GMT Concepts and Theory

C. Peter Lotz

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- GMT Is Simple Because It Consists of Three Fundamental Components

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  - Requesters

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  - Requesters
  - Distributors

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- GMT Is Simple Because It Consists of Three Fundamental Components
  - Requesters
  - Distributors
  - GMT Lists

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- Matter Is Simple Because It Consists of Three Fundamental Components

- Matter Is Simple Because It Consists of Three Fundamental Components
  - Electrons

- Matter Is Simple Because It Consists of Three Fundamental Components
  - Electrons
  - Protons

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- Matter Is Simple Because It Consists of Three Fundamental Components
  - Electrons
  - Protons
  - Neutrons

Therefore

– Understanding GMT Is Simple

In the Same Way That

– Understanding Sub-Atomic Particle Physics Is Simple

So…

Let’s Look at These Little Buggers

Requesters

- Are Assigned to a Transmission List
  - Should Be Higher Channel Than Other Devices
- Can Be Associated With a Device
  - This Is the Disk Decoder Assigned to the List
    - If the Air and Protect Devices Have Separate Storage, A Requester Is Required for Each
  - Allows Re-Request of Deleted Material
    - Only One Device Can Be Associated With a Requester
    - A Requester Can Be Associated With Two Devices
  - On a Push List There May Be No Other Devices Assigned To The List

- Filter Requests
  - Same Parameters As Disk's Record Qualifiers
    - SOM Filtering for Baseband Filtering is Available
    - Multiple Requesters May Be Used to Make Requests for Different Types of Events
- Set Request Status on Transmission List
  - Outstanding Requests Are 'Requested'
  - 'Failed' Indicates Request Returned
    - Returned requests can be configured to be re-requested
  - There Is No 'Successful' Status
    - Event will typically be registered by destination disk

Requesters

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- Pass the Transmission List Event Information
  - Time Can Be the Time The Request Is Issued by the Requester or the List Time Of Day
    - Weighting Can Be Used to Delay Apparent Time
  - Data Is Taken From the List, Not the Database
    - Since GMT Operates Within the Device Server, There Is No Database Access
      - ID
      - Segment
      - SOM
      - Tape ID

Requesters

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- Maintain Collection of Pending Requests
  - Collection Size Displayed in ID Field of Device Status Window
  - Items Removed When Returned by Distributor
  - Collection Can Be Cleared Manually
- Eliminate Duplicate Requests
  - Uses Both ID and Segment
  - No Request Is Made If Event Matches Entry in Collection
- Can ‘Throttle’ rate of requests

Requesters

- Define Destination for Transfers
  - Encoder Port of Disk
  - Fibre Handle of Disk
    - Archive Transfer Destinations Defined by Distributor
  - FTP Handle
  - Multi-Requesters Define Multiple Destinations
    - Not Used With Air / Protect
  - Request Includes Destination Information
    - Device Server
    - Device Channel
    - Fibre Handle
    - FTP Handle

Requesters

- Point to a Specific Distributor
- Can Make Requests for Multiple Transfer Modes
  - Baseband
  - Fibre
  - Archive
- Can Register and Play Events
  - Used on Push Lists
    - Registers Events After Successful Transfer
    - Plays Events to Generate As-Run

Distributors

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- Are Assigned to a GMT List
- Support Only One Transfer Mode
  - Baseband
  - Fibre
  - Archive
- The First Distributor to Receive a Request ‘Stamps’ the Request As Entry Point
  - Used in Ring Configurations
  - If a Request Returns to the Entry Distributor, It Is Returned to the Requester As ‘Failed’
    - ‘Next Ring’ Allows Forwarding to an Alternate Path

Distributors

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- Build Collection of Unprocessed Requests
  - There Is No Available View of Distributor Collections
  - There Is No Way To Clear
- Process One Request at a Time at a Given Rate
  - This is the ‘Integration Time’
  - Baseband Distributors Process One Request Every Five Seconds
  - Fibre and Archive Events Process One Event Every Two Second

Distributors

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- Combine Multiple Requests For Same ID segment to Different Destinations
  - Baseband Distributors Only
  - Integration Of That Distributor's Unprocessed Requests Only
- Eliminate Duplicate Requests For an ID/Segment To A Destination
  - Only That Distributor's Unprocessed Requests Are Checked
    - Eliminated Requests Are Returned to Requester As 'Failed'

Distributors

- Allow Configuration of ID Modify / Segment Search Path
  - Complements and must be compatible with Disk configurations
  - May allow requests to be steered to different sources
    - Content Server
    - Live Ingest
    - AI

- Define Source Device
  - Baseband Devices Must Be on the Same Device Server
  - Disk Objects, for Fibre Transfers, Archive Objects, and Proxy FTP Objects Can Be on Another Device Server
  - Define Fibre Handle of Fibre Source
    - Archive Distributors Can Define Destination Fibre Handle

Distributors

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- Query Destination Disk or FTP Object
  - If ID segment Is Present, Request Is Returned to Requester
  - A ID Status Query Is Sent Via the Disk Object, Rather Than Checking the Device Collection
- Query Source Device for Availability
  - For Disks, Directly Query ID Status

- If ID Segment Is Not Available
  - If ‘Wait for Missing Media’ Is Enabled, Event Is Built Regardless
  - If a ‘Next Distributor’ Is Configured, Request Is Forwarded to It
  - Otherwise, the Request Is Returned to the Requester As ‘Failed’

Distributors

- Build Events on GMT List
  - Fibre, Archive, and FTP Events Are Single Events Containing a Transfer Command in the Title Field
    - Source and Destination Are Defined When Event Is Built
    - Media Client List Update Will Not Overwrite Title
  - Fibre, Archive, and FTP Events Are Registered and Run by a Distributor

- Build Events on GMT List
  - Baseband Transfers Consist of a Primary Event to Play Back From the Source and One or More Secondary Events to Record Into the Destination(s)
    - All Of the Events Have the Same Information
    - Recording Is Via a Secondary A/V Event With a Type of ‘R’
  - Baseband Events Are Registered and Run By Media Devices Assigned to the GMT List

