Cross-Layer anticipation of resource allocation for multimedia applications based on SIP signalling over DVB-RCS Satellite system

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Plan

- Context : DVB-S/RCS Satellite networks and QoS
- Dynamic resource allocation: problem definition
- Resource provisioning in dynamic allocation scheme
  - Evaluations
- Conclusion

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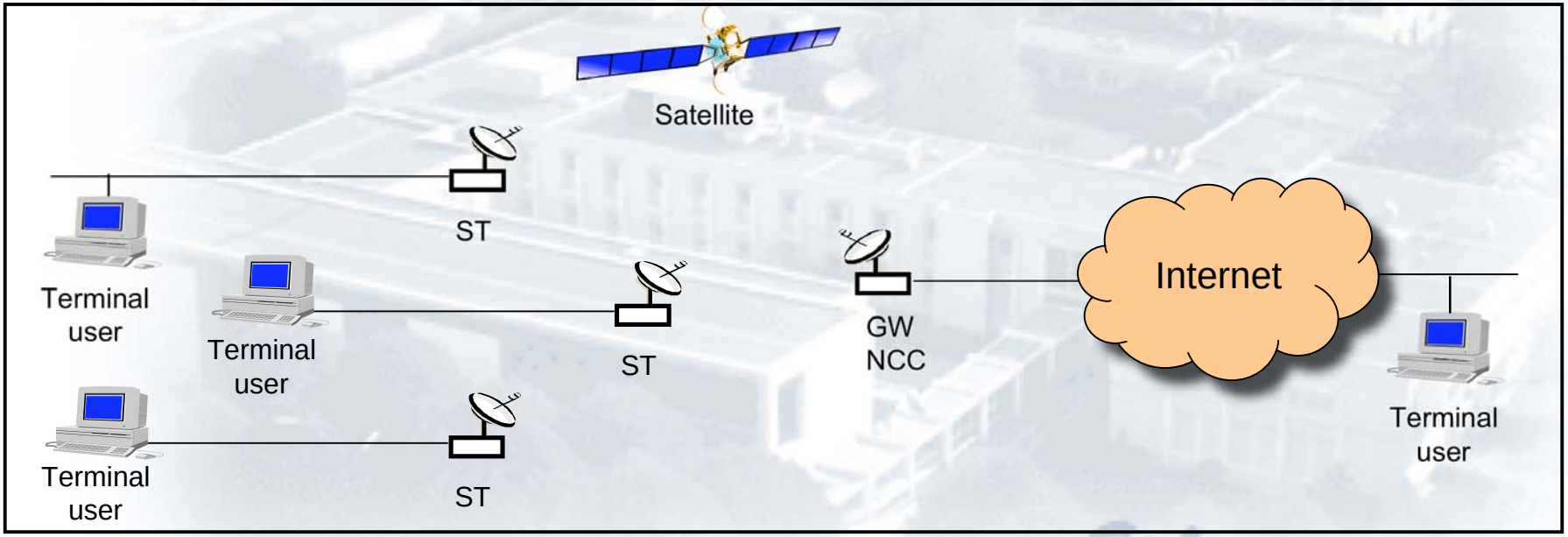
Context: DVB-S/RCS Satellite System

- DVB-S/RCS Satellite Network (GEO Stationary Satellite).
- Access Network (star scheme).

