802.16 d standard
WIMAX

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Scheduling services

- Represent the data handling mechanisms supported by MAC scheduler for data transport on a connection
- Each connection is associated with a single data service
- Each data service is associated with a set of QoS parameters that quantify aspects of its behavior
- These parameters are managed using DSA (dynamic service addition) & DSC (dynamic service change) message dialogs

QoS service flow parameters

	UGS	rtPS	nrtPS	BE
Max sustained traffic rate	v	v	v	v
Max latency	v	v		
Tolerated jitter	v			
Request/ transmission policy	v	v	v	v
Min reserved traffic rate	v	v	v	
Traffic priority			v	v

Outbound transmission scheduling

- The following items are taken into account for each service flow
  - The scheduling service specified for the service flow
  - The values assigned to the service flow's QoS parameters
  - The availability of data for transmission
  - The capacity of the granted BW

Uplink request/grant scheduling

- Performed by BS
  - Provide each subordinate SS with
    - BW for uplink transmissions
    - Opportunities to request BW
- By specifying a scheduling service & its associated QoS parameters
  - BS scheduler can anticipate the throughput & latency needs of uplink traffic
  - Provide polls/grants at the appropriate times

Scheduling services & usage rule

	Piggyback request	BW stealing	Polling
UGS	x	x	*
rtPS	v	v	Unicast
nrtPS	v	v	** All forms of polling
BE	v	v	All forms of polling

* PM (poll me) bit is used to request a unicast poll for BW needs of non-UGS connections

** Scheduling may restrict a service flow to unicast polling via transmission/request policy

UGS

- BS shall provides Data Grant Burst information elements (IEs) (QoS parameters ?) to the SS at periodic interval
  - based upon the Maximum sustained Traffic Rate of the service flow
- Request/Transmission policy setting
  - SS is prohibited from using any contention request opportunities for this connection

UGS (2)

- Grant management sub-header
  - Used to pass status information from SS to BS, regarding the state of service flow
  - Slip Indicator (SI) bit
    - Allow the BS to provide for long term compensation for conditions, such as lost maps or clocks mismatches, by issuing additional grants (?)
    - This service flow has exceeded its transmit queue depth → SI= 1
    - The service flow is back within limits → SI = 0
  - Poll-Me (PM) bit
    - Used to request to be polled for a different, non-UGS connection

UGS (3)

- BS shall not allocate more BW than Max sustained traffic rate,
  - Excluding the case when the SI bit is set
    - BS may grant up to 1% additional BW for clock rate mismatch compensation

rtPS

- Request/Transmission policy setting
  - SS is prohibited from using any contention request opportunities for this connection

nrtPS

- Offer unicast polls on a regular basis
  - Assure that the service flow receives request opportunities even during network congestion
- BS typically polls connection identifiers (CIDs) on an interval on the order of 1 sec or less
- Request/Transmission policy setting
  - SS is allowed to use any contention request opportunities for this connection

nrtPS (2)

- SS uses
  - contention request opportunities
  - unicast request opportunities
  - Unsolicited Data Grant Burst Types
- All other bits of Request/Transmission policy are irrelevant to the fundamental operation of scheduling service

BE

- Provide efficient service for BE
- SS uses
  - contention request opportunities
  - unicast request opportunities
  - Unsolicited Data Grant Burst Types
- All other bits of Request/Transmission policy are irrelevant to the fundamental operation of scheduling service