- Build Events on GMT List
  - Baseband Playback Events Are Built Unregistered
  - Baseband Record Events Are Built Registered to an Encoder
    - If Multiple Requests Have Been Integrated, Multiple Record Events, One Registered to Each Encoder, Will Be Attached to a Single Playback Event

- Build Events on GMT List
  - Duration of Fibre and Archive Events Is Non-Deterministic
    - For Requests Less That 2 Minutes, GMT Event Duration Will Be Request Duration + 10 Minutes
    - For Requests Greater That 2 Minutes, GMT Event Duration Will Be Equal to Request Duration
  - Baseband Event Durations Are Equal to Requests' Duration
    - Must Be Automatically Updated by Media Client

Distributors

- Build Events on GMT List
  - All Other Information From The Transmission List Event Is Copied
    - ID
    - Segment
    - SOM
    - Tape ID
  - Only Used By Baseband Events
- GMT Event Contains the Identity of the Distributor That Created It

Distributors

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- Once A Request Is Processed, It Is Deleted From the Distributor's Collection
  - This Takes Place In Almost All Cases
    - Returned As Failed
      - Returned to Entry Point
      - Duplicate
      - Unavailable
      - Present in Source

Distributors

- Once A Request Is Processed, It Is Deleted From the Distributor's Collection
  - This Takes Place In Almost All Cases
    - Passed to Another Distributor
      - Next Distributor
      - Next Ring
    - Event Built on GMT List
      - Found In Source
      - 'Wait for Missing Media' Is Enabled on a Baseband Distributor

- Once A Request Is Processed, It Is Not Deleted From the Distributor's Collection
  - If 'Wait For Missing Media' Is Enabled on a Fibre or Archive Distributor
    - The Request Is Retained in the Distributor's Collection, in a 'Wait State'
    - The Source Device Is Periodically Polled for Media Availability
      - Direct Queries to the Device

- Once A Request Is Processed, It Is Not Deleted From the Distributor's Collection
  - If 'Wait For Missing Media' Is Enabled on a Fibre or Archive Distributor
    - The Distributor Will Run the Event Only When the Media Becomes Available
      - The Event Will Be Unregistered Until The Source Device Replies To The Distributor That the Material Is Available
        - Other Distributors With the Same Source Will Not Register Events in Wait Mode
        - Baseband Devices May Erroneously Register Waiting Events

Distributors

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- When an Event Runs on the GMT List, It Is Again Added to the Distributor's Collection
  - Fibre and Archive Events Are Run by a Distributor
    - Any Distributor Assigned to the GMT List With the Same Source As the Distributor That Created the Event
  - Baseband Events Are Run by the Registered Devices, but the Distributor Monitors the Event
- When Event on GMT List Terminates, Request Is Returned to Requester
  - Message Indicates Success or Failure of Event
  - Request Is Deleted From Distributor's Collection

GMT Lists

- Are Non-Sequential, Non-timed Lists
  - List Automatically Threads and Runs
  - Events Can Run Out of Order
    - Cued Status of Event Causes It to Run
      - Distributor Validate Availability of Fibre and Archive Media
      - Lowest Registered Events Run First
        - Events May Be Manually Moved in List to Alter Priority
      - Both Source and Destination Must Be Cued for Baseband Events
  - Multiple Events Can Run Simultaneously

GMT Lists

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- Are Non-Sequential, Non-timed Lists
  - Event Time and Thus Ordering May Be Time of Request or Time Of Day of Original Transmission List Event, Depending On Requester's Configuration
  - Events Are Not Marked Missed Until Run
    - 'Orphans' Must Be Manually Deleted

GMT Lists

- Certain Devices Are Assigned
  - These Devices Must Be on the Same Device Server As the GMT List
  - Distributors
    - Multiple Distributors May Utilize a Single List
  - Baseband Devices
    - Source Devices
    - Destination Encoders

GMT Lists

- Certain Devices Are Not Assigned and May Be on a Different Device Server Than the GMT List
  - Source Devices for Fibre Moves
    - Any Port on the Source Disk Can Be Used
    - Port May Be Assigned and in Use by Another List
  - Archives
    - May Be Run on a Gateway Computer
      - This Eliminates the TCP/IP Stack on the Device Server
      - Gateway Does Not Require a V-Sync Card
      - Multi-Server Login, or a Client Logged Into the Gateway, Is Required to View Storage Window
  - FTP Proxy Object

- Events Register and Run Depending on Their Type
  - Fibre Events Utilize a Distributor
    - If Multiple Distributors With the Same Source Are Assigned
      - All of Them Can Run an Event Created by Any of Them
      - Multiple Events Can Run Simultaneously
        - Support of Multiple Simultaneous Transfers Is Vendor Specific and May Be Limited by Either the Source or the Destination

- Events Register and Run Depending on Their Type
  - Transfer Command Is Issued to Disk When Event Runs
    - Command Is Issued to the Destination Disk
      - The SGI Disk Will Require Commands to Be Sent to Source Disk
      - Profiles Can Have Commands Sent To Any Interconnected Profile
    - Disk May Buffer Commands
      - Transfer May Not Be Initiated When Event Begins

- Events Register and Run Depending on Their Type
  - The Destination Disk Is Queried
    - If the ID segment Is Present, the Event Is Now Marked Done
      - Previously the Event Would Be Marked ‘Missed’
    - This Allows Duplicated Requests To Be Effectively Eliminated
    - Under Certain Cases This Can Prevent The ReTransfer of Defective Clips

- Events Register and Run Depending on Their Type
  - There Is No Method for Determining the Transfer Rate of a Fibre Transfer
    - Multiple Distributors Allowing Multiple Simultaneous Transfers May Affect Transfer Rate
      - Rate May Be Affected by Other Factors
    - Transfer Status Queries Are Periodically Issued to Disk
      - If Transfer Is in Progress or Pending, Duration of Event Is Reset to Original Value
      - Certain Disk System Failures May Not Generate a Failure