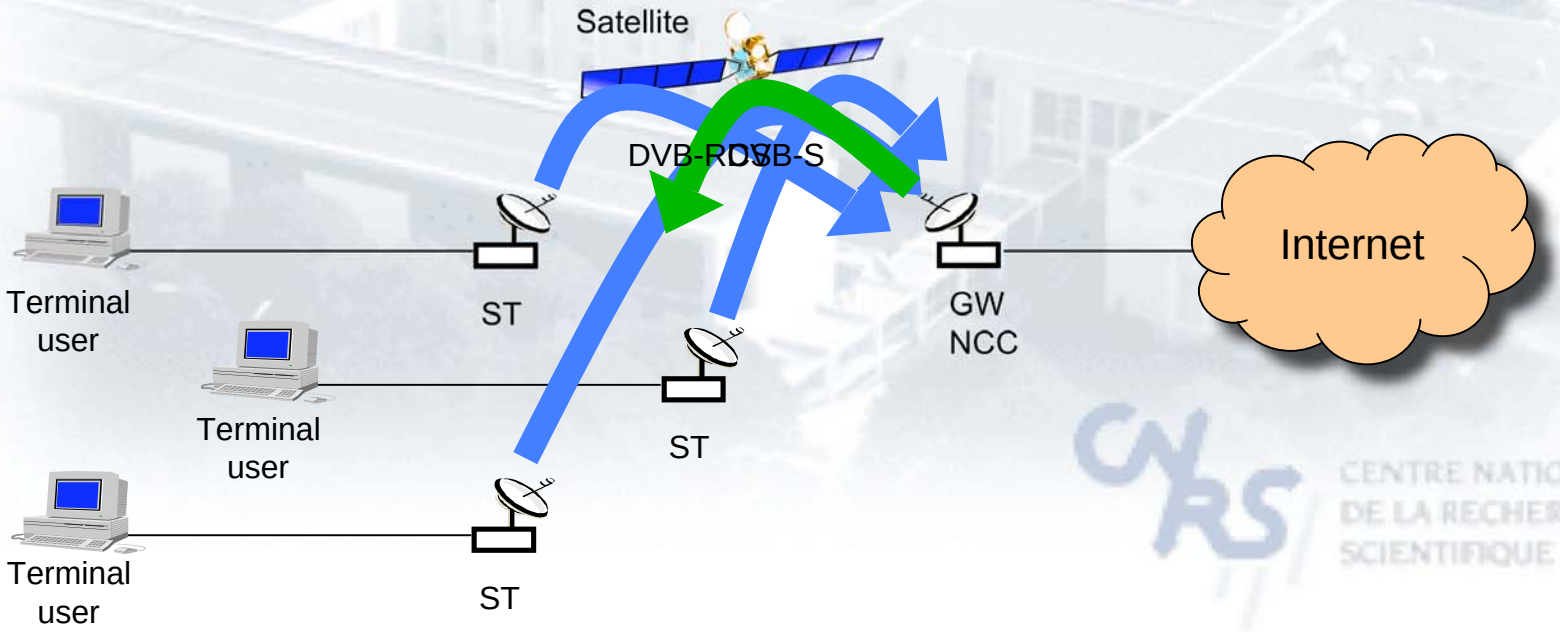


- GW : access router for the satellite network.
- NCC : resource manager of the satellite network (integrated to the GW).
- ST : access router for the user network.

Context: DVB-S/RCS Satellite System

Access topology :

- Forward link : only used by the GW/NCC.
- Return link: shared by several STs.

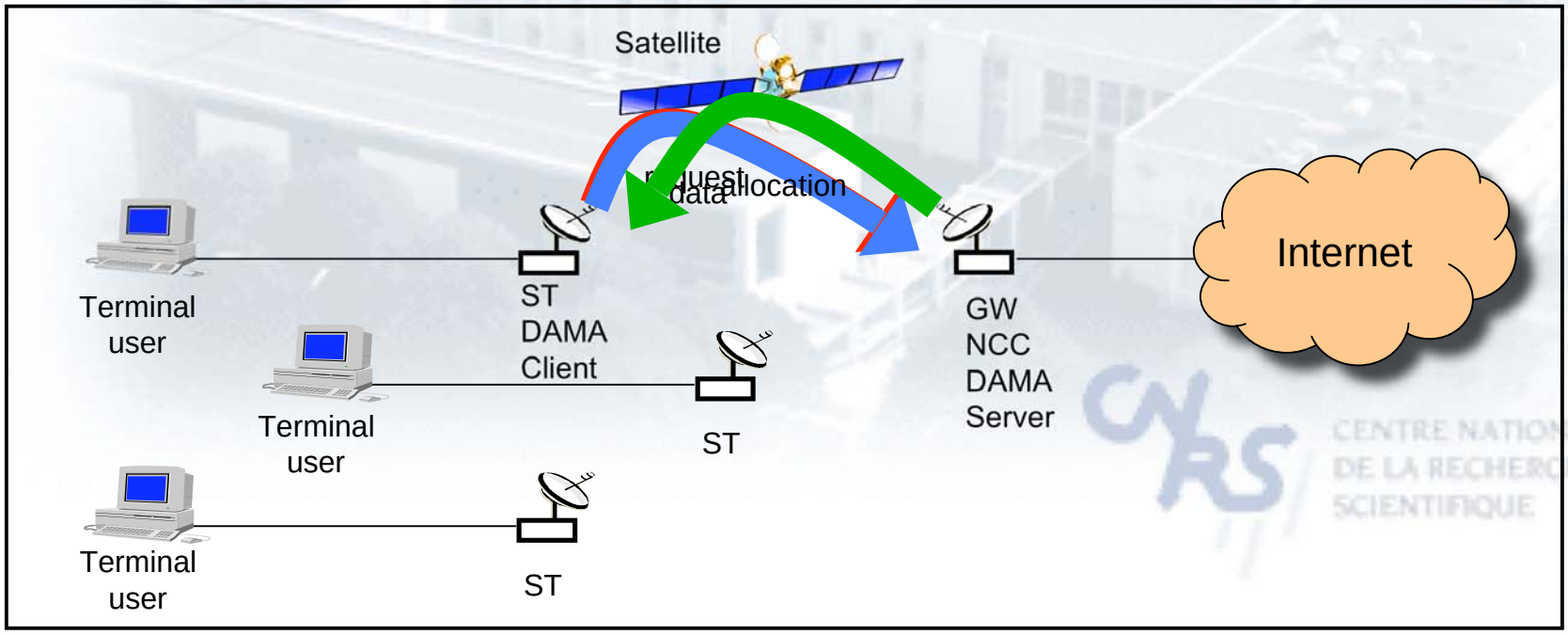


Resource allocation for the return link

How to share this return link between STs ?

