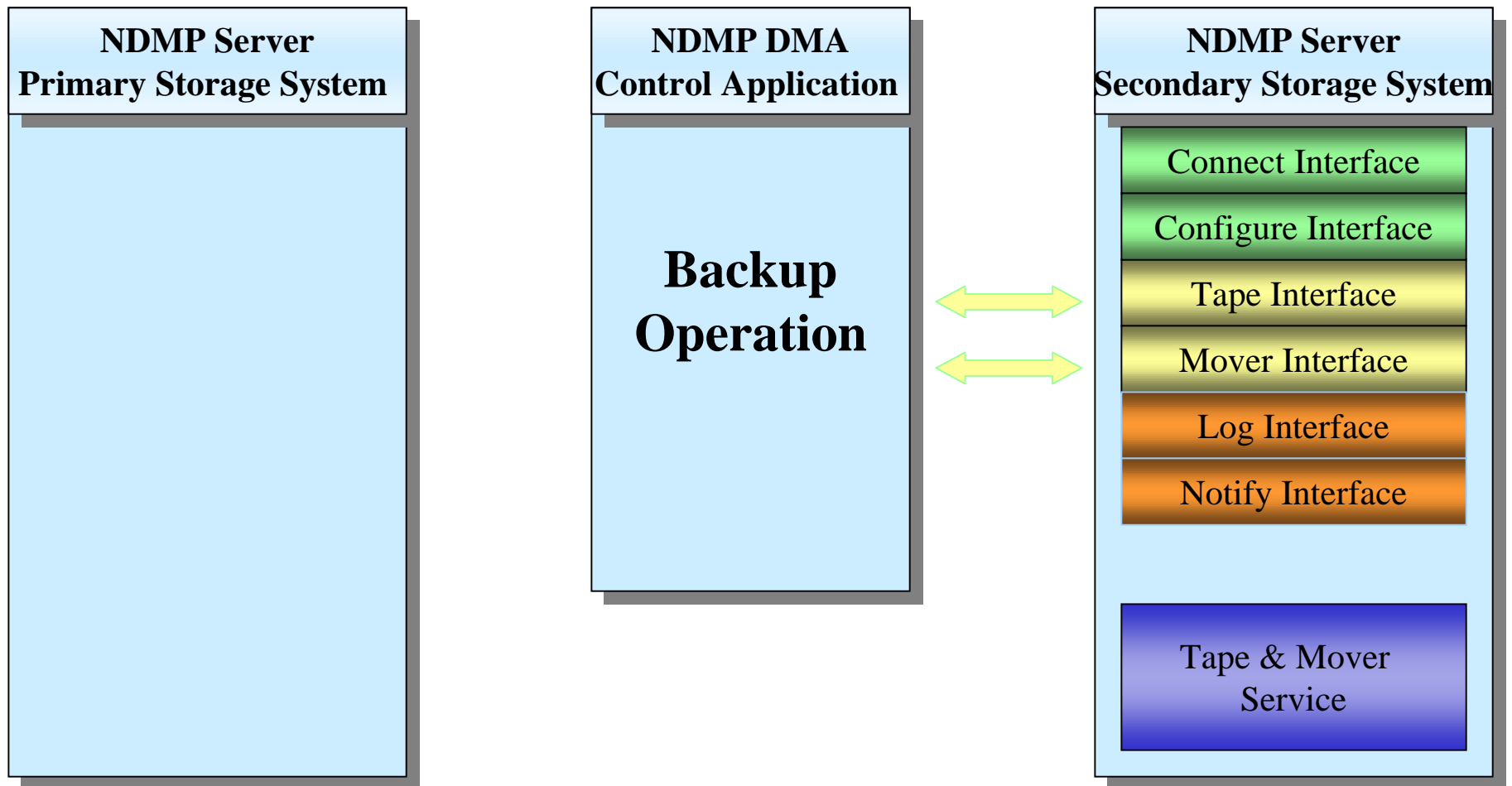


- **DMA completes post processing with primary storage System**
  - `NDMP_CONNECT_CLOSE`

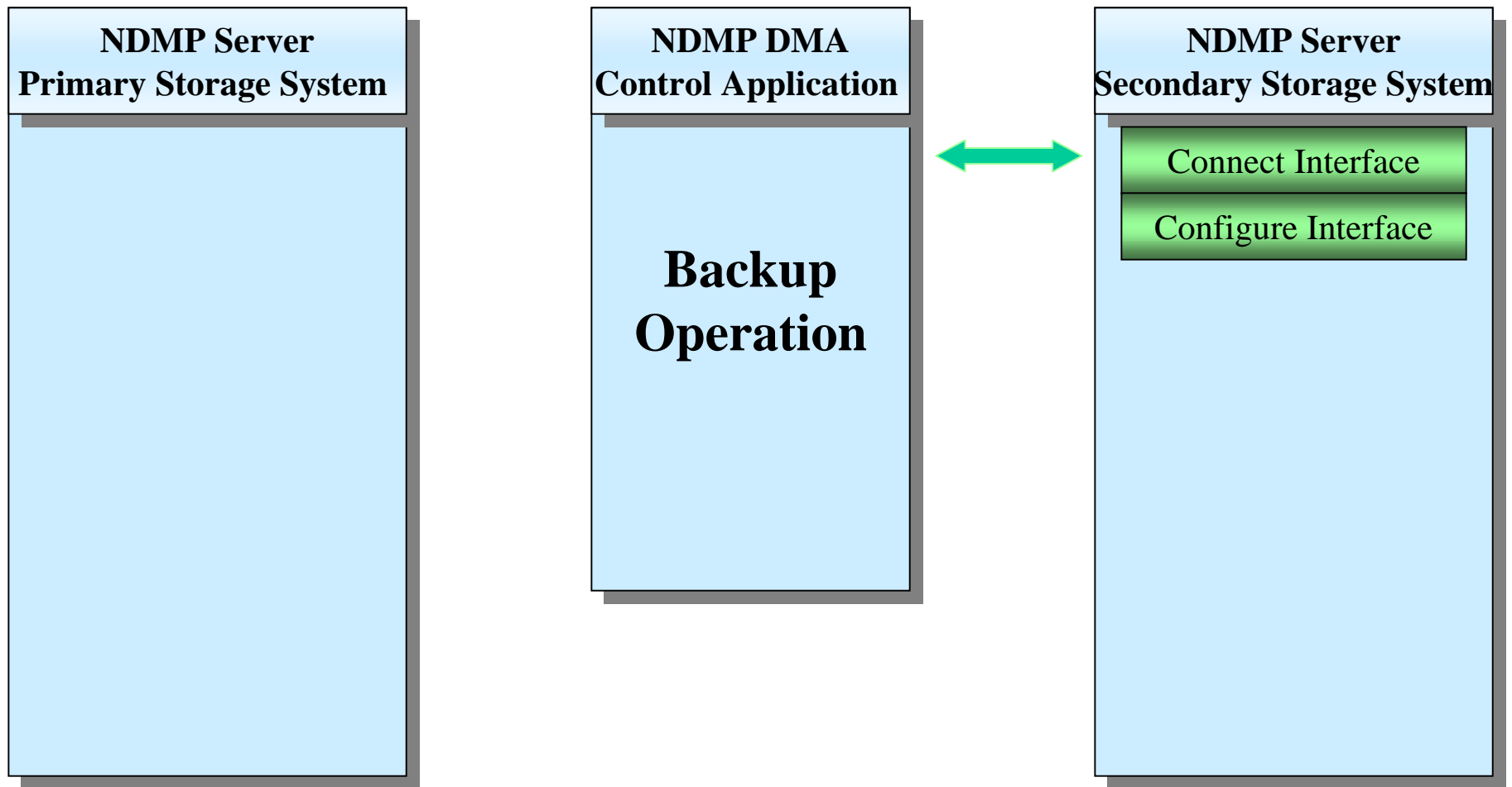


- **Secondary storage System detects data connection closure**
  - pad and output last mover record to tape device
  - NDMP\_NOTIFY\_MOVER\_HALTED

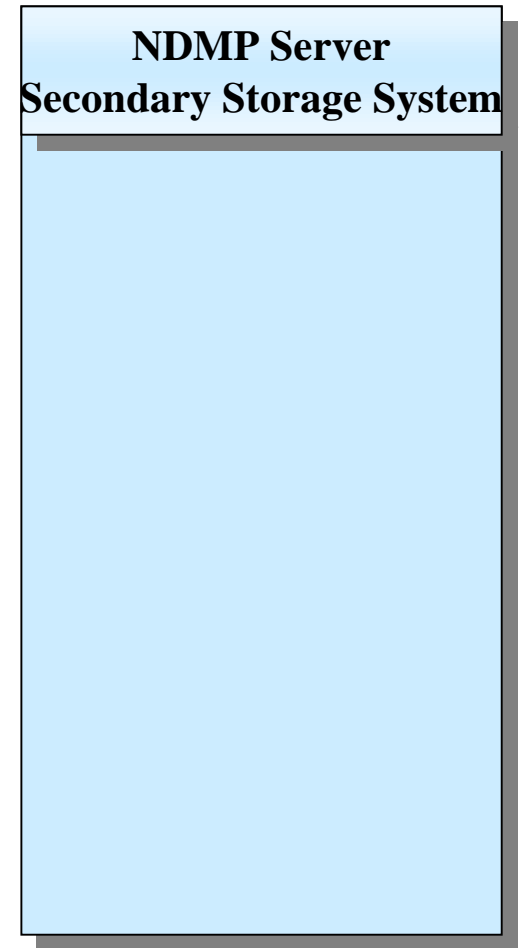
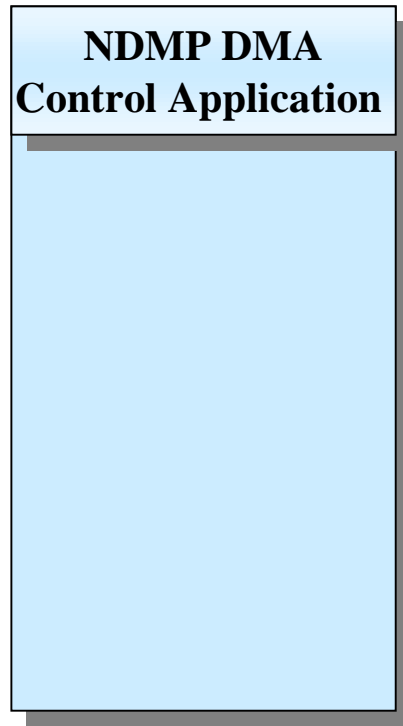
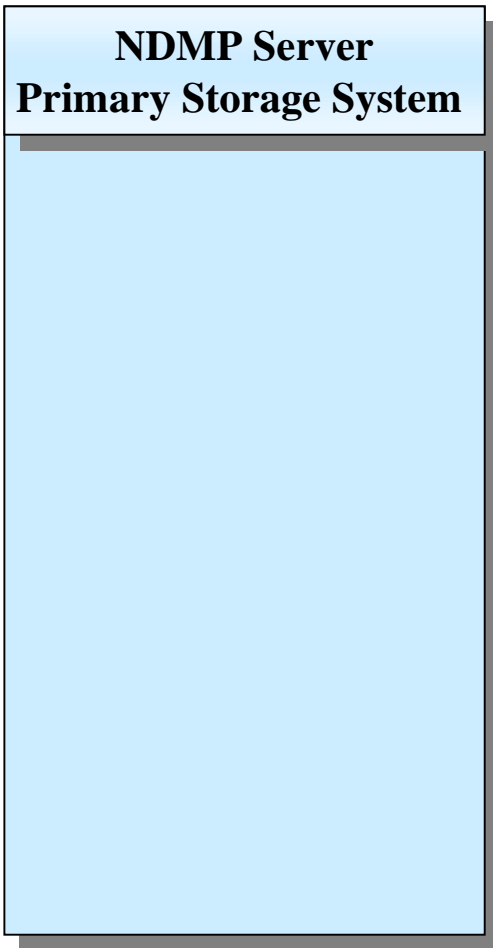




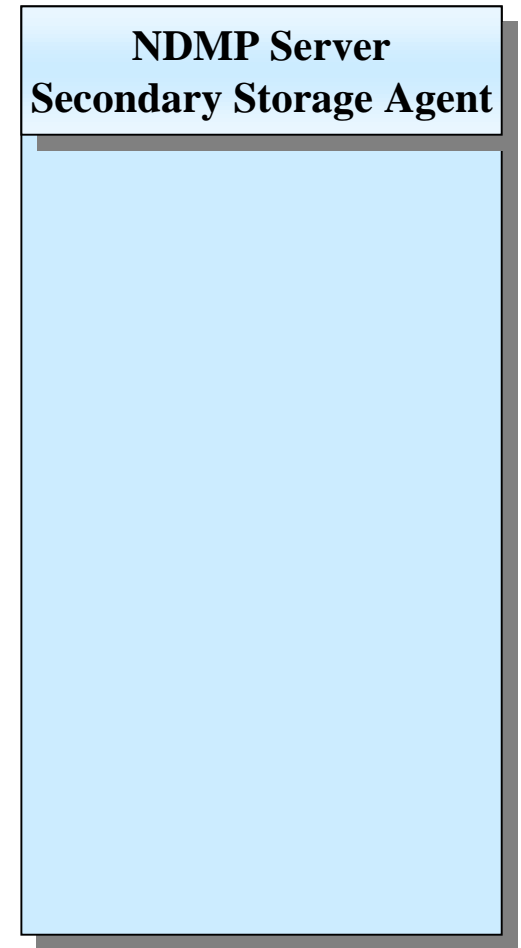
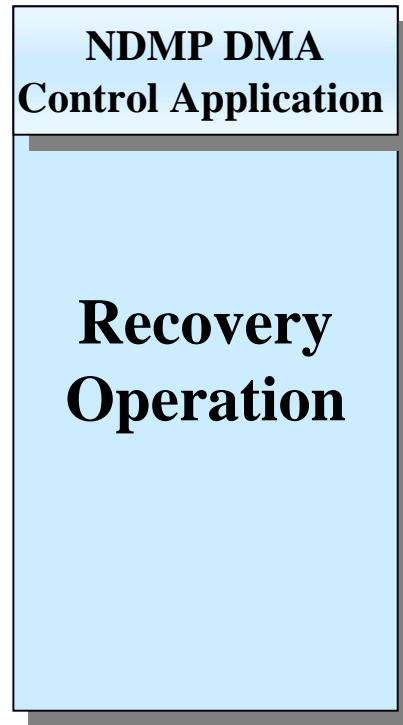
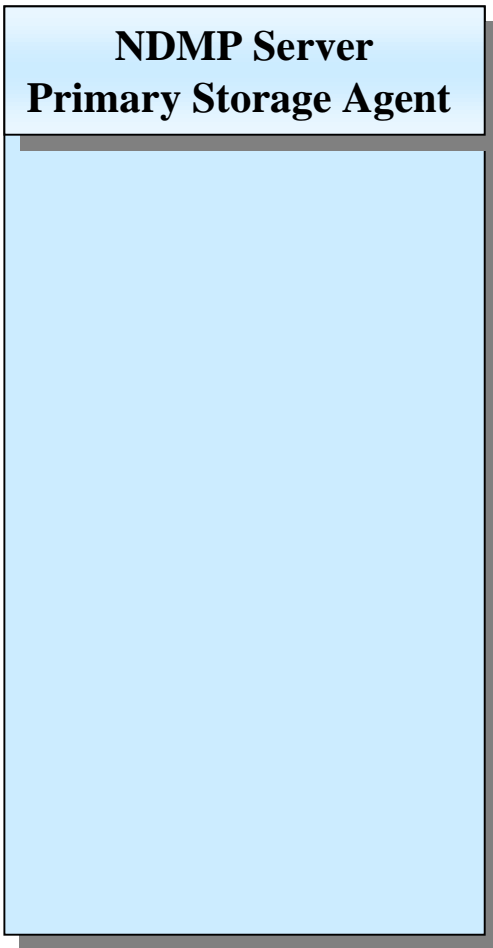
- **DMA completes post processing with secondary System**
  - NDMP\_MOVER\_GET\_STATE
  - NDMP\_MOVER\_STOP
  - NDMP\_TAPE\_WRITE - to output trailer & file marks (optional)
  - NDMP\_TAPE\_CLOSE