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- Events Register and Run Depending on Their Type
  - When the Disk Indicates a Transfer Is Complete
    - The Duration Is Set to Zero
    - The Event Is Marked Done
  - If Event Runs Out Without a Transfer Complete
    - The Event Is Marked As Failed
  - If a Transfer Fails, the Partially Transferred File Is Deleted From the Destination
    - If the Failure Is Due to a Failure of the Destination Disk, Deletion Does Not Occur, and No Further Error Is Generated

- Events Register and Run Depending on Their Type
  - Archive Events Utilize a Distributor
    - As With Fibre Events, Multiple Distributors With the Same Source Can Be Assigned
    - If an Archive Contains Multiple Drives, at Least One Distributor Per Drive Should Be Available

- Events Register and Run Depending on Their Type
  - Transfer Command Is Issued to the Archive When the Event Runs
    - The Archive Will Cache Commands
      - Mounted Tapes Are Typically Reused If There Is a Cached Request for Another File on That Volume
      - If There Are No Pending Commands, the GMT Event Is Not Marked Complete Until the Tape Is Unmounted
        - Additional Distributors Can Increase Overall Throughput

- Events Register and Run Depending on Their Type
  - The Archive Will Return a Failure If the ID segment Exists in the Destination Disk
  - There Is No Method for Determining the Transfer Rate of an Archive Transfer
    - Transfer Status Queries Are Periodically Issued to the Avalon
      - If Transfer Is in Progress or Pending, Duration of Event Is Reset to Original Value

- Events Register and Run Depending on Their Type
  - When the Archive Indicates Transfer Is Complete
    - The Duration Is Set to Zero
    - The Event Is Marked Done
  - If Event Runs Out Without a Transfer Complete
    - The Event Is Marked As Failed
  - If a Transfer Fails, the Partially Transferred File Is Deleted From the Destination
    - If the Failure Is Due to a Failure of the Destination Disk, Deletion Does Not Occur, and No Further Error Is Generated

- Events Register and Run Depending on Their Type
  - Baseband Events Are Registered and Run by Assigned Media Devices
    - Record Events Can Only Be Run by the Requester's Destination Device Due to the Pre-Registration of the Event When Created

- Events Register and Run Depending on Their Type
  - Baseband Events Are Registered and Run by Assigned Media Devices
    - Any Baseband Device Assigned to a GMT List Can Register and Run a Playback Event
      - Same Registration Mechanism As Transmission Lists
      - Typically Each Source Device Has an Associated Distributor
        - A Multi-Stream Device Such As a Cart Machine Requires Only One Distributor
        - A Pool of Devices, Such As External VTRs, May Utilize a Single Distributor If 'Wait for Missing Media' Is Enabled
      - If Multiple Devices Contain Media When Events Are Created, Lowest Channel Device Containing Media Will Register Event

- Events Register and Run Depending on Their Type
  - Encoders Are Cued on the Lowest Event Number With a Cued Source Device
    - If an Encoder Hangs While Cuing, Transfer Can Occur With Remaining Devices
  - Events Are Marked ‘Done’ According to Normal Transmission List Behavior
    - Failure of Source Device Will Abort All Recordings
      - Partial Recordings Are Deleted
    - Failure of One of Multiple Recordings Will Not Terminate Playback or Other Recordings

GMT Lists

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- A Single GMT List Can Support Multiple Simultaneous Processes
  - Multiple GMT Lists May Be Required or Desirable
    - If Baseband Devices Are on Multiple Device Servers
    - To Separate Different Processes
      - Clearer Logging
      - Easier Management
    - To Allow Baseband Devices to Be Grouped
    - To Prevent Erroneous Registration of Waiting Events
    - To Control System Loading

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See,

Wasn’t That Simple!

GMT's Function

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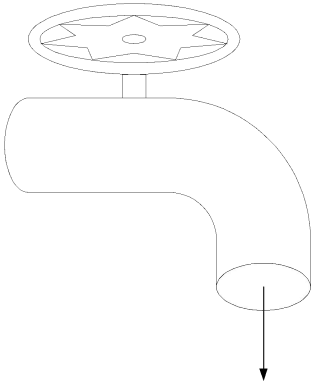
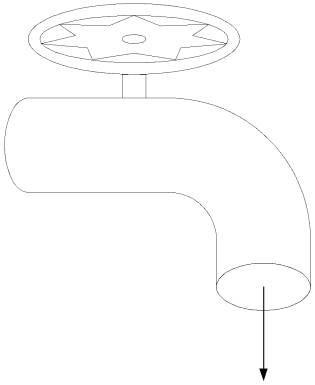
- GMT Is Demand Driven
  - It Operates Solely to Fulfill Requests
  - Success Is Measured by Responding to Requests
    - 'Transfer Does Not Have to Fulfill Actual Requirements of Operation to Be Be Successful
      - Too Late
      - Wrong Destination
      - Corrupt Transfer
  - It Is Dependant on the Proper Operation of Other Components

Requester Output



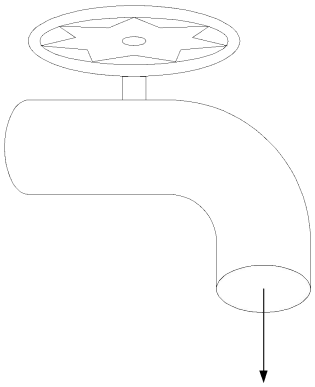
- A Requester Will Normally Generate Requests As Fast As Events Enter the Lookahead of the Transmission List to Which It Is Assigned and Pass Its Filtering
  - With an Event Based Lookahead, Requests Are Made One at a Time, at the Rate Events Run on the List
  - With Duration Based Lookahead, Requests Are Typically Made Several at a Time, but Overall at the Same Rate As List Events Run