DAMA : bandwith on demand (BoD), client/server architecture :

- DAMA Client (ST) : Capacity Request (CR).
- DAMA Server (NCC) : resource allocation plan (TBTP).



Classes of Service

ETSI BSM TS 102 462 Recommandations

Classes of Service (CoS) at MAC level	Associated Capacity Request (CR)	Customers
RT (Real Time) For applications with high temporal constraints	**CRA** (Continous Rate Assignment) STATIC allocation	Corporate Service
VR (Variable Rate) For delay tolerant applications	**RBDC** (Rate Based Dynamic Capacity) On Demand Allocation (kbps)	Home & home office Services
JT (Jitter tolerant) For jitter tolerant applications	**VBDC** (Volume Based Dynamic Capacity) On Demand Allocation (ATM cells)	

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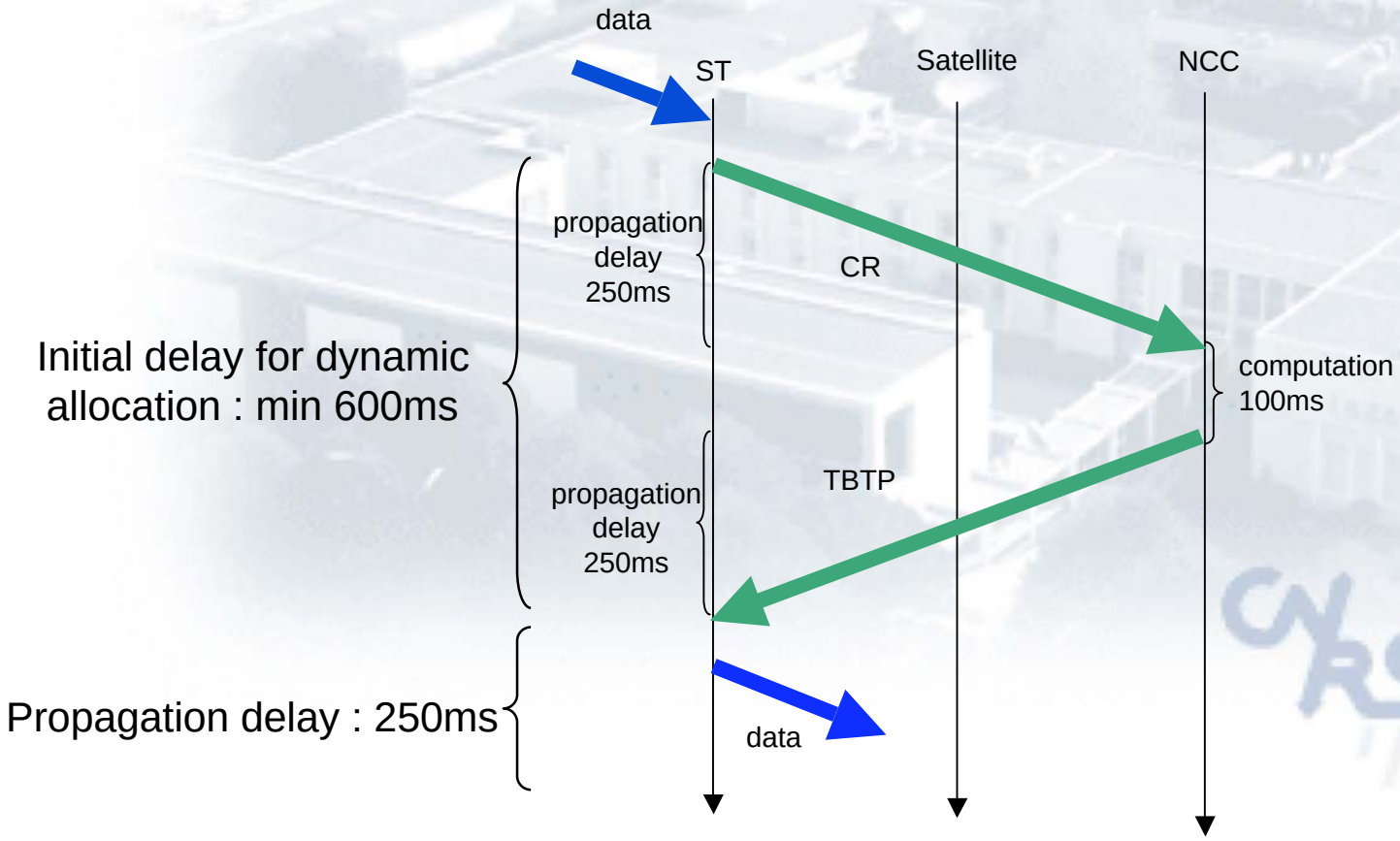
Dynamic allocation: problem definition