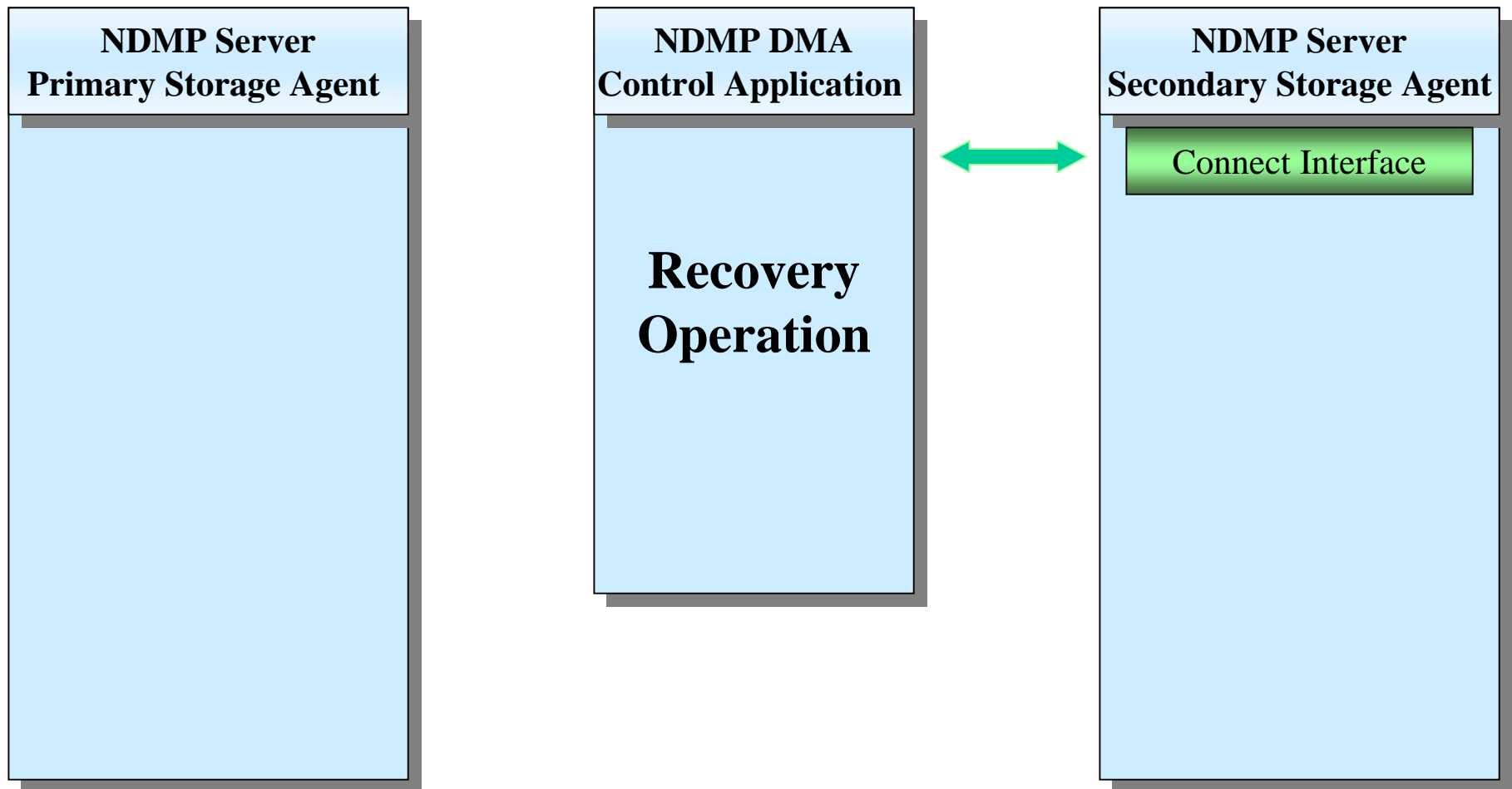


- **DMA completes post processing with secondary System**
  - NDMP\_CONNECT\_CLOSE

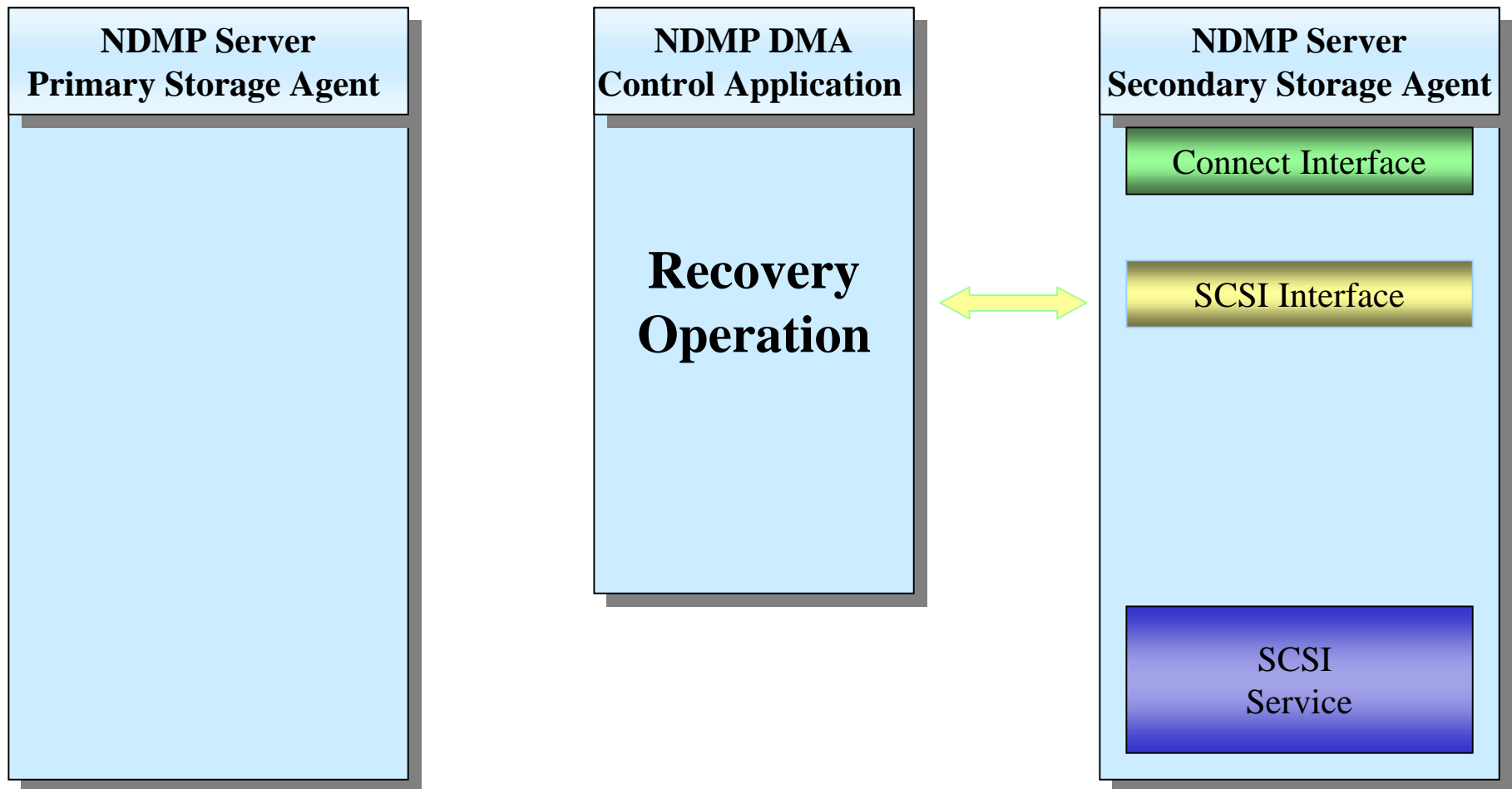


# NDMP Recovery Operation Workflow

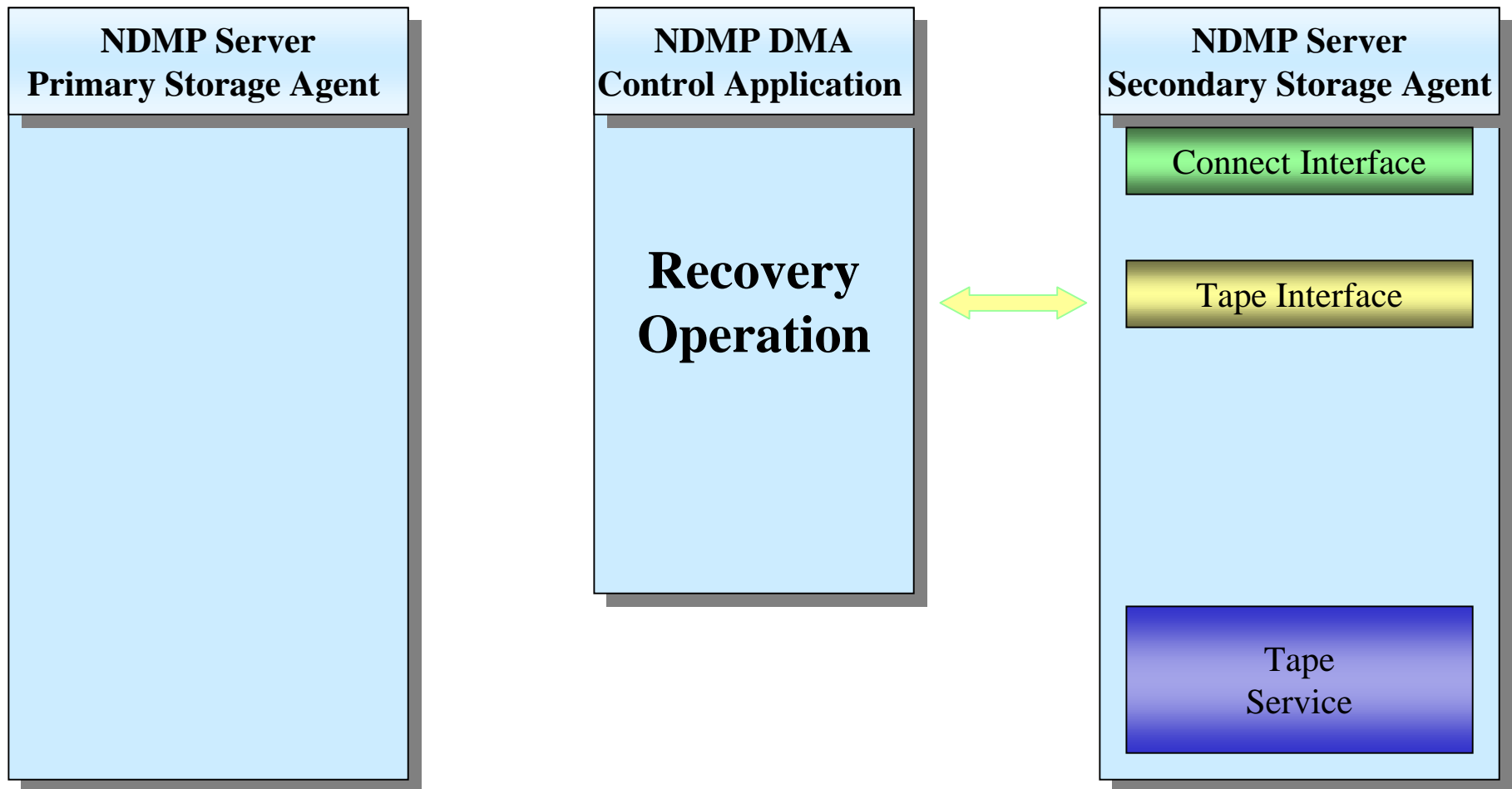




- **DMA creates a control connection to the secondary storage agent**
  - Connect using TCP port 10,000
  - NDMP\_CONNECT\_OPEN (to negotiate version)
  - NDMP\_CONNECT\_CLIENT\_AUTH (to authenticate DMA to Server)