Requester Output



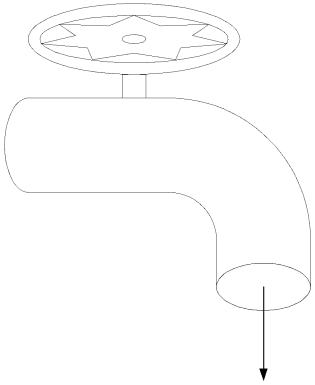
- A Requester Will Normally Generate Requests As Fast As Events Enter the Lookahead of the Transmission List to Which It Is Assigned and Pass Its Filtering
  - Setting the Request Sending Interval Can Throttle the Rate Of Requests
    - Under Certain Circumstances This May Be Needed to prevent Overflow Conditions
    - Too Large An Interval Can Interfere With Integration of Baseband Transfers

Requester Output



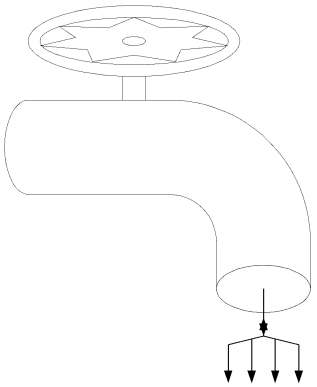
- When a Playlist Is Loaded or Appended, Multiple Requests Can Be Generated at Once If Events Are Loaded Into the Lookahead
  - This Occurs More Often in Testing and Installation Than Operation
- Toggling the Lookahead Will Typically Cause a Large Number of Requests to Be Generated
  - Removing Events From the Lookahead Has No Effect on Requests

Requester Output



- Inserting, Pasting, or Dropping Multiple Events Into the Lookahead Can Cause Multiple Requests to Be Made at Once
- Revising Events Will Not Generate Multiple Requests
- Replacing an ID Will Not Generate Multiple Requests

Multi-Requester Output

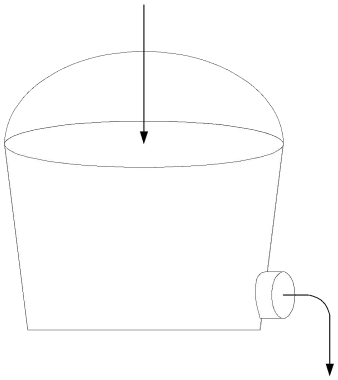


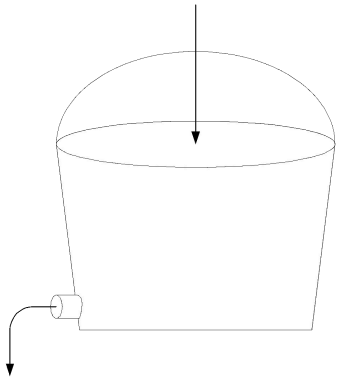
- Multi-Requesters Have All of the Behaviors of a Requesters
- Multiple Requests Are Made for Each Transmission List Event
  - A Single Set of Filters Controls All Requests
  - Each Request Has a Different Destination
  - Each Request Is Represented Separately In the Requester's Collection

Air / Protect Requests

- A Distributor Fed by Requesters Associated With a Transmission List's Air and Protect Disks Will Receive Two Simultaneous Requests If Material Is Missing From Both Disks
  - If the Material Is Missing From Only One of the Disks, Air or Protect, Only One Request Will Be Issued
  - If GMT Is Configured to Request Material From the Alternate Disk, There Is No Scenario Where Both Disks Will Transfer a Clip From the Other

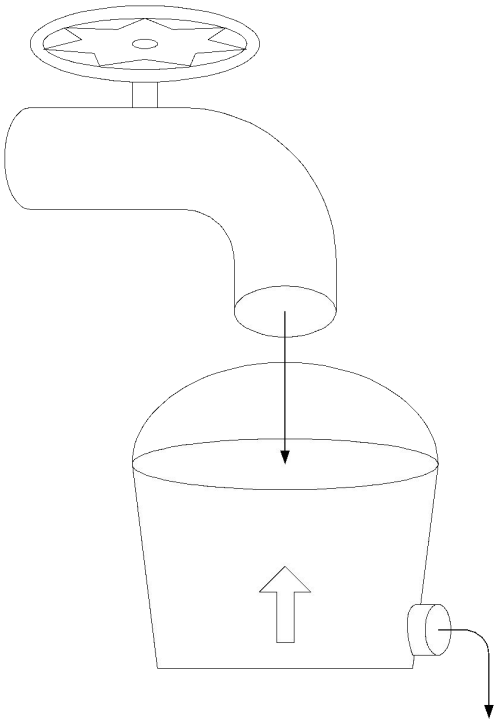
Distributor Throughput





- Regardless of the Rate at Which They Receive Requests, Distributors Always Process and Pass Requests at a Given Rate
  - Fibre and Archive Distributors Process One Request Every Two Seconds
  - Baseband Distributors Process One Request Every Five Seconds

Distributor Collection



- If a Requester Generates Requests Faster Than the Distributor to Which It Points Processes Them, Requests Accumulate in the Distributor's Collection
  - The Distributor Only Eliminates Duplicates Among the Unprocessed Requests in Its Collection
  - Only a Baseband Distributor Will Integrate Events, and Only Those in Its Collection