BW allocation & request mechanisms

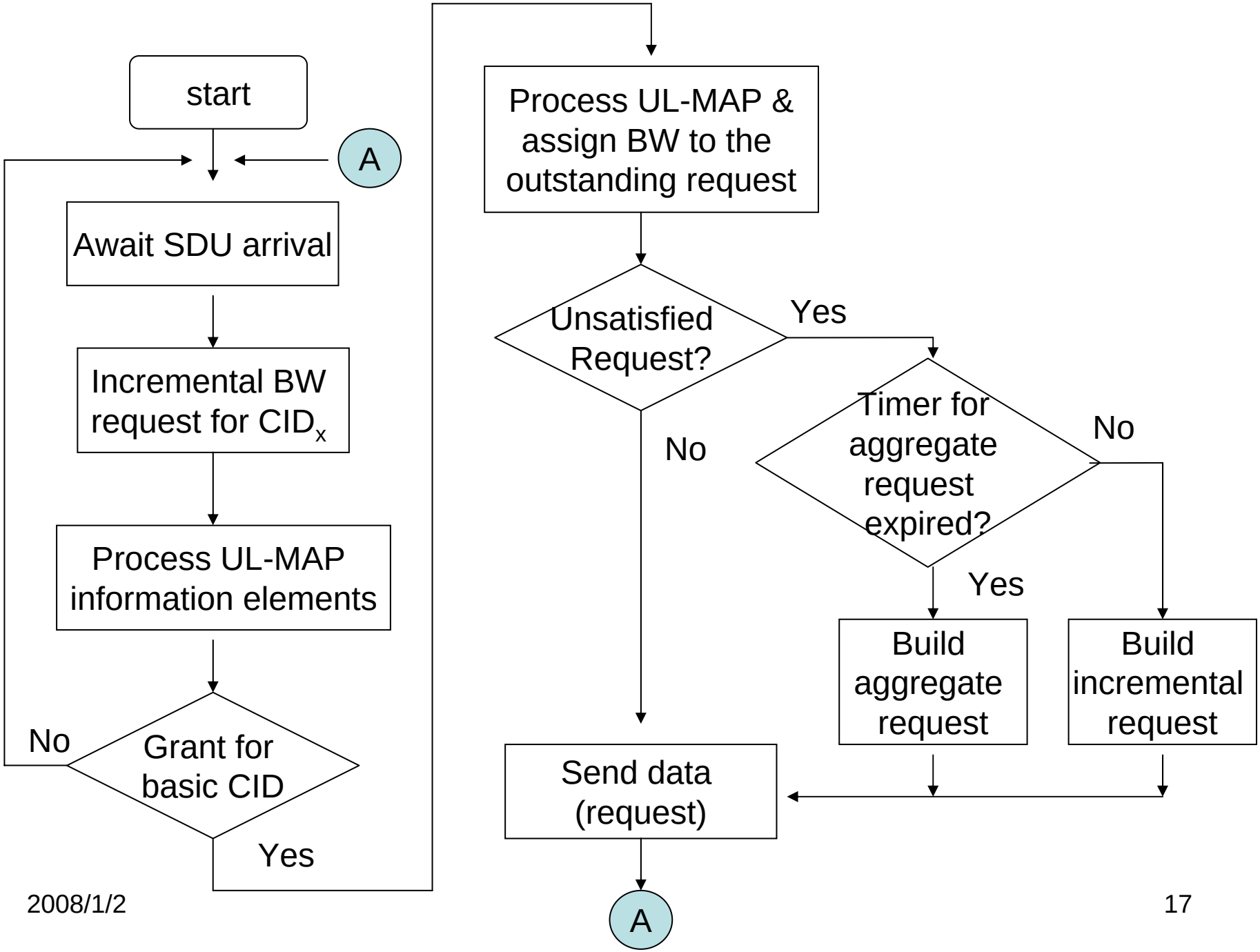
- The needs of incompressible UGS connections do not change between connection establishment & termination
- The requirements of compressible UGS connections (T1), may increase or decrease depending on traffic
  - Demand assigned multiple access (DAMA) services are given resources on a demand assignment basis, as the need arises