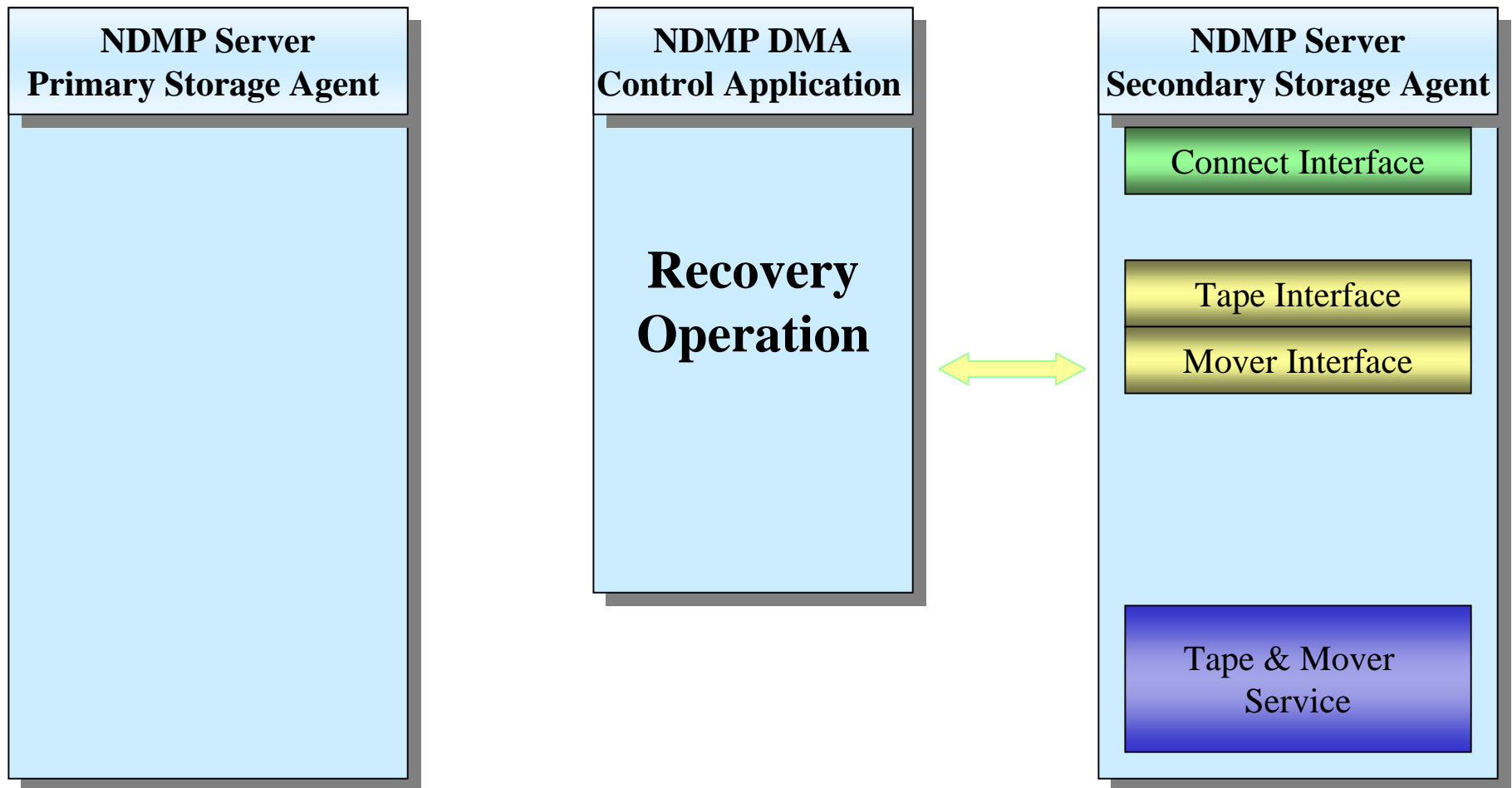


- **DMA uses the tape library media changer to load the required tape**
  - The SCSI service is invoked
  - NDMP\_SCISI\_OPEN
  - NDMP\_SCISI\_EXECUTE\_CDB - to manipulate media changer
  - NDMP\_SCISI\_CLOSE

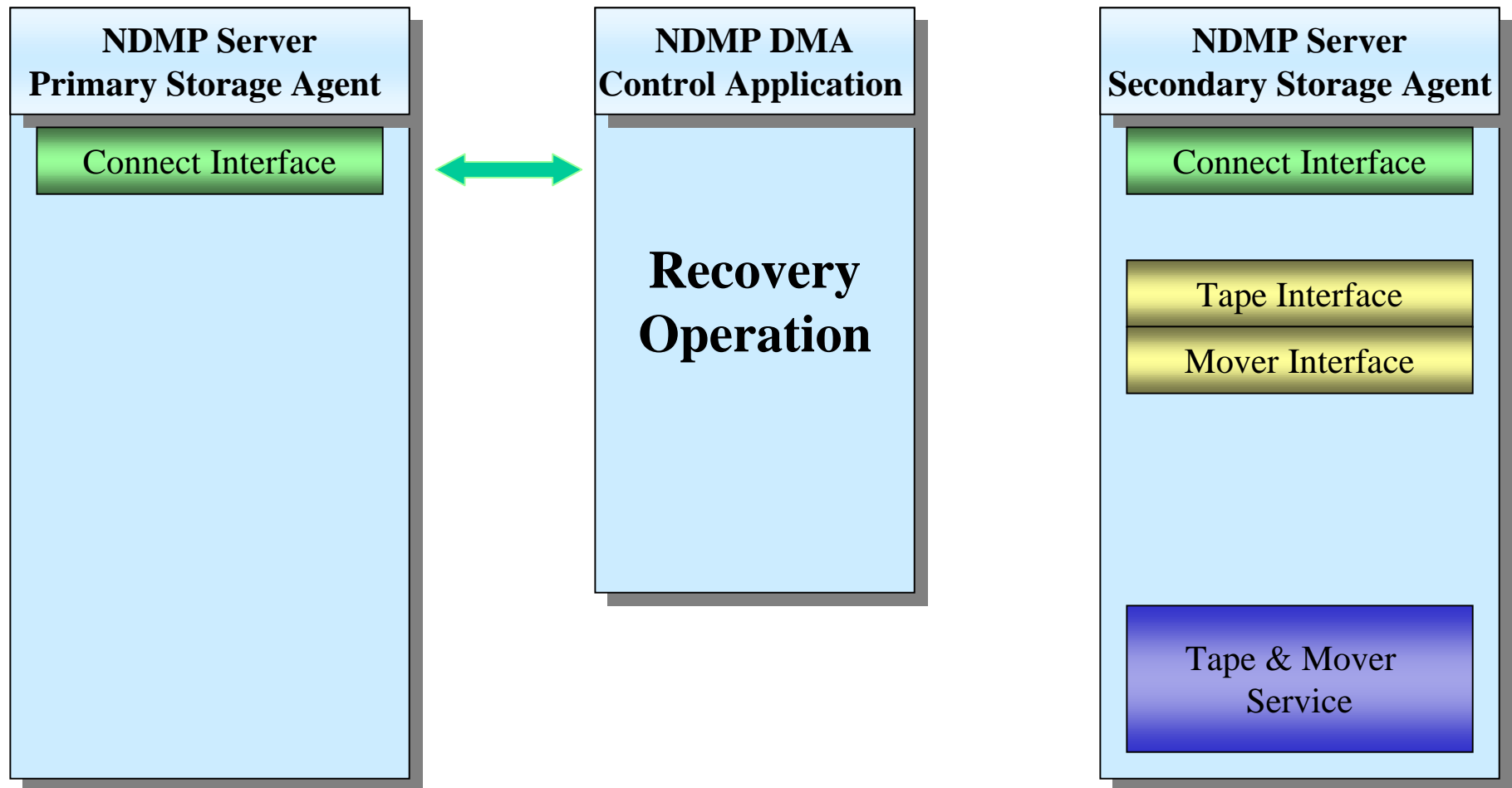


- **DMA prepares the tape service for a recovery operation**
  - The tape service is invoked
  - NDMP\_TAPE\_OPEN
  - NDMP\_TAPE\_READ - to validate volume label
  - NDMP\_TAPE\_MTIO - to position tape to start of backup data

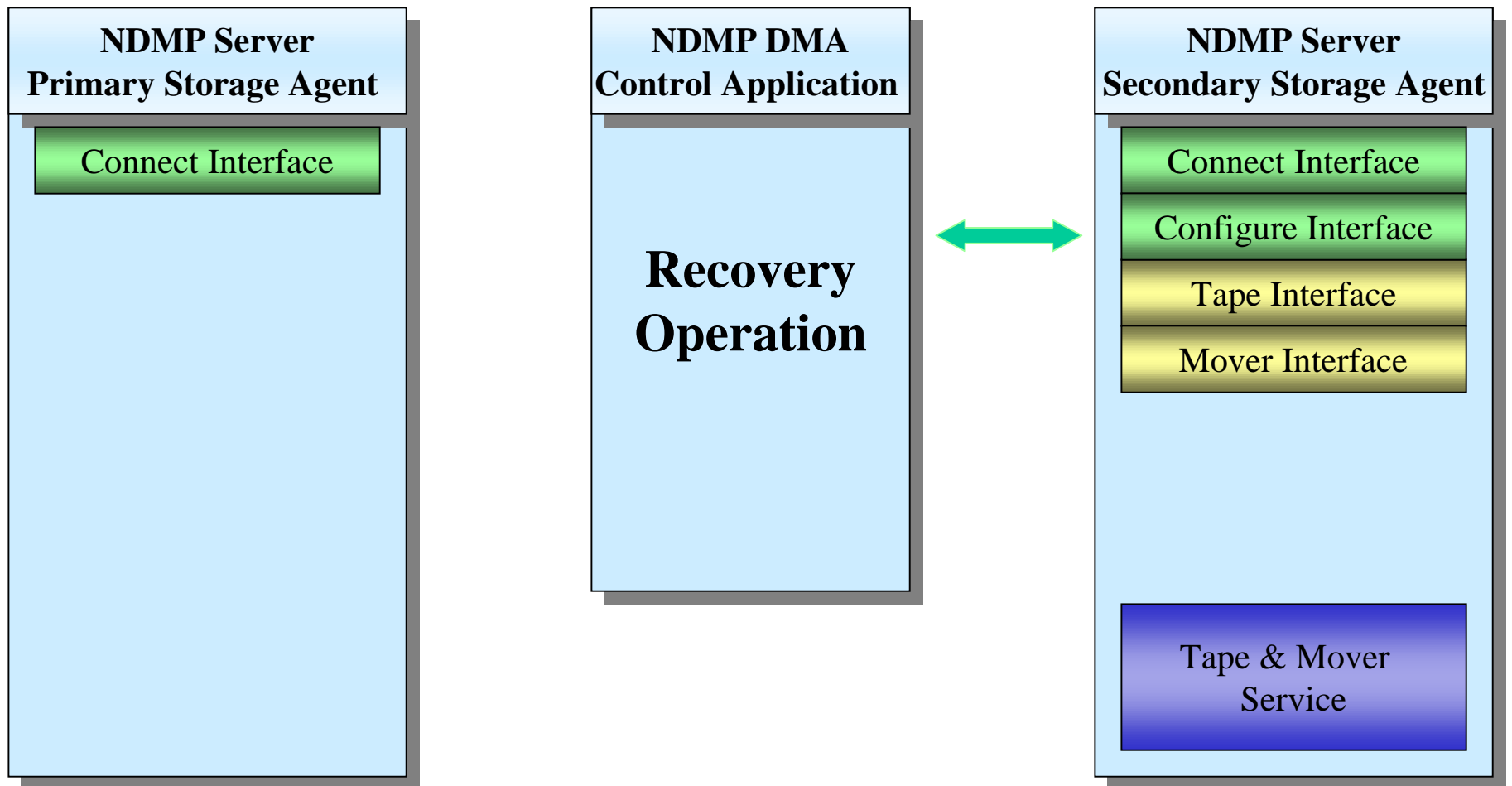




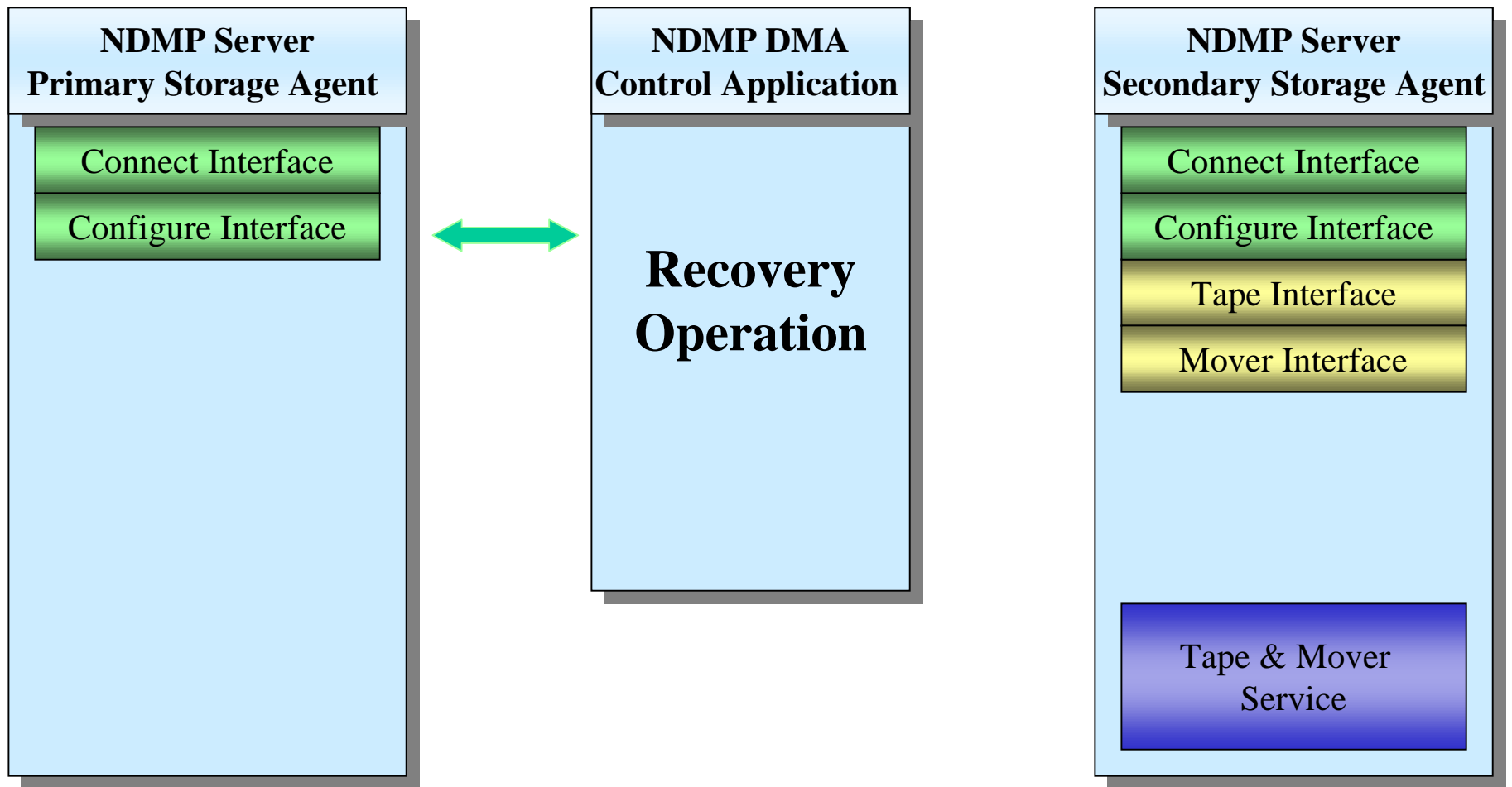
- **DMA prepares the mover for a recovery operation**
  - The mover is invoked
  - NDMP\_MOVER\_SET\_RECORD\_SIZE
  - NDMP\_MOVER\_SET\_WINDOW