Distributor Collection

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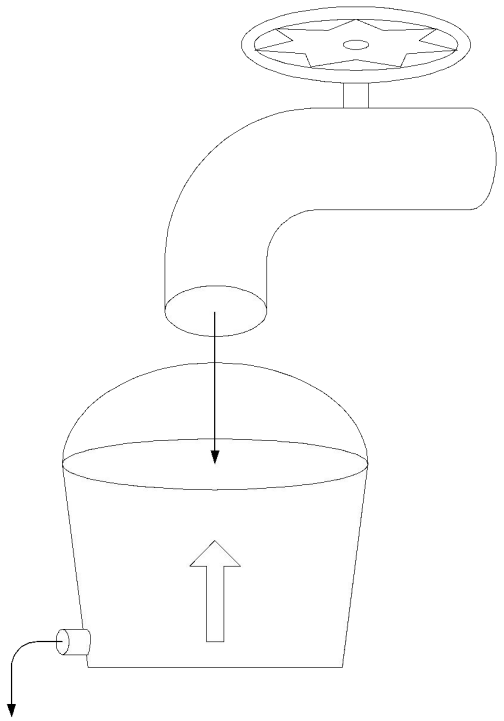
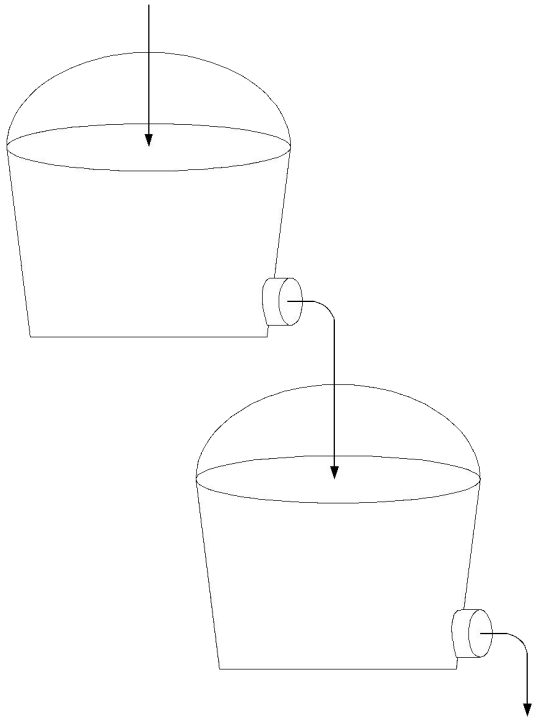
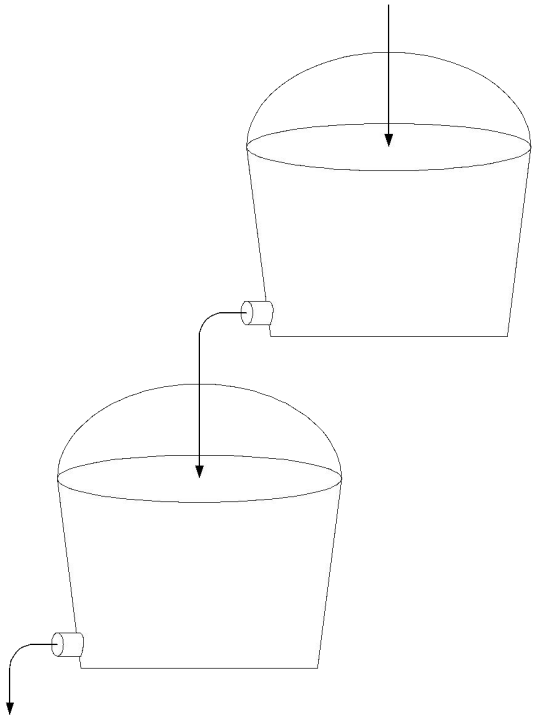
- If Excessive Requests Accumulate in a Distributor's Collection, an Overflow Occurs
- Each Distributor Maintains a Separate Collection
  - Duplicate Elimination and Integration Occur Only Among Events in a Single Distributor's Collection



Next Distributor

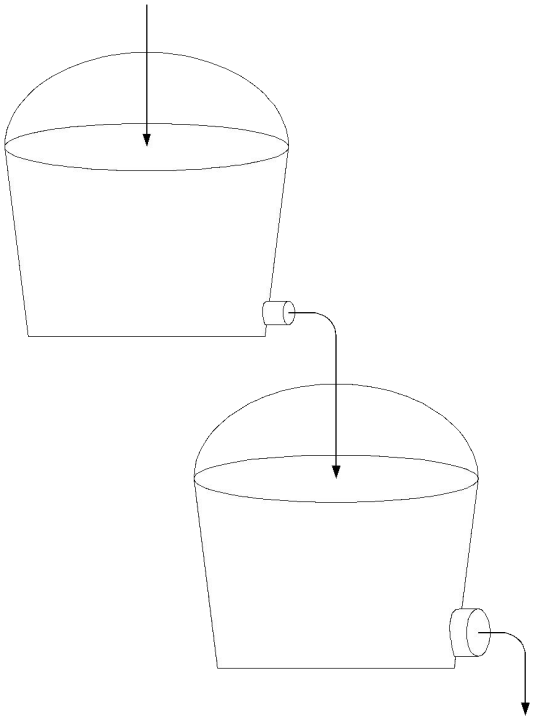


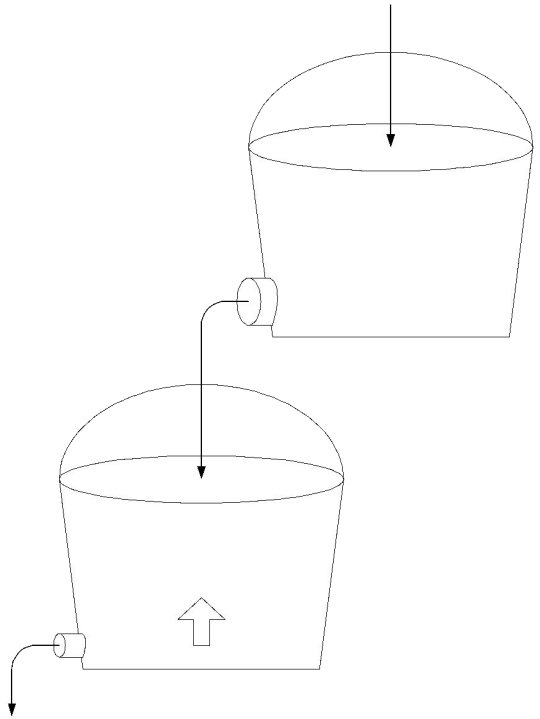
- Regardless of the Rate a Distributor Receives Requests and the Number of Requests It Accumulates in Its Collection, the Next Distributor Will Not Accumulate Requests in Its Collection If the Two Distributors Are the Same Routing Mode