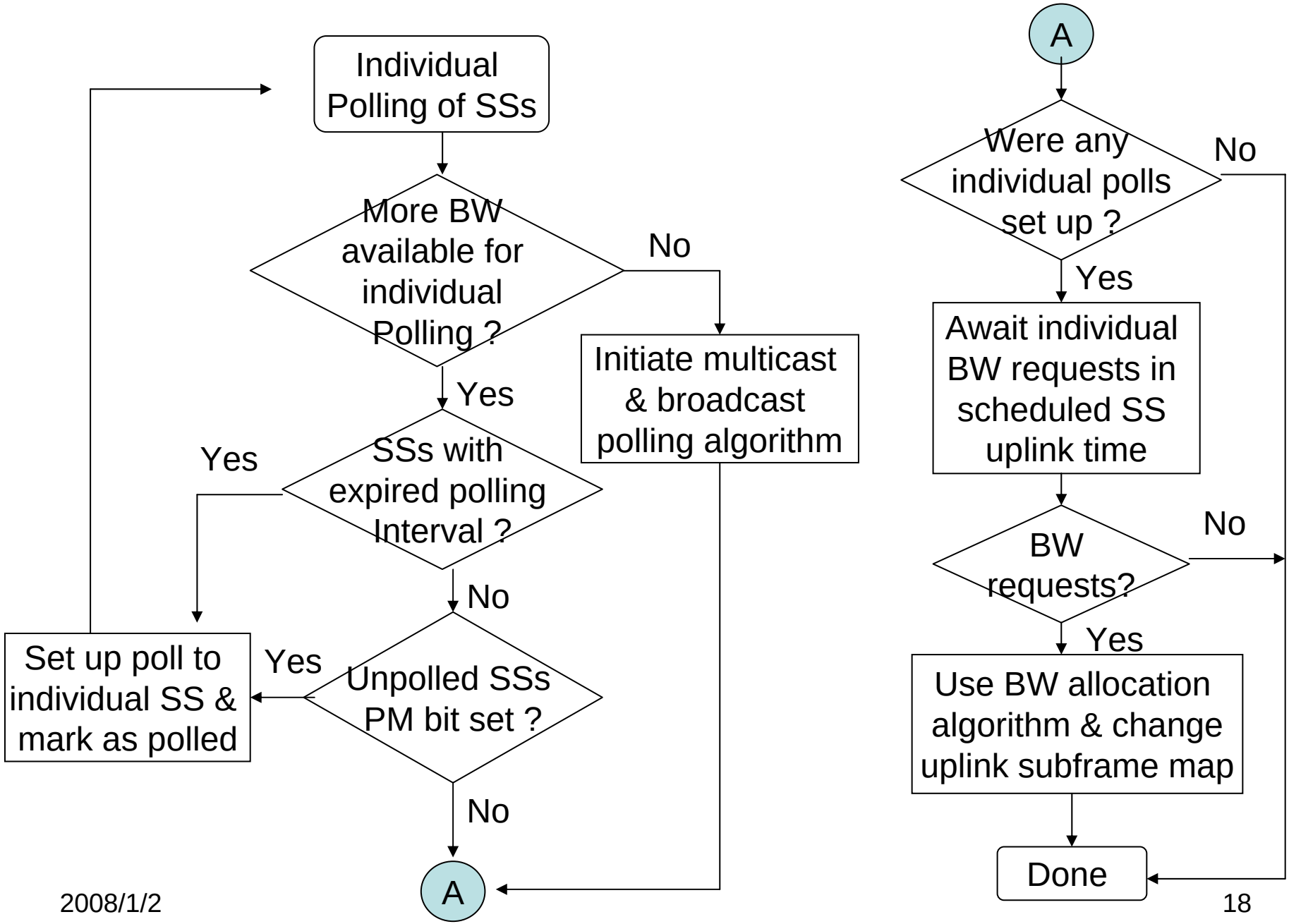
BW allocation & request mechanisms (2)

- When an SS needs to ask for BW on a connection with BE scheduling service
  - It sends a message to the BS containing the immediate requirements of DAMA connection
- QoS for the connection was established at connection establishment & is looked up by BS

BW request method

- Request
  - SSs use to indicate to BS that they need uplink bandwidth allocation
- Grants
  - Polling
    - Unicast
    - Multicast & broadcast
    - PM bit


start
A
Await SDU arrival
Incremental BW request for CIDx
Process UL-MAP information elements
Grant for basic CID
No
Yes
Process UL-MAP & assign BW to the outstanding request
Unsatisfied Request?
Yes
No
Timer for aggregate request expired?
No
Yes
Build aggregate request
Build incremental request
Send data (request)
A


Individual Polling of SSs
More BW available for individual Polling ?
No
Initiate multicast & broadcast polling algorithm
Yes
SSs with expired polling Interval ?
Yes
No
Set up poll to individual SS & mark as polled
Yes
Unpolled SSs PM bit set ?
No
A
A
Were any individual polls set up ?
No
Yes
Await individual BW requests in scheduled SS uplink time
BW requests?
No
Yes
Use BW allocation algorithm & change uplink subframe map
Done