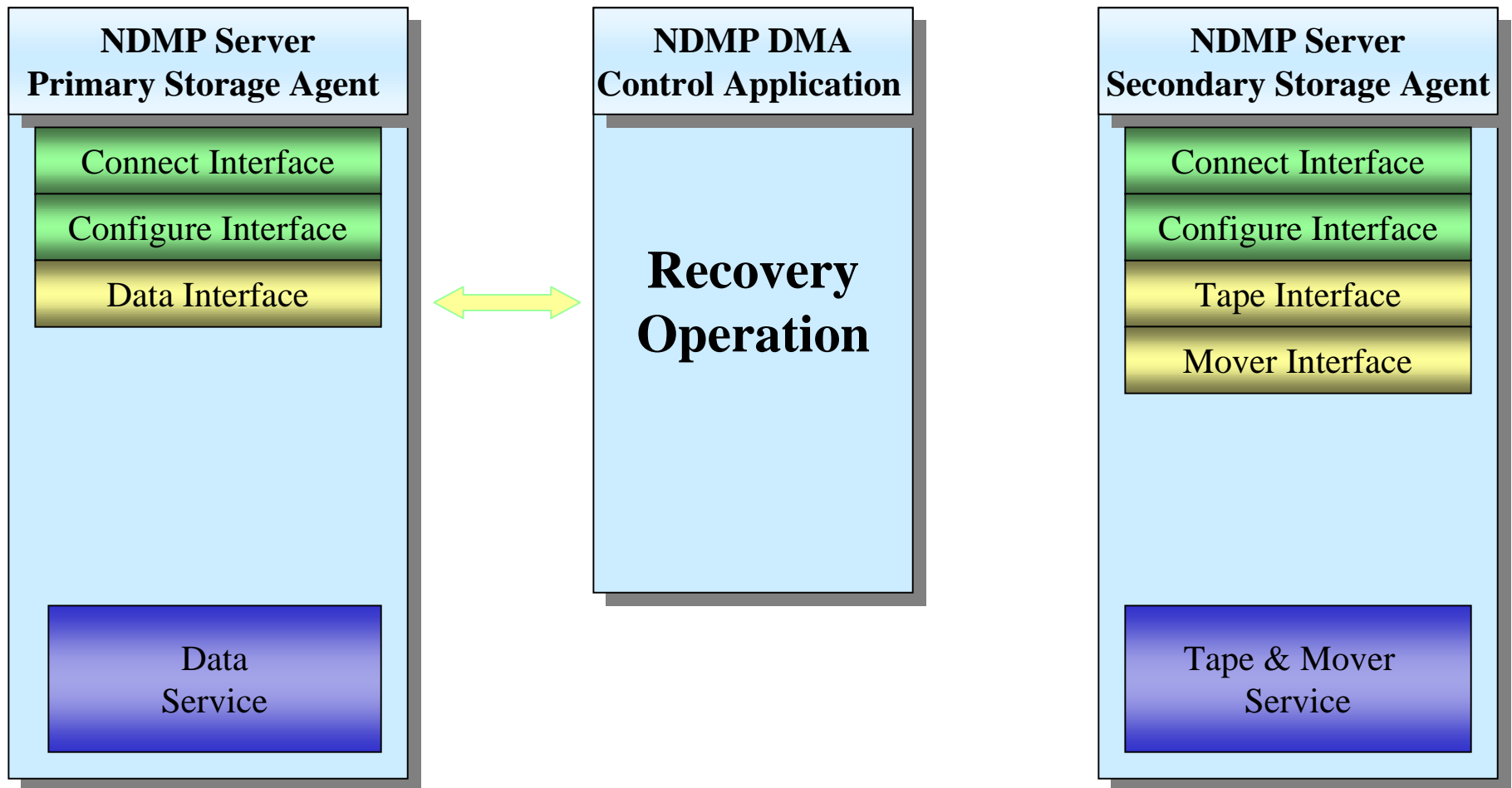
- **DMA opens control connection to the primary storage agent**
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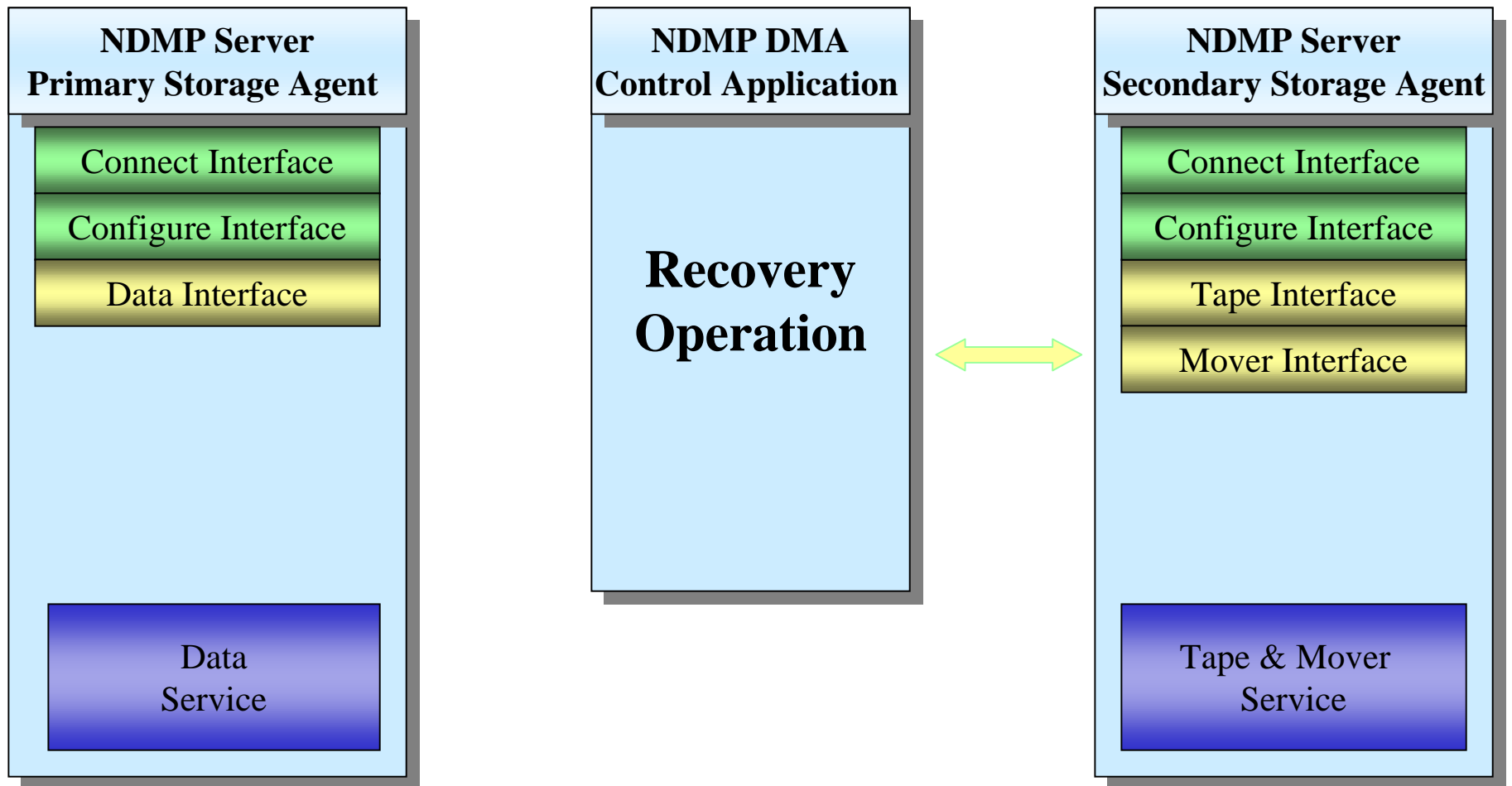
- **DMA queries secondary storage agent for capabilities**
  - `NDMP_CONFIG_GET_CONNECTION_TYPE`



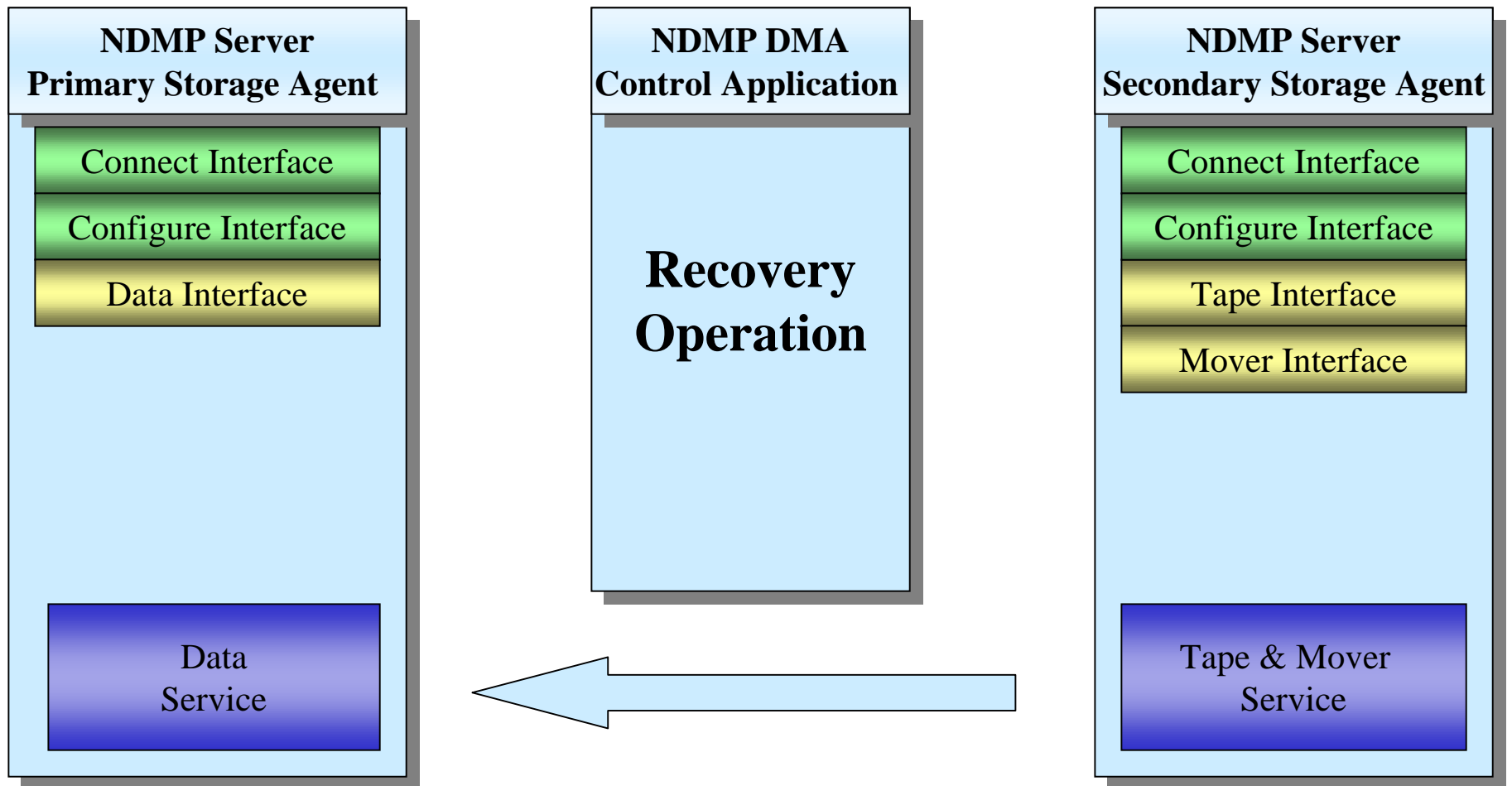
- **DMA queries primary storage agent for capabilities**
  - NDMP\_CONFIG\_GET\_BUTYPE\_INFO
  - NDMP\_CONFIG\_GET\_CONNECTION\_TYPE



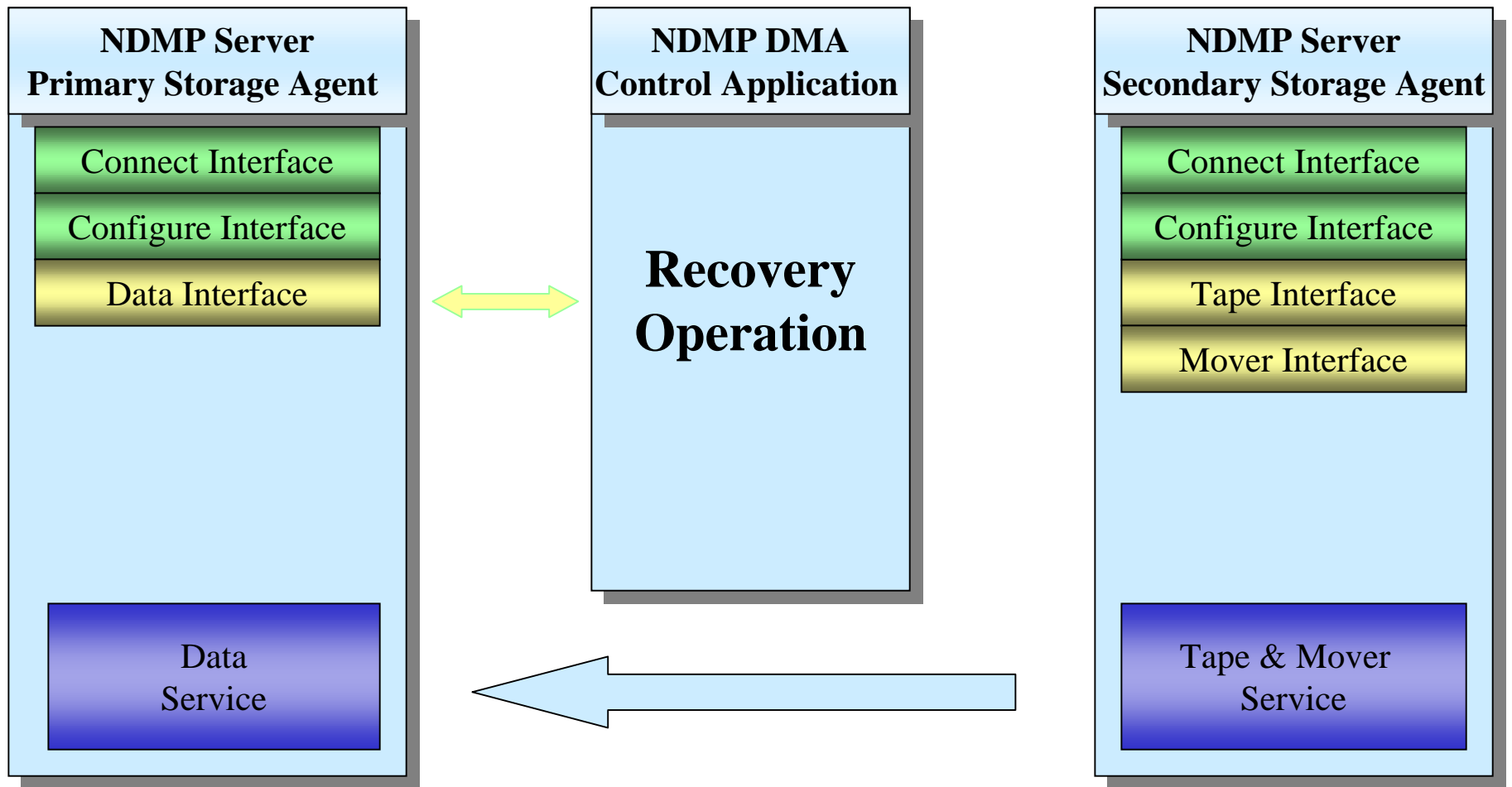
- **DMA obtains the data server's data connection address information**
  - The Data service is invoked
  - NDMP\_DATA\_LISTEN



- **DMA creates a data connection connection between NDMP servers**
  - NDMP\_MOVER\_CONNECT