Next Distributor

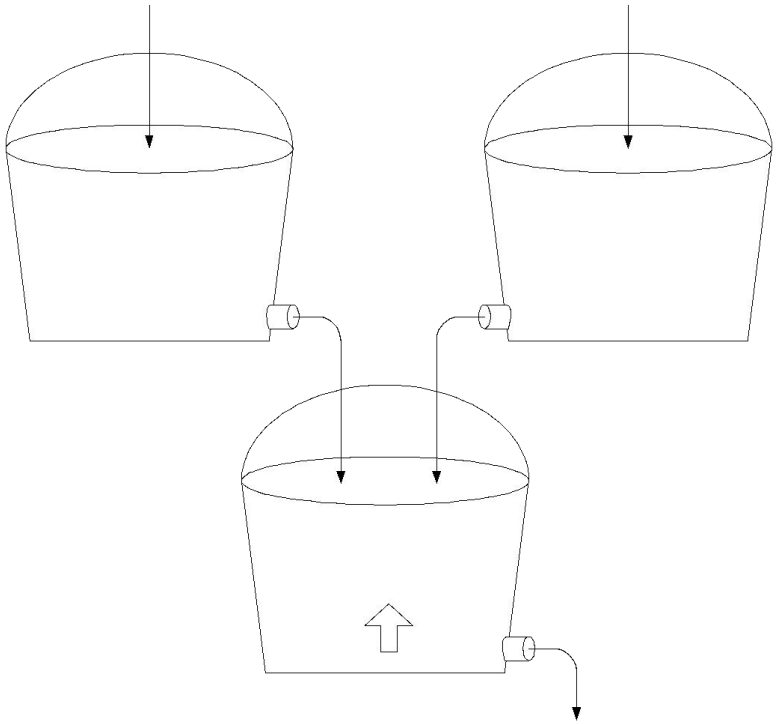
- If a Fibre or Archive Distributor Is Fed by a Baseband Distributor, It Will Not Accumulate Requests in Its Collection





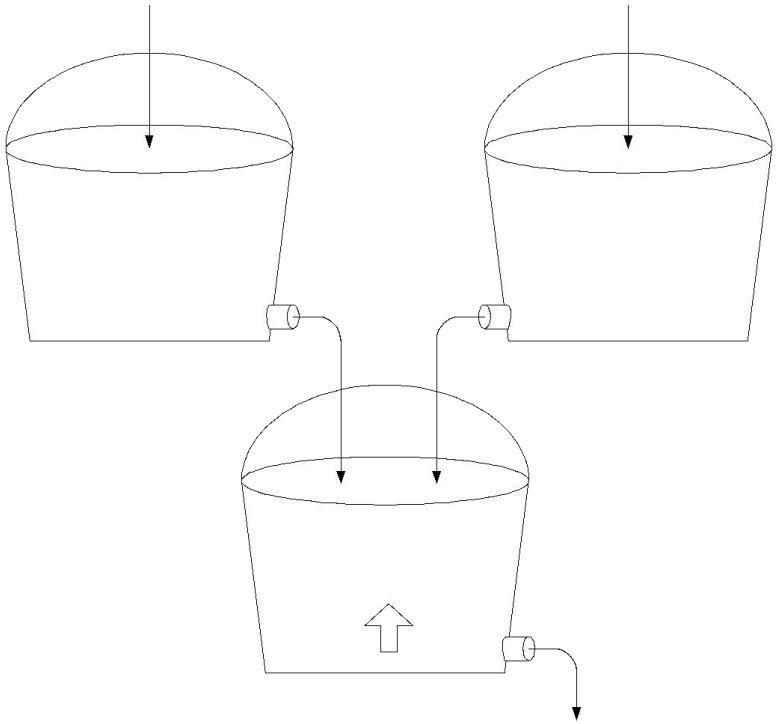
- If a baseband distributor is fed by a fibre or archive distributor, it may accumulate requests in its collection

Next Distributor



- If a Distributor Is Fed by Multiple Requesters or Distributors, It May Accumulate Requests in Its Collection
  - Cross Checked Air / Protect Pairs
  - Peer to Peer Ring Searches
  - Push Lists

Next Distributor



- Convergent Search Paths May Separate Air / Protect or Multi-Requests by Inserting Requests Between Them
  - Distributors Further Down the Search Path May Be Effected
    - Duplicate Requests May Not Be Eliminated
    - Baseband Integration May Not Be Done

Next Distributor

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Requests May Accumulate If ⇨ Is Fed By ⇩	A Fibre or Archive Distributor	A Baseband Distributor
Any Number of Requesters	Yes	Yes
One Fibre or Archive Distributor	No	Yes
Multiple Fibre or Archive Distributors	Yes	Yes
One Baseband Distributor	No	No
Multiple Baseband Distributors	Yes (>2)	Yes
Multiple Mixed Distributors	Yes	Yes
Any Number of Requesters and Any Number of Distributors	Yes	Yes

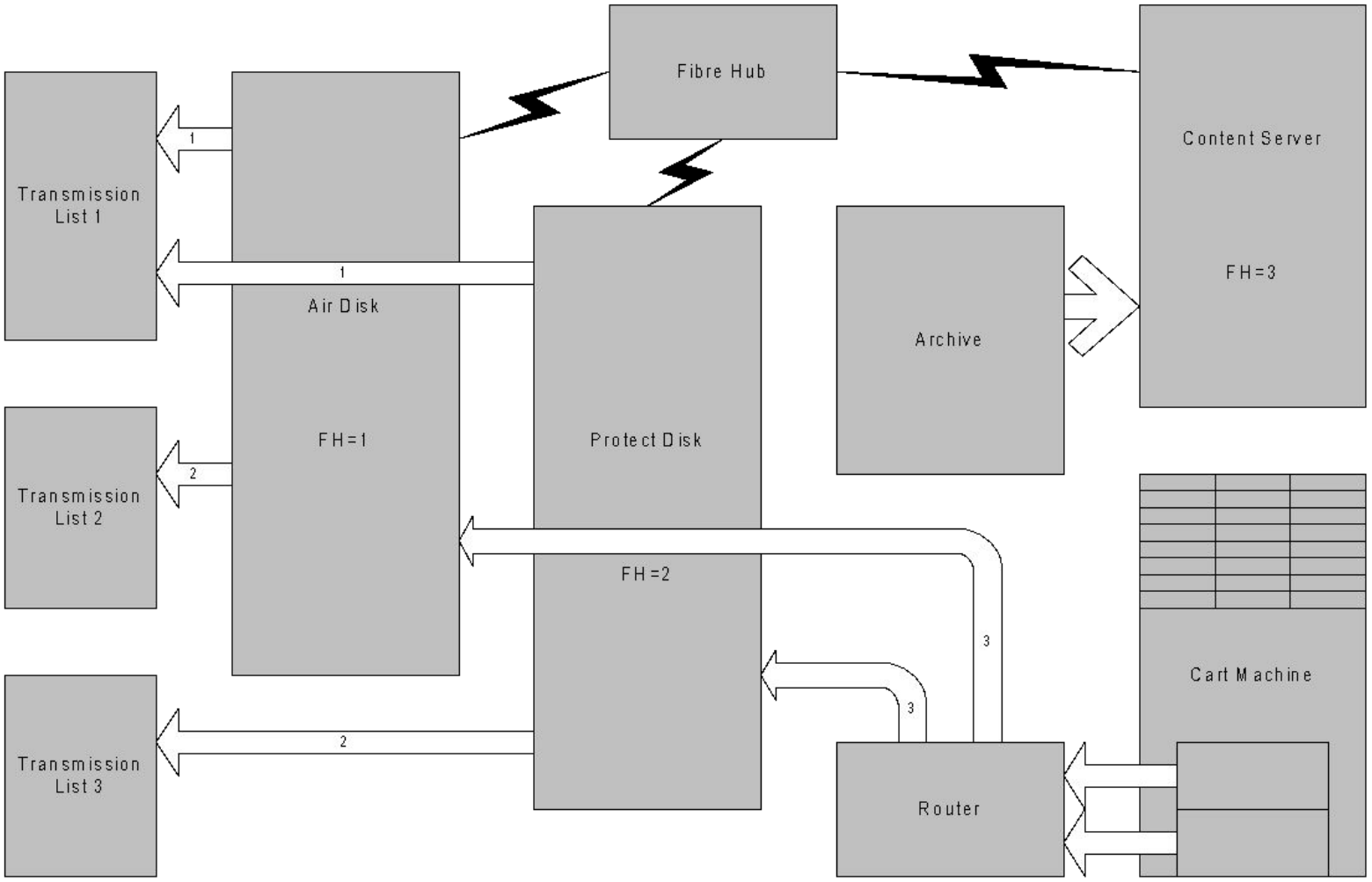
Plant Description

- The System Consists of Three Video File Servers, an Archive and a Cart Machine
  - Two of the Disks Are Used for on Air Playback
  - The Third of the Disks Is a Content Server
  - Spots Are Sent to the Archive, Which Is Connected to the Content Server Via SCSI
  - Programming Is Loaded Into a Cart Machine and Cached Into the Playout Servers
    - Each Playout Server Has an Encoder Dedicated to Baseband Transfers