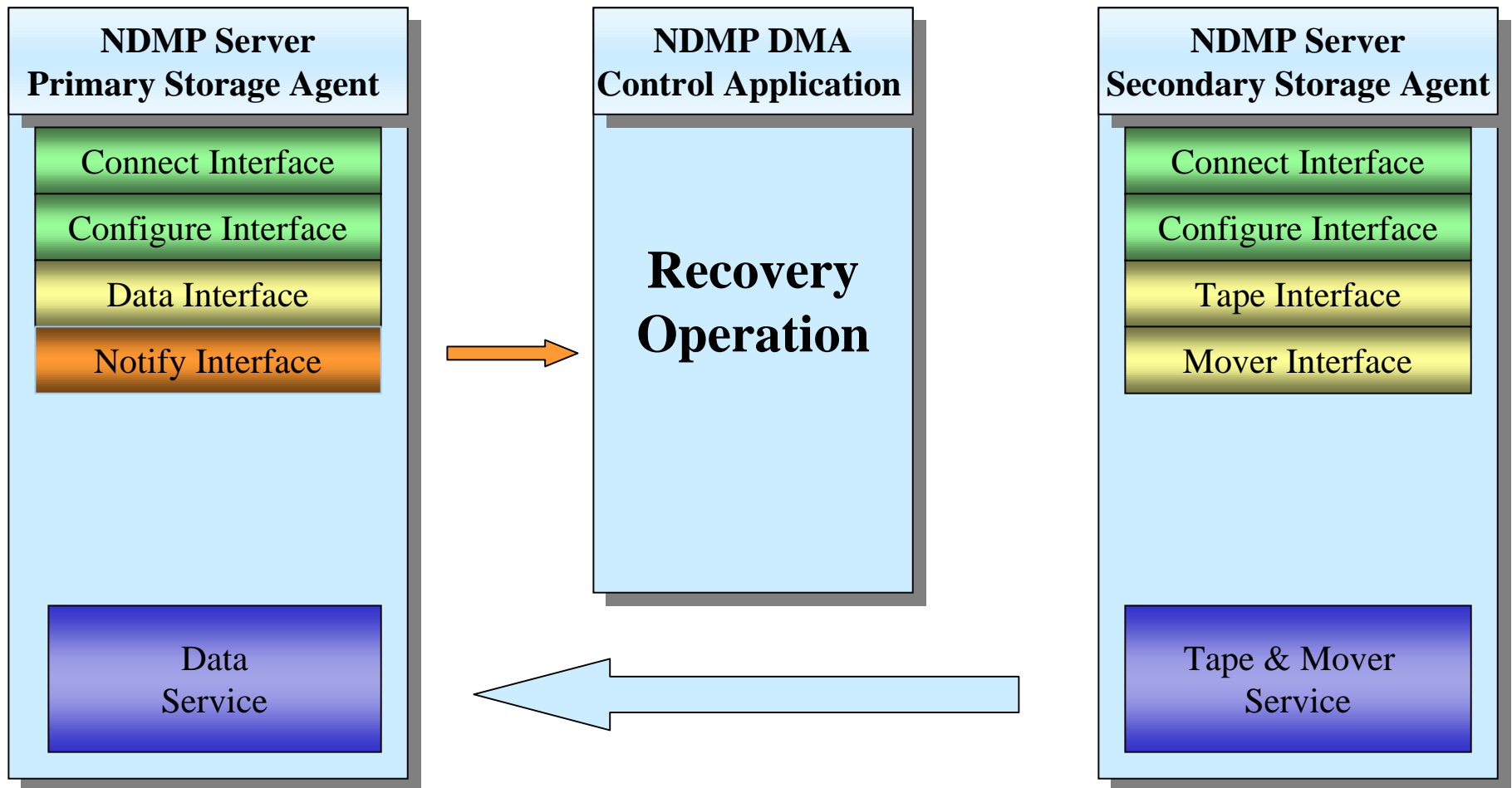


- **DMA creates a data connection connection between NDMP servers**
  - The mover connects to the specified IP address & TCP port

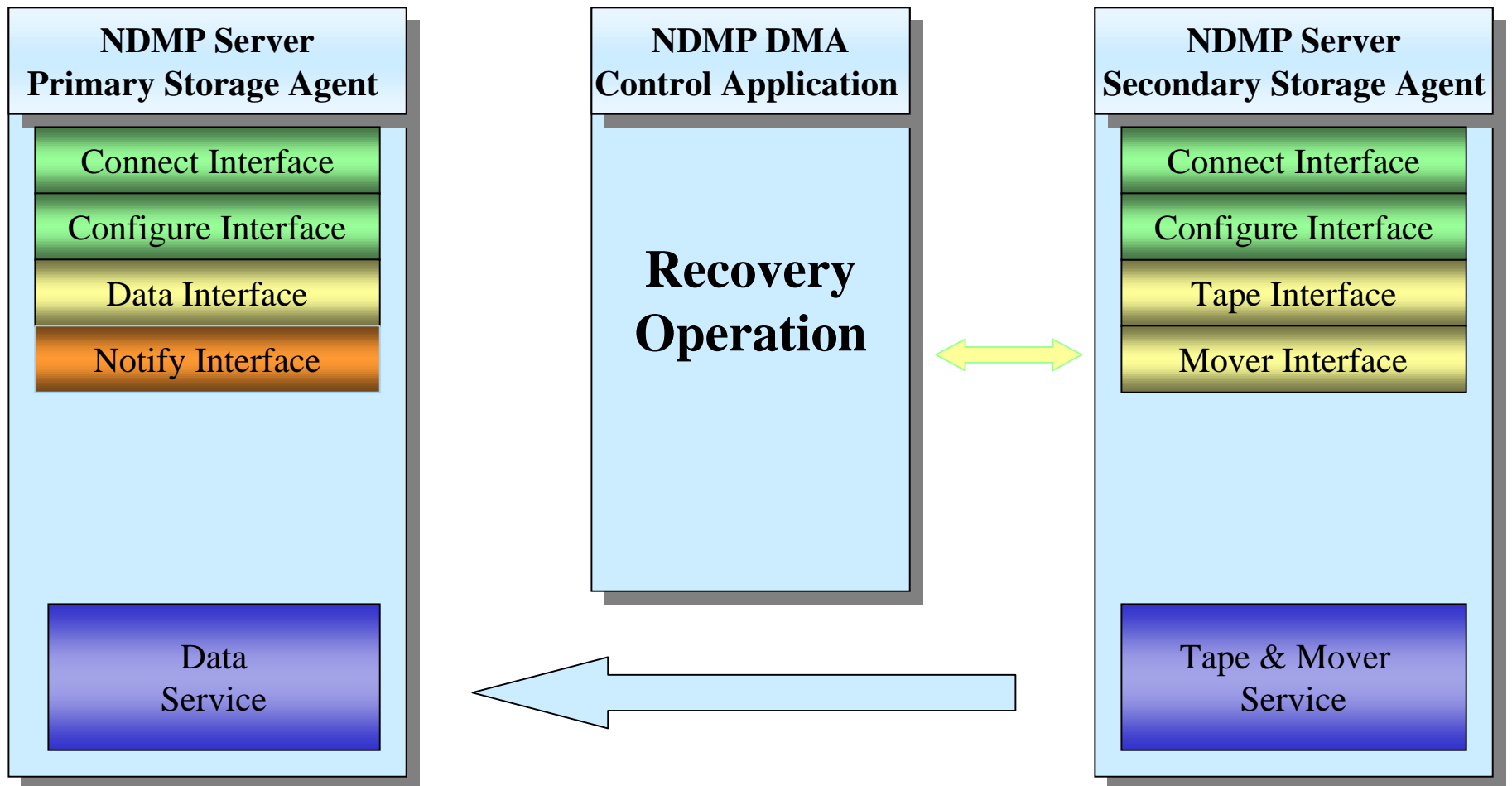


- **DMA instructs the data server to initiate the recovery operation**
  - `NDMP_DATA_START_RECOVER`

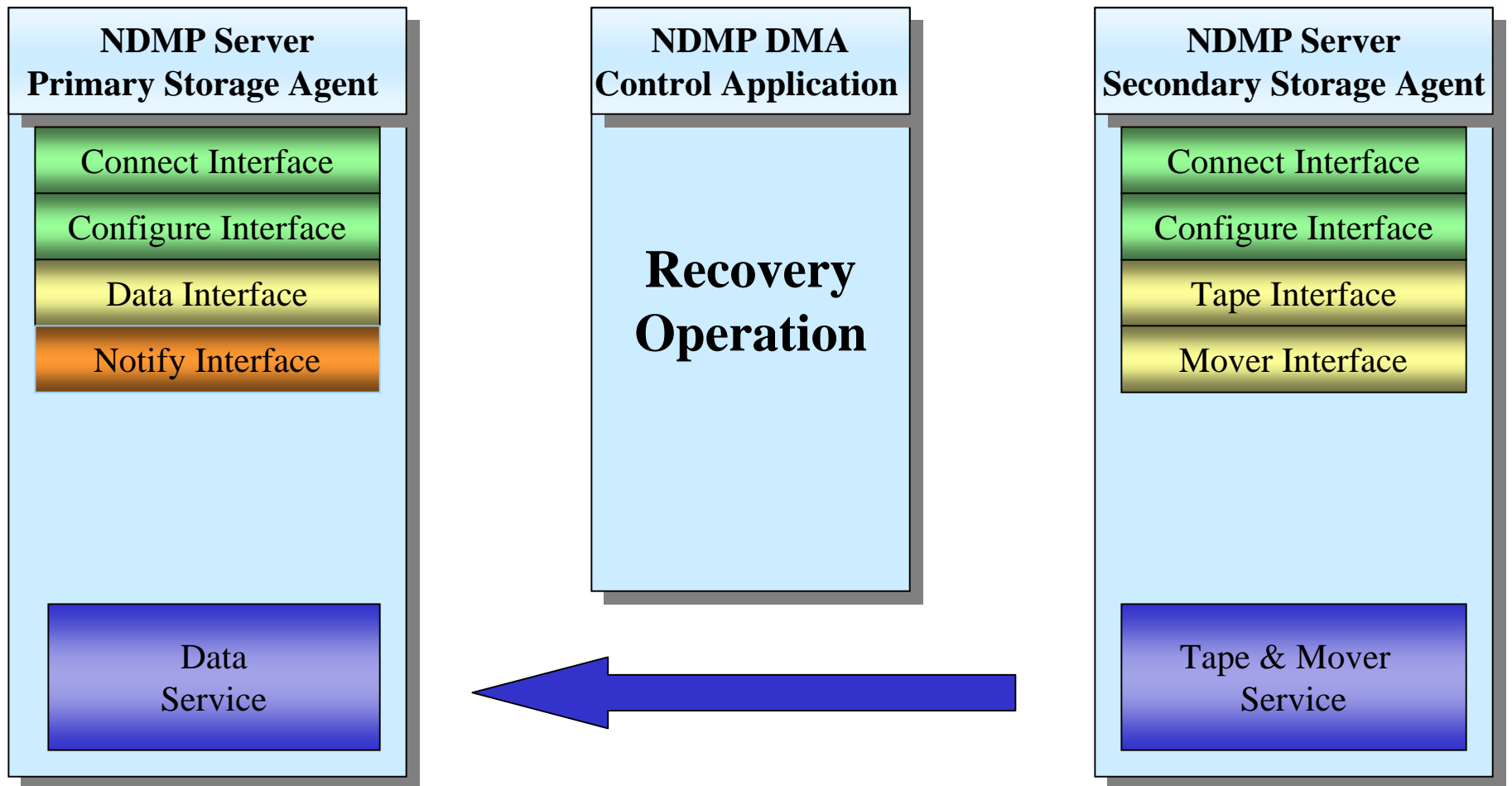




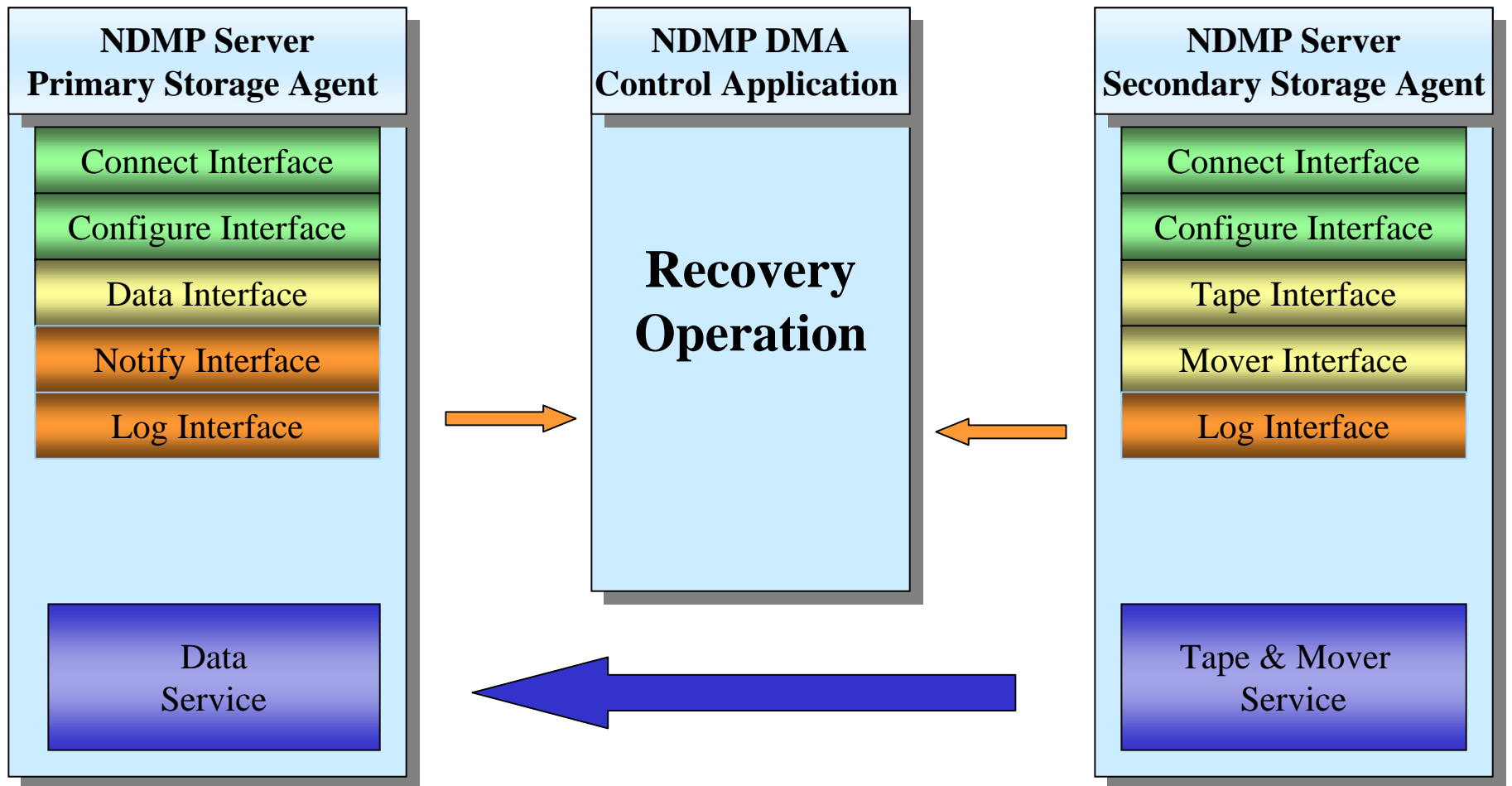
- **DMA recovery request is processed**
  - Data service determines the offset & length of the DMA specified recovery data
  - Data server requests the specified data stream be transferred
  - NDMP\_NOTIFY\_DATA\_READ



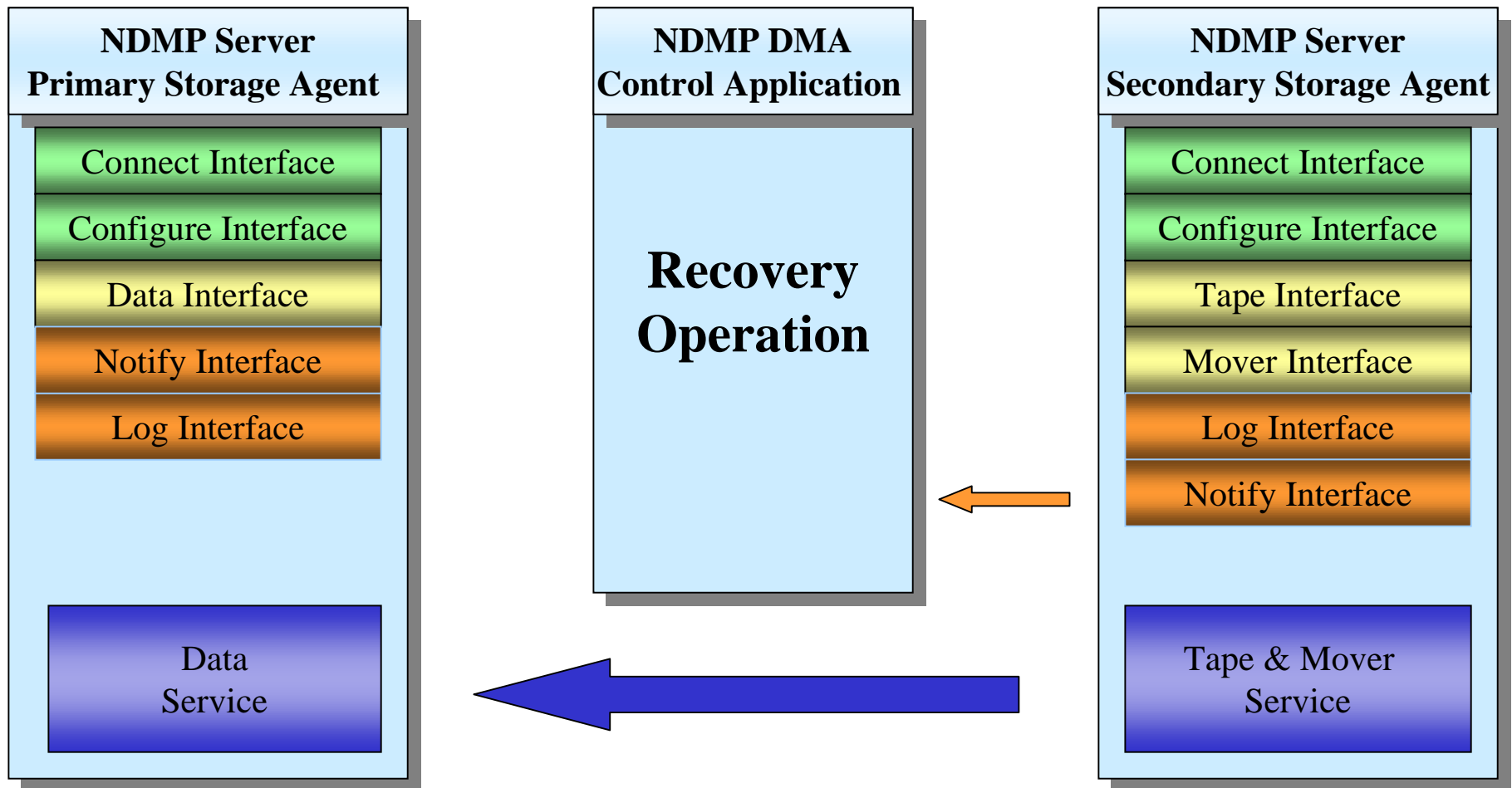
- **DMA instructs the mover to transfer the specified recovery stream**
  - NDMP\_MOVER\_READ
  - the mover interacts with the tape service to access the recovery stream



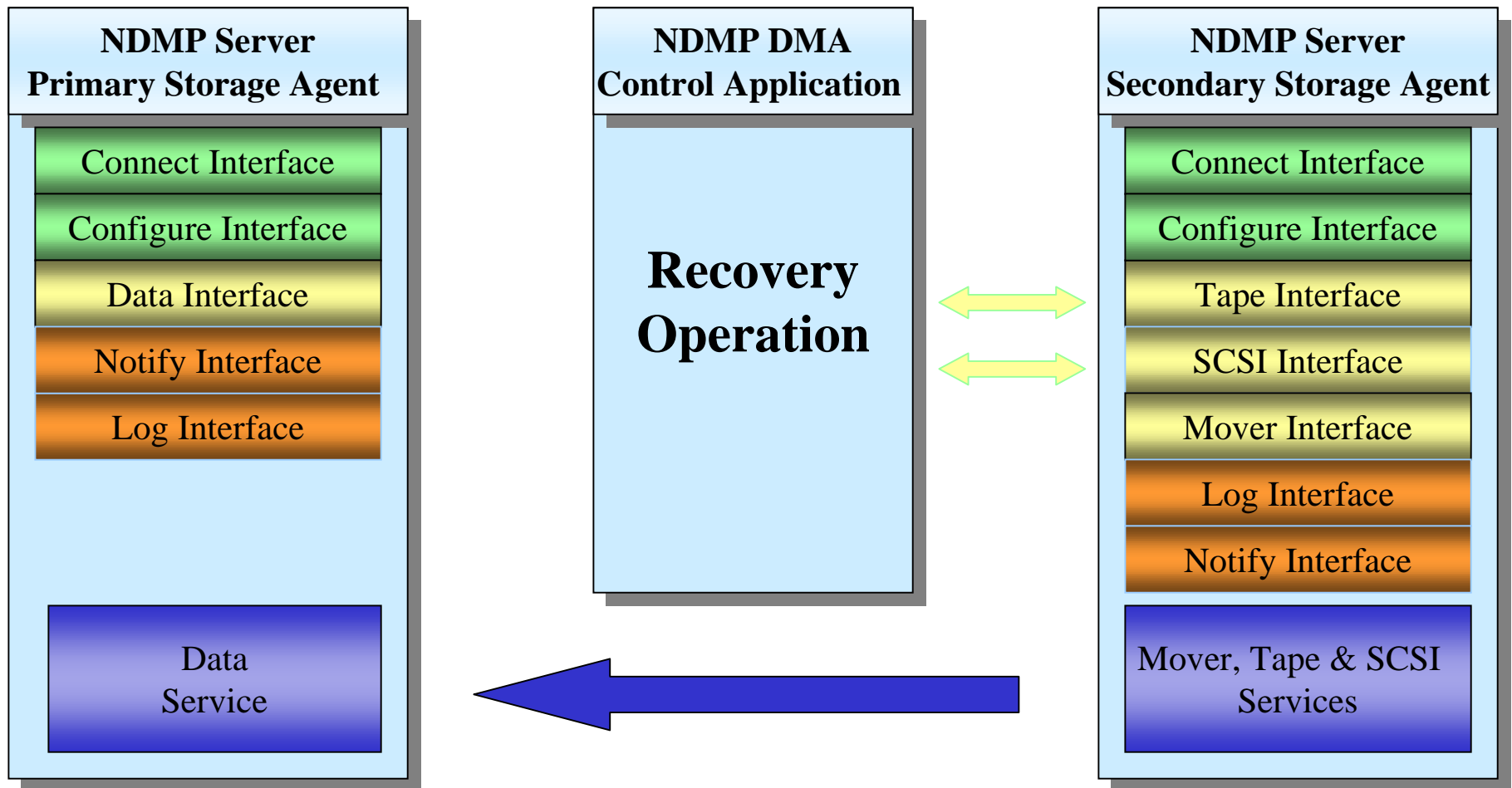
- **DMA instructs the mover to transfer the specified recovery stream**
  - The mover begins sending recovery stream over data connection



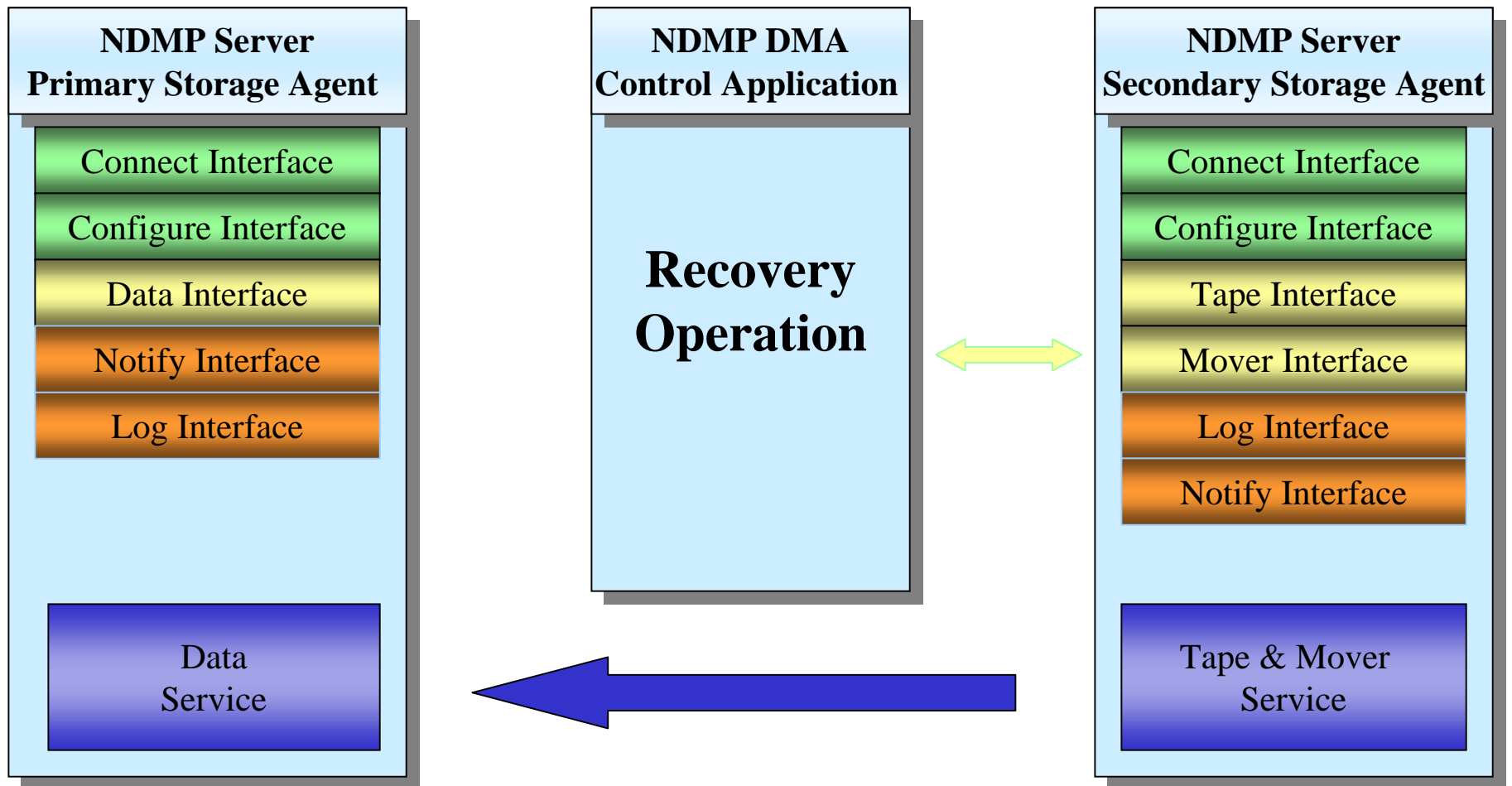
- **NDMP Data & Tape services send periodic log messages to DMA**
  - `NDMP_LOG_MESSAGE`



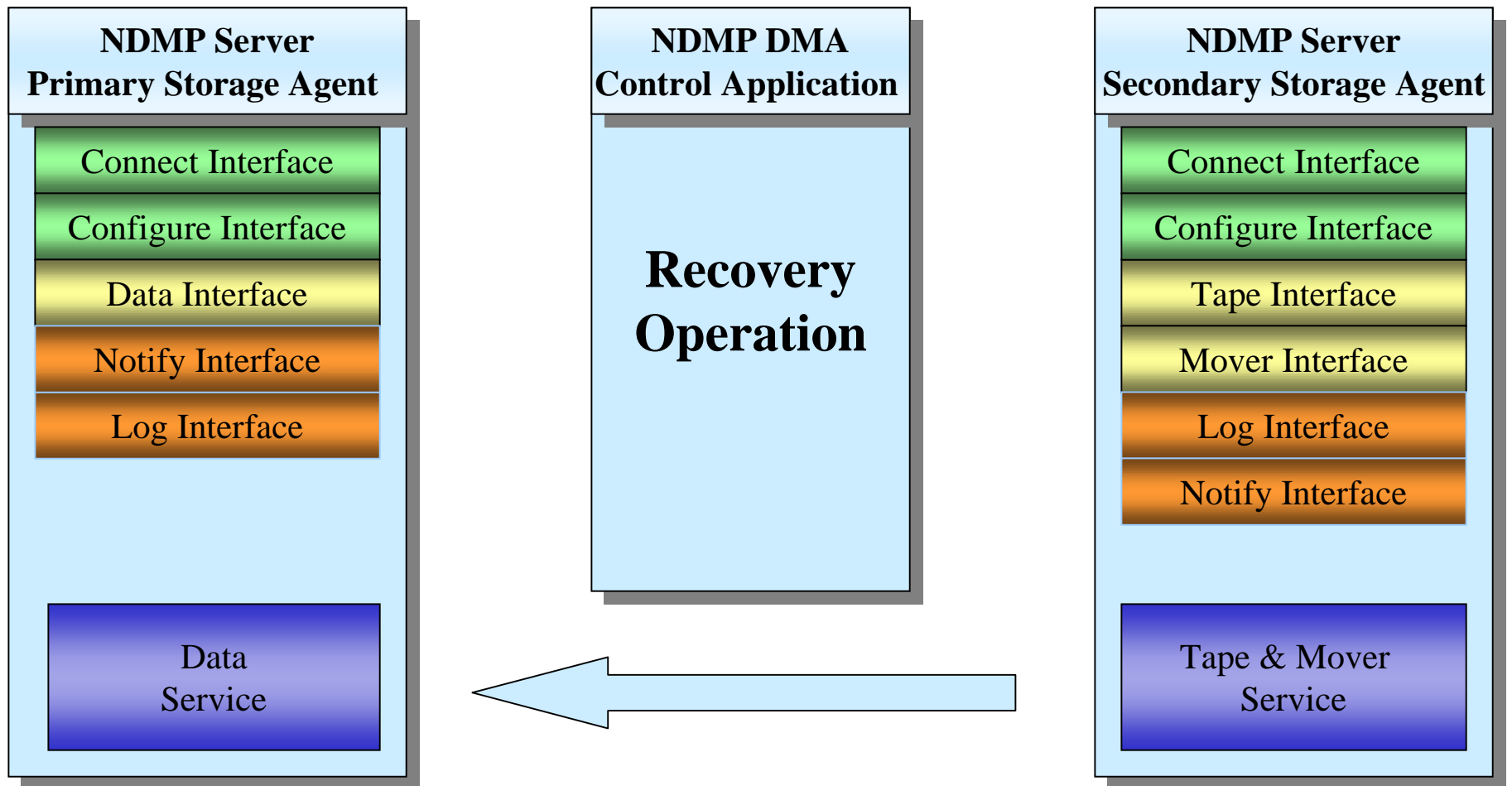
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  - example: end of mover window or tape medium encountered
  - NDMP\_NOTIFY\_MOVER\_PAUSED