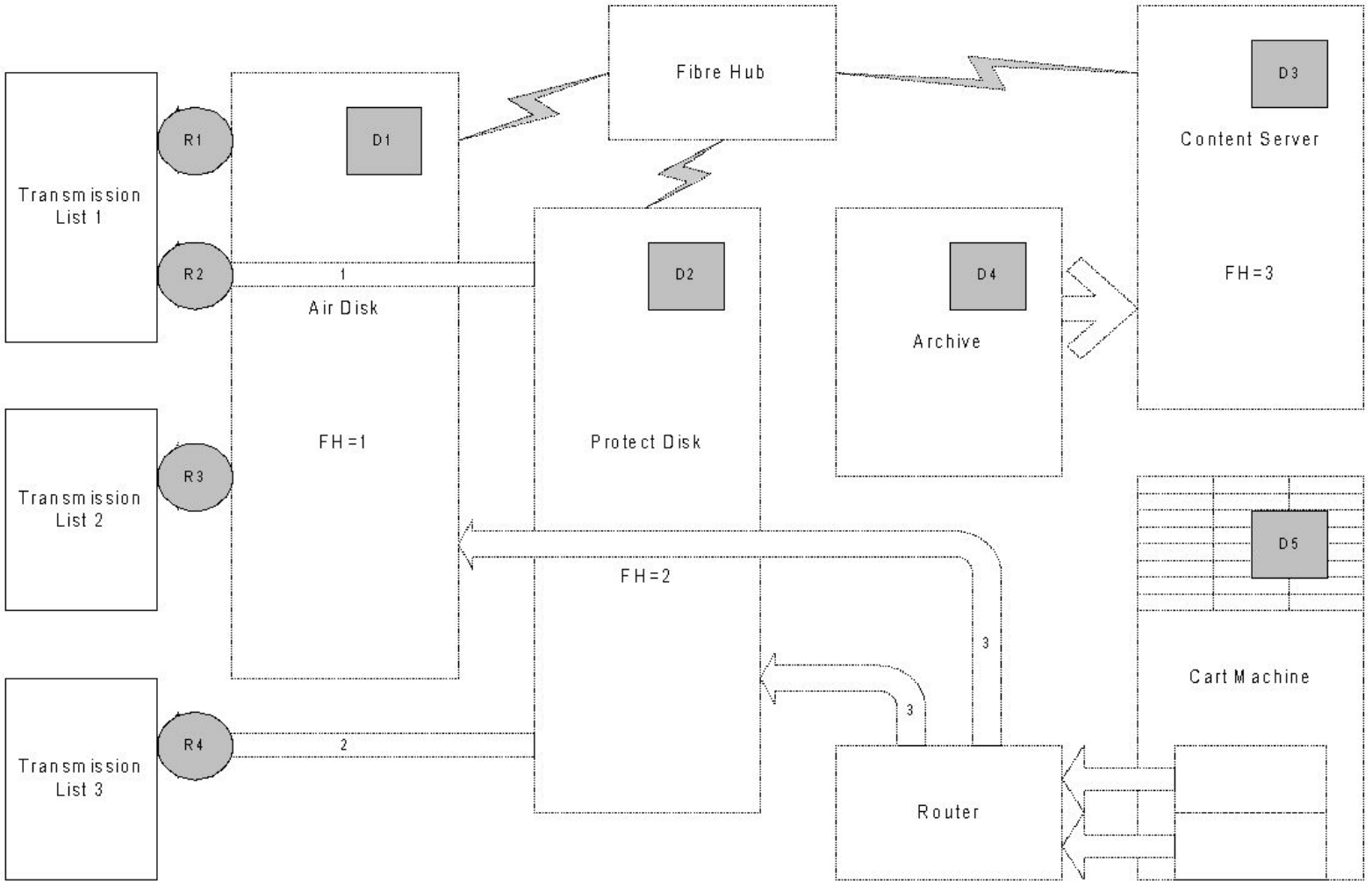
Plant Description

- There Are Three Transmission Lists
  - List 1 Plays Out Air/protect From Servers 1 and 2
  - List 2 Plays Out From Server 1 Only
  - List 3 Plays Out From Server 2 Only
- For List 1 Only, Playout Servers Should Search for Missing Media in the Other Playout Server
- If Material Is Not Found in the Playout Servers, Search Path for All Lists Should Be
  - Content Server
  - Cart Machine
  - Archive

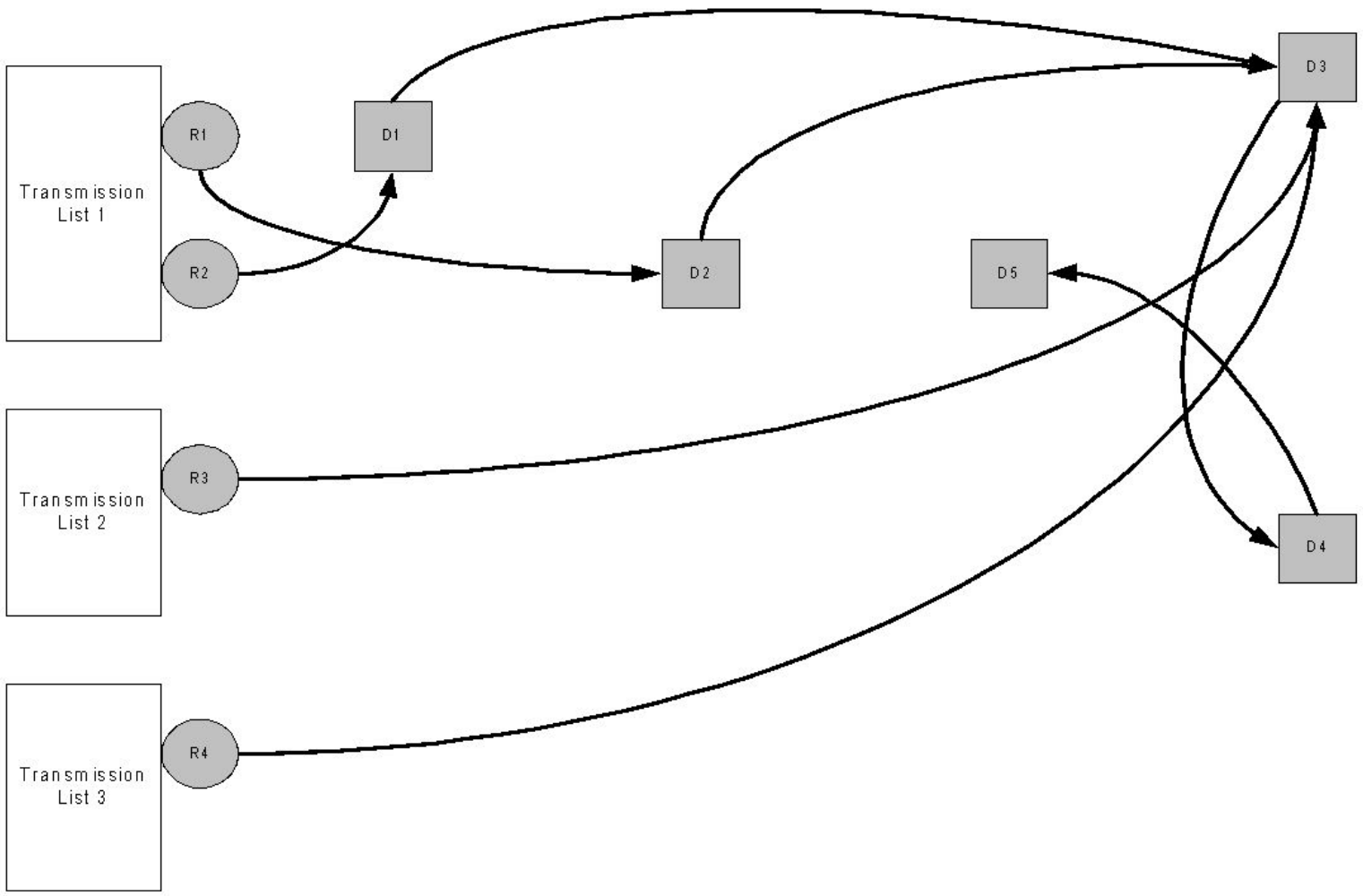
Plant Layout



GMT Components



GMT Pointers



Request Flow