- **DMA initiates tape swap possibly utilizing media changer support**
  - NDMP\_TAPE\_MTIO - to rewind/unload tape
  - NDMP\_SCSI\_EXECUTE\_CDB - to manipulate media changer
  - NDMP\_TAPE\_MTIO - to position new tape
  - NDMP\_TAPE\_READ - to validate new tape header

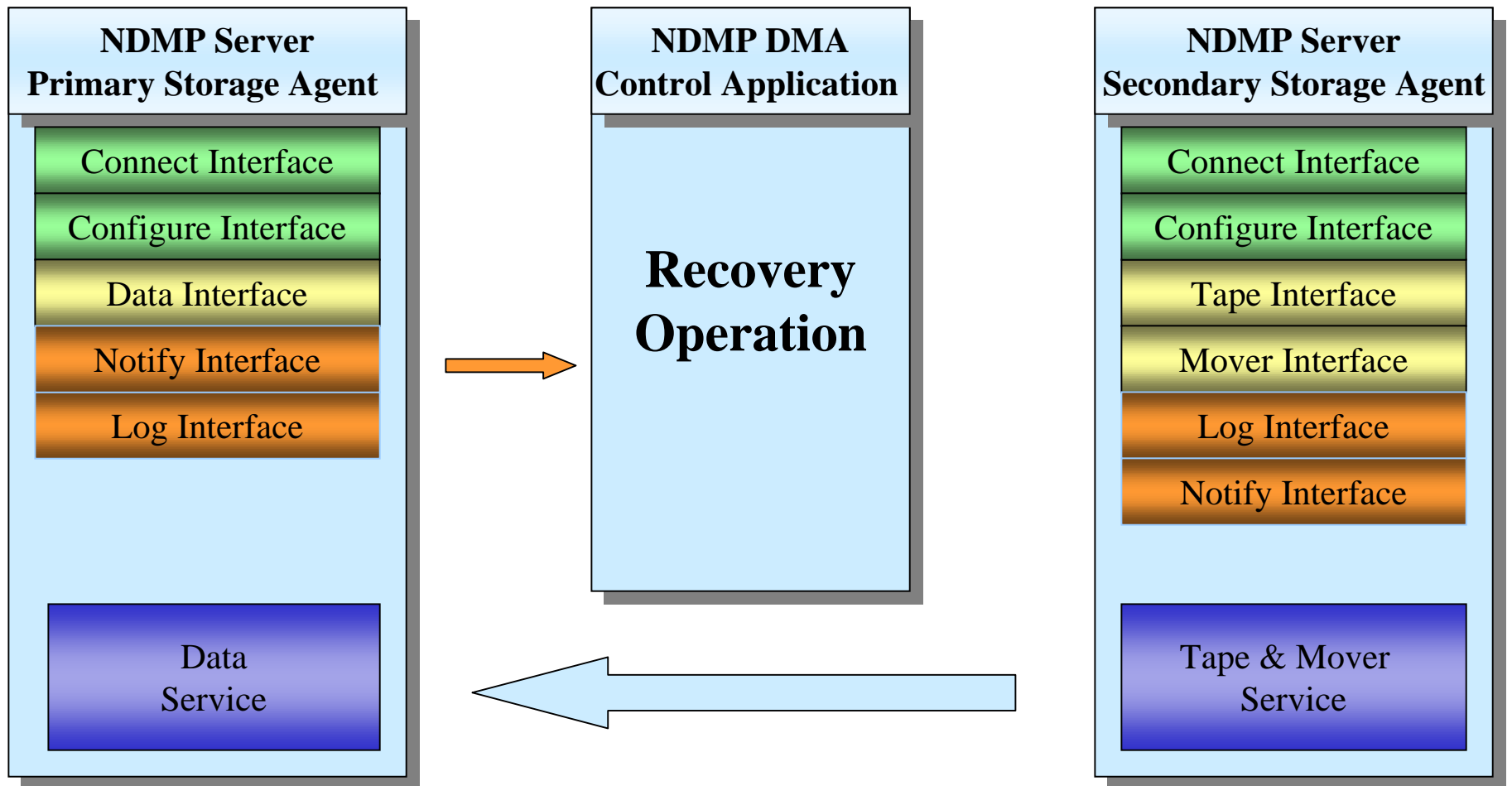


- **DMA prepares the mover to continue the recovery operation**
  - NDMP\_MOVER\_SET\_WINDOW
  - NDMP\_MOVER\_CONTINUE

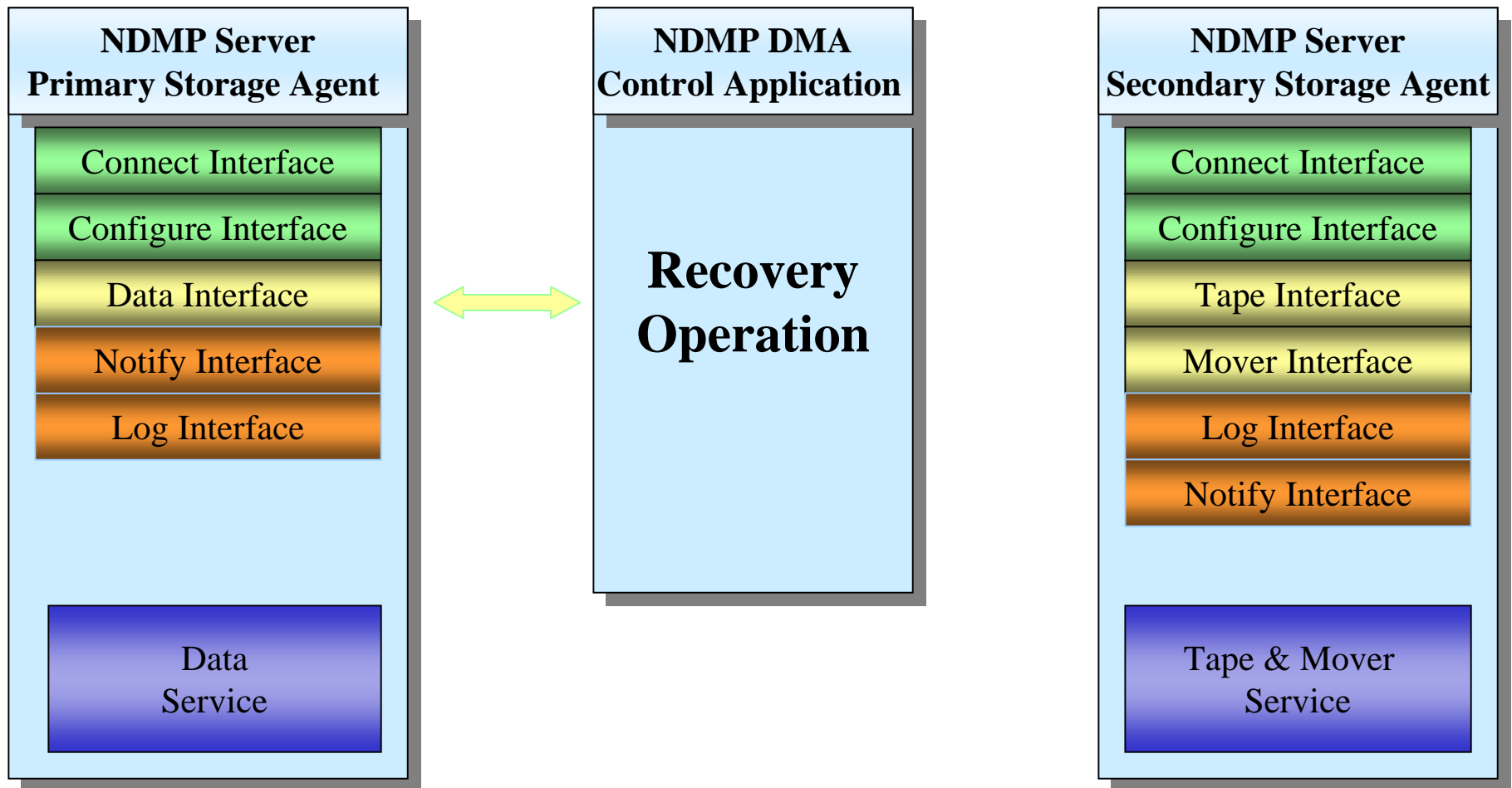


- **Data server detects end of recovery operation**

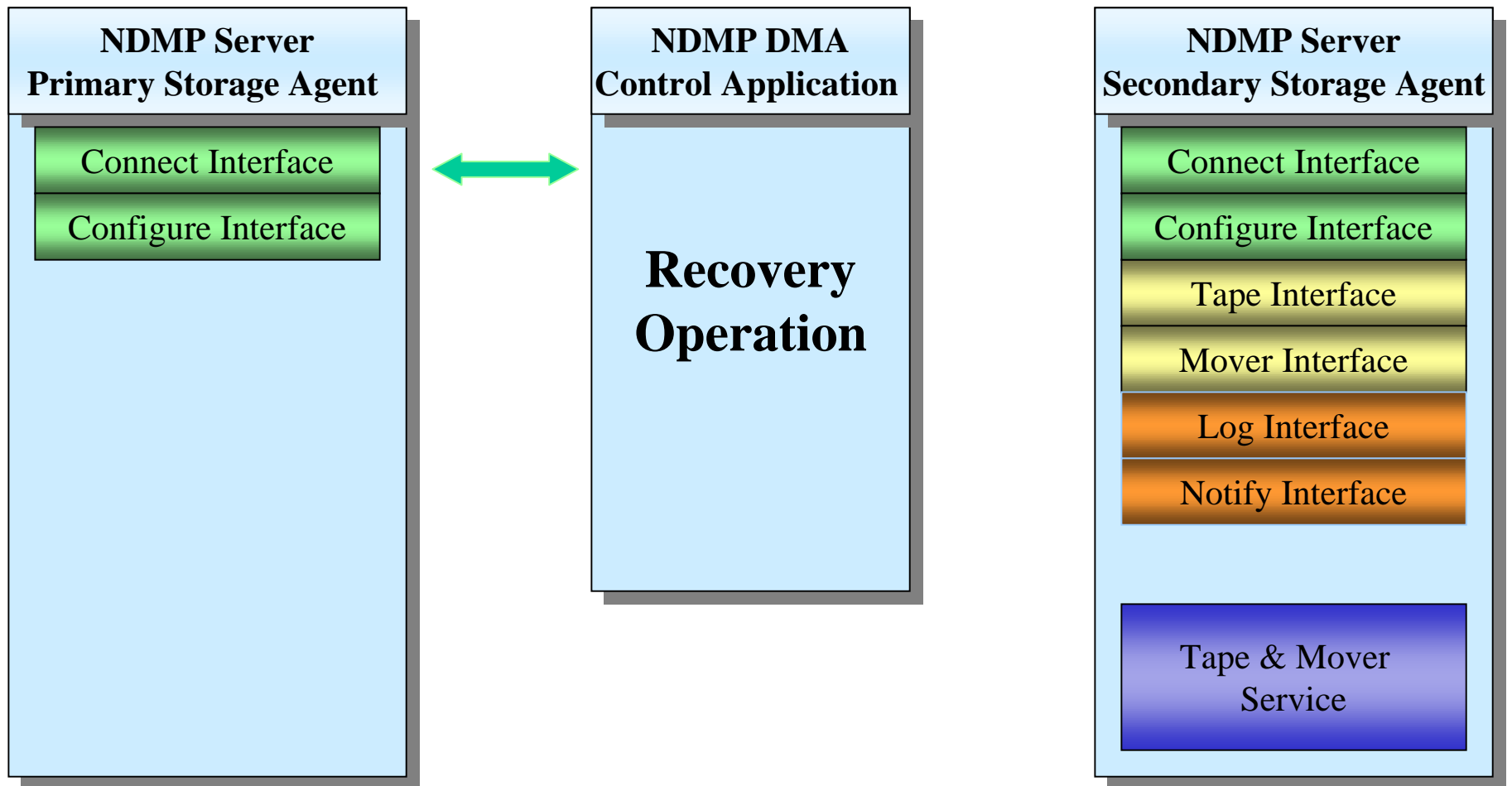




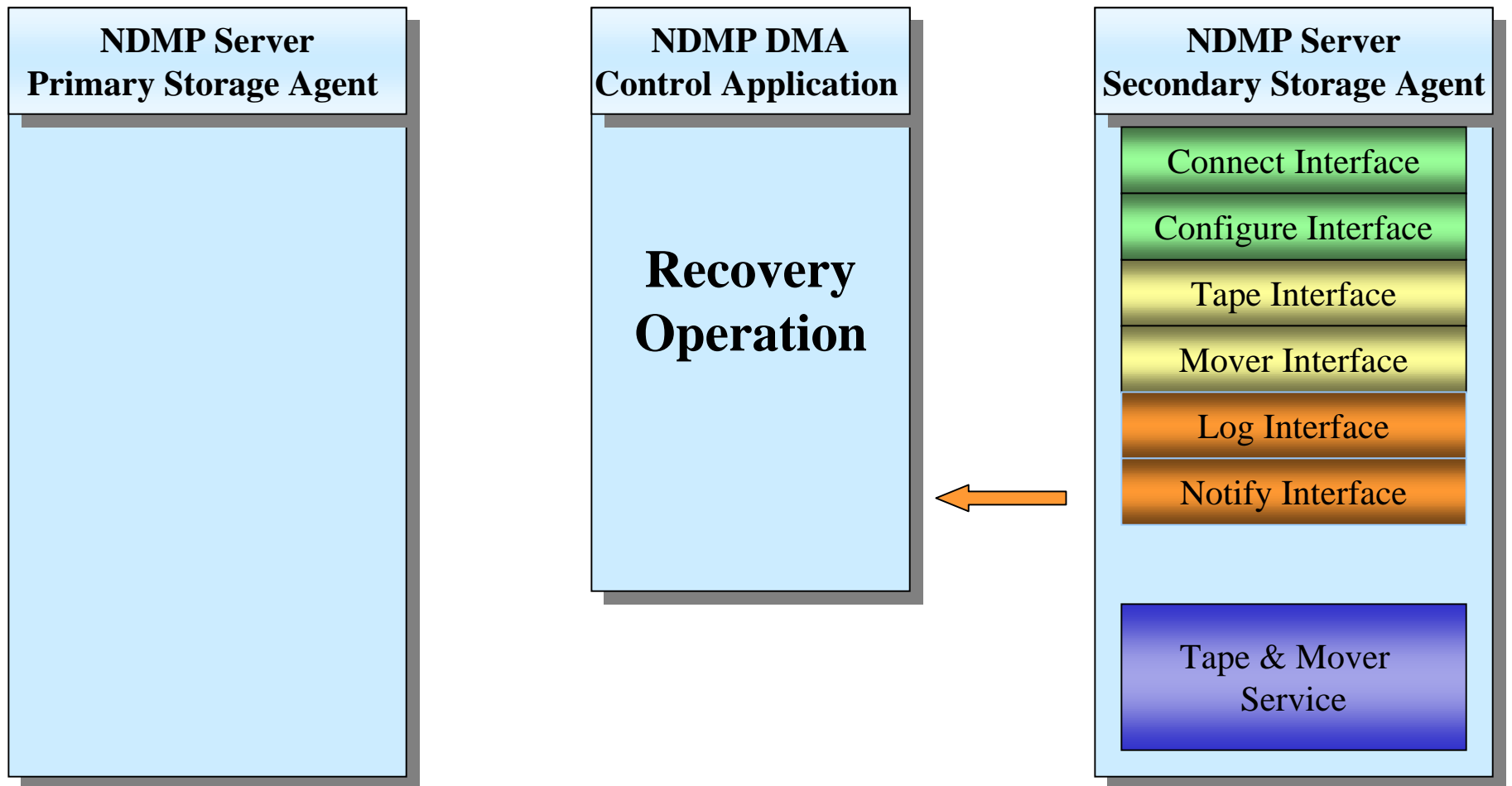
- **Data server notifies DMA of completed recovery**
  - NDMP\_NOTIFY\_DATA\_HALTED
  - data server closes data connection to secondary storage agent



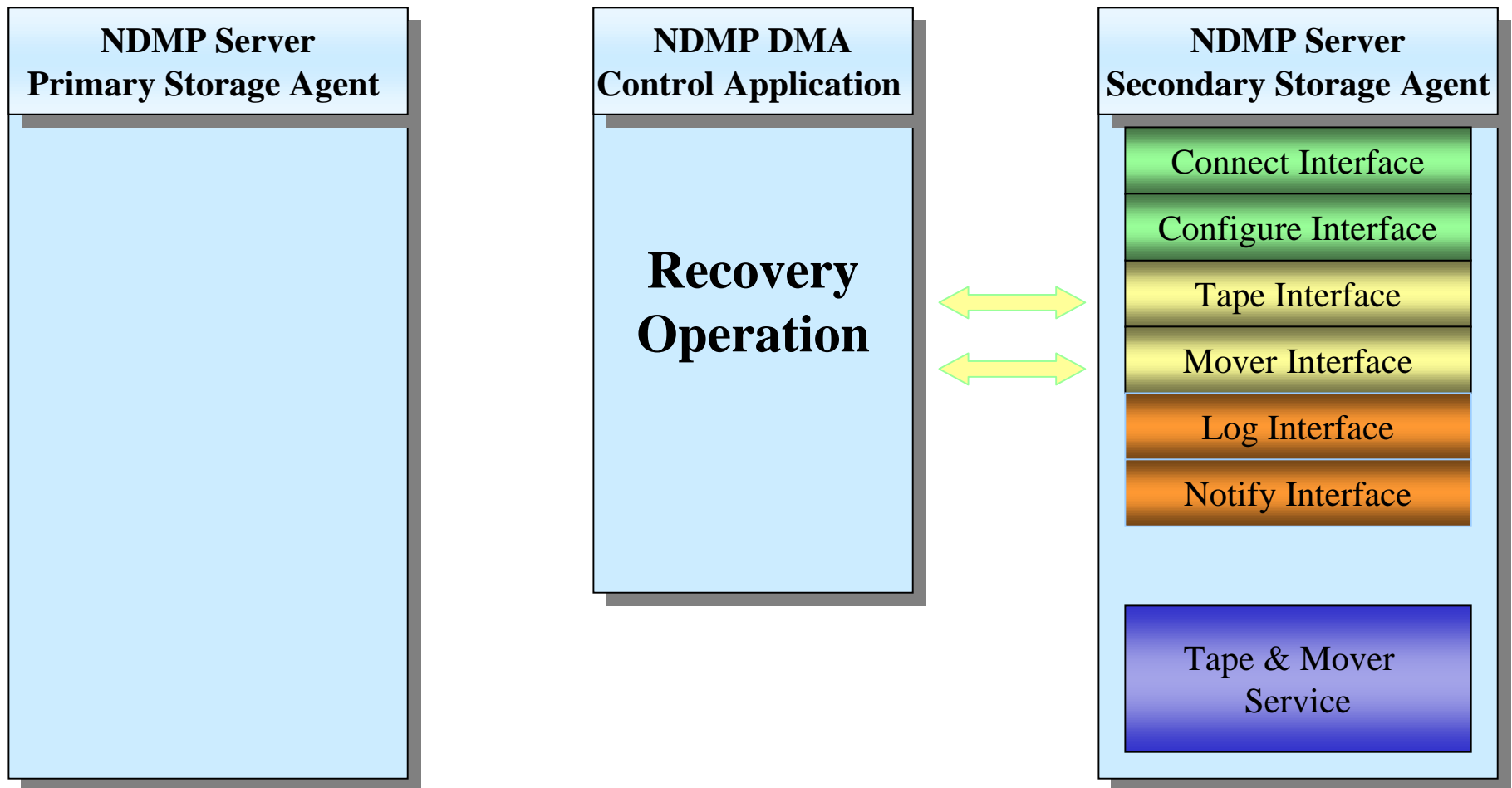
- **DMA completes post processing with primary storage agent**
  - NDMP\_DATA\_GET\_STATE
  - NDMP\_DATA\_STOP



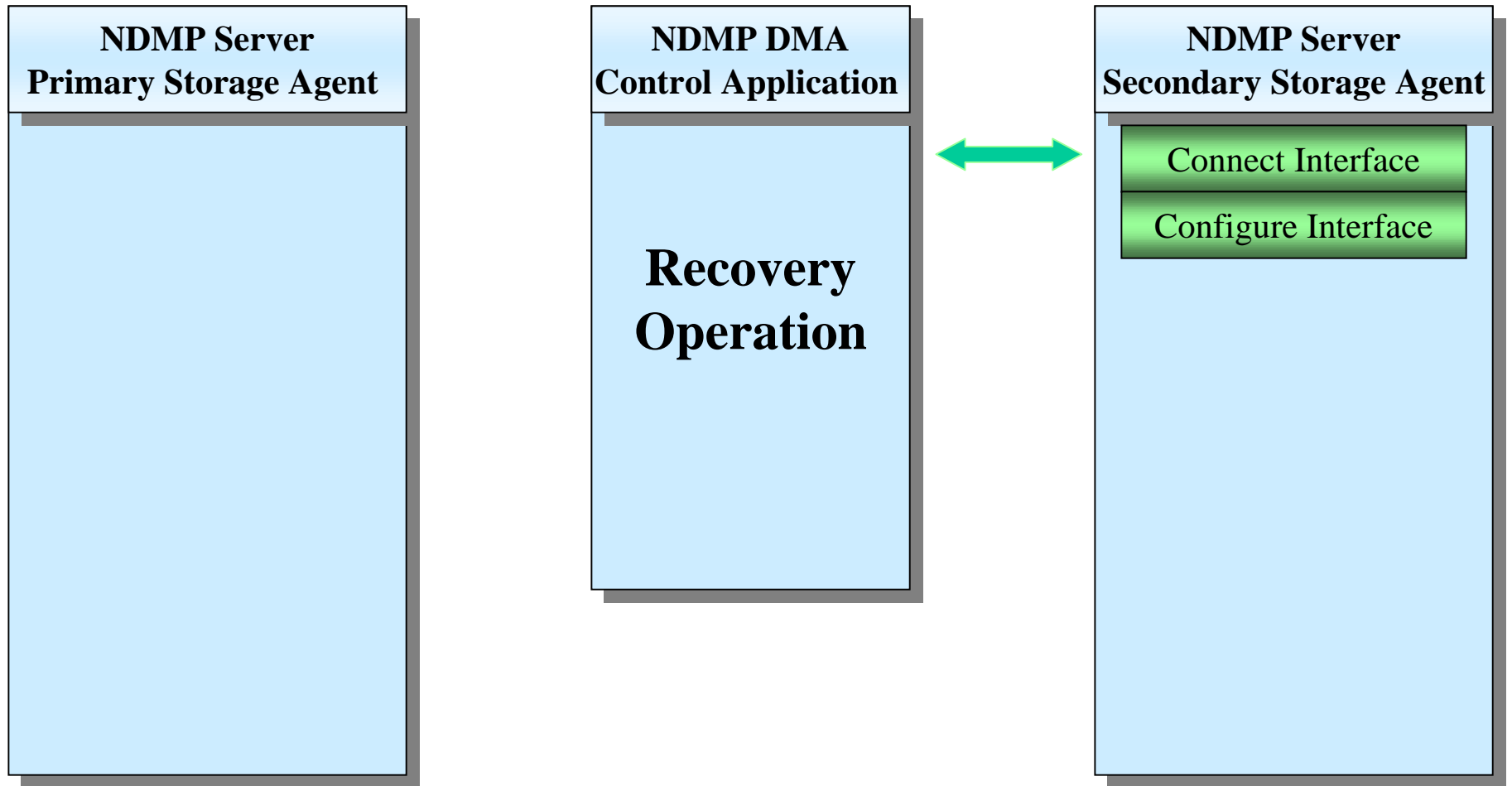
- **DMA completes post processing with primary storage agent**
  - `NDMP_CONNECT_CLOSE`



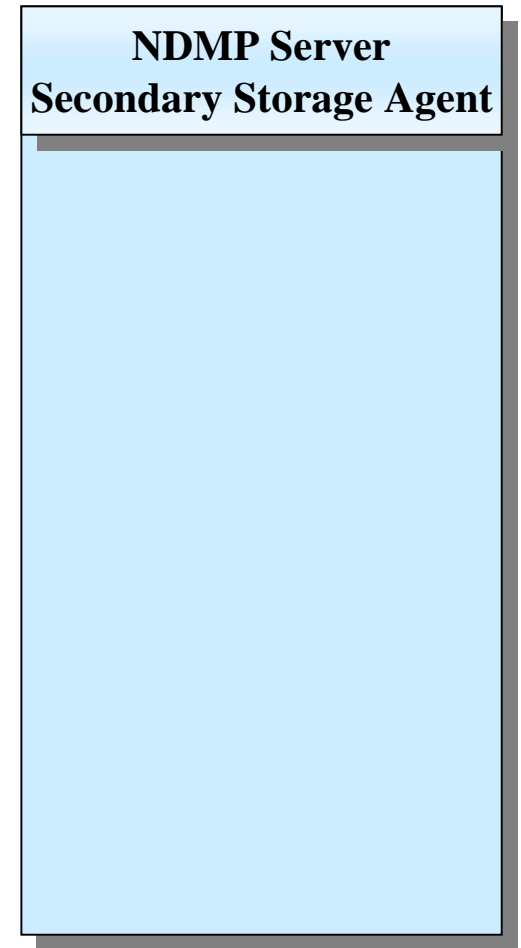
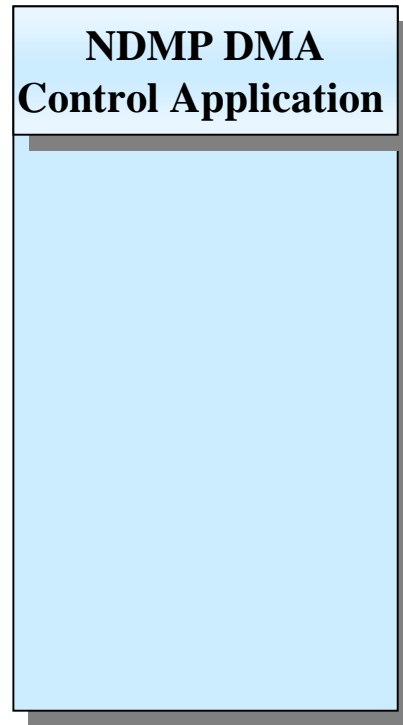
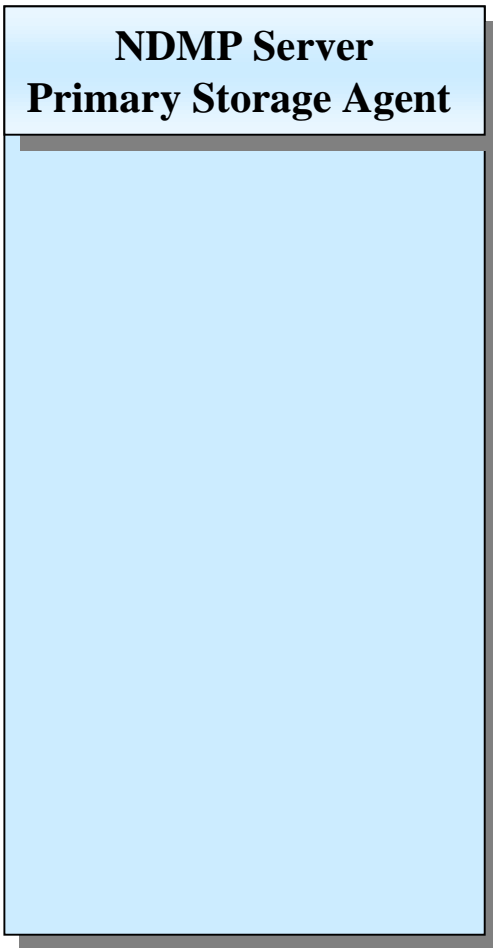
- **Secondary storage agent detects data connection closure**
  - pad and output last mover record to tape device
  - NDMP\_NOTIFY\_MOVER\_HALTED

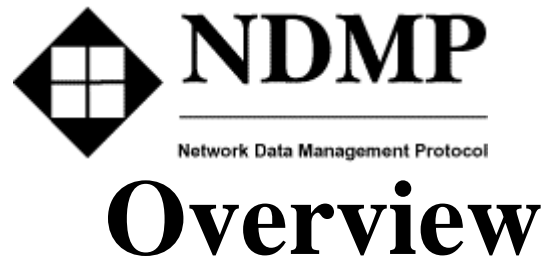


- **DMA completes post processing with secondary agent**
  - NDMP\_MOVER\_GET\_STATE
  - NDMP\_MOVER\_STOP
  - NDMP\_TAPE\_CLOSE



- **DMA completes post processing with secondary agent**
  - `NDMP_CONNECT_CLOSE`





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**March 5, 2001**