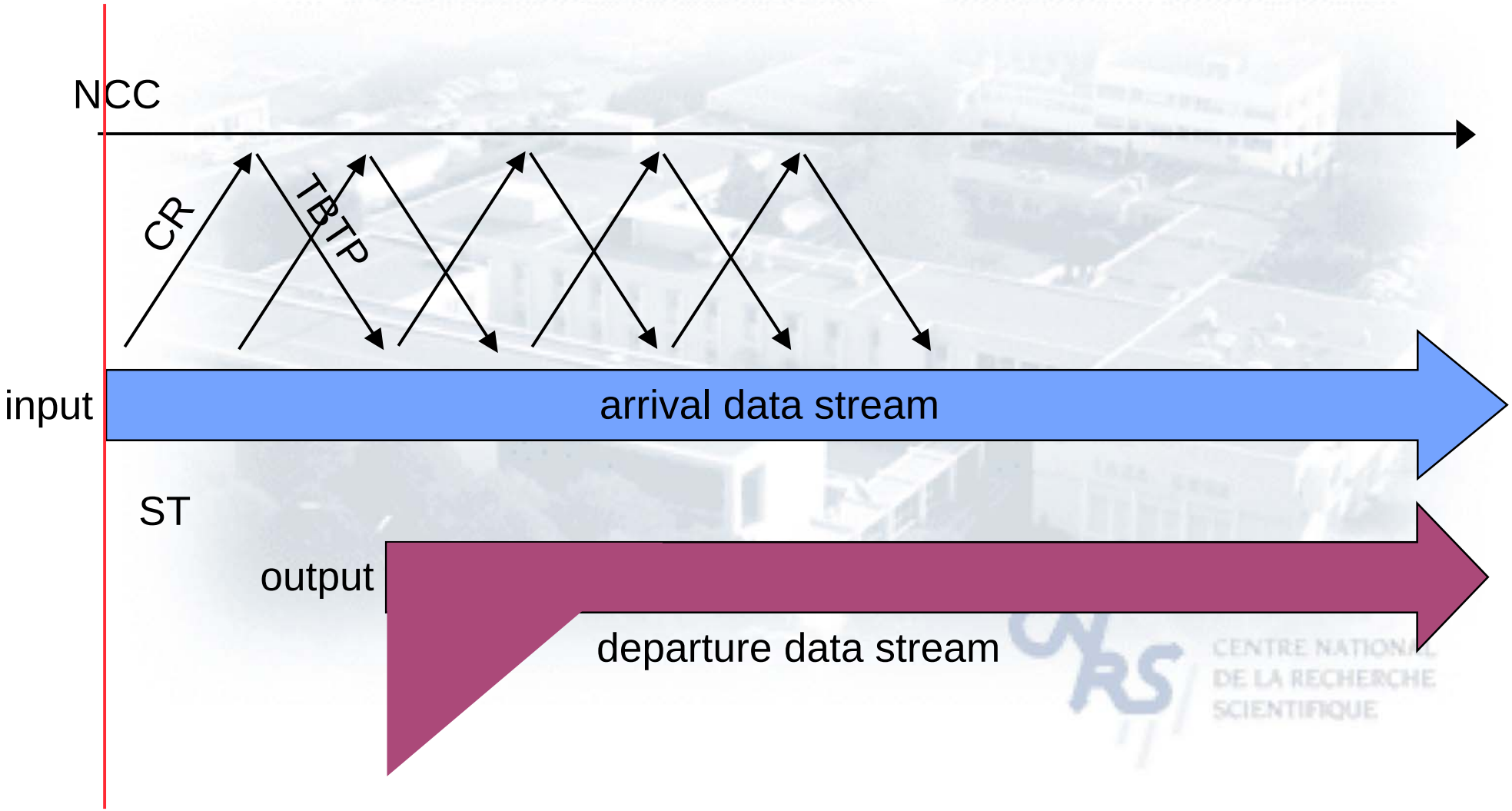
DAMA scheme: principle



ITU-T G.1010 Recommandations

Applications	**Maximum delay recommanded (ms)**	**Dynamic allocation CoS DVB-VR support (600ms)**
Web-browsing (HTML)	4s	Supported by dynamic allocation
Data Transfer (FTP)	60s	Supported by dynamic allocation
Streaming Audio/Video	10s	Supported by dynamic allocation
Audio/Video Conferencing	400ms	Not supported by dynamic allocation

More request to transmit more data…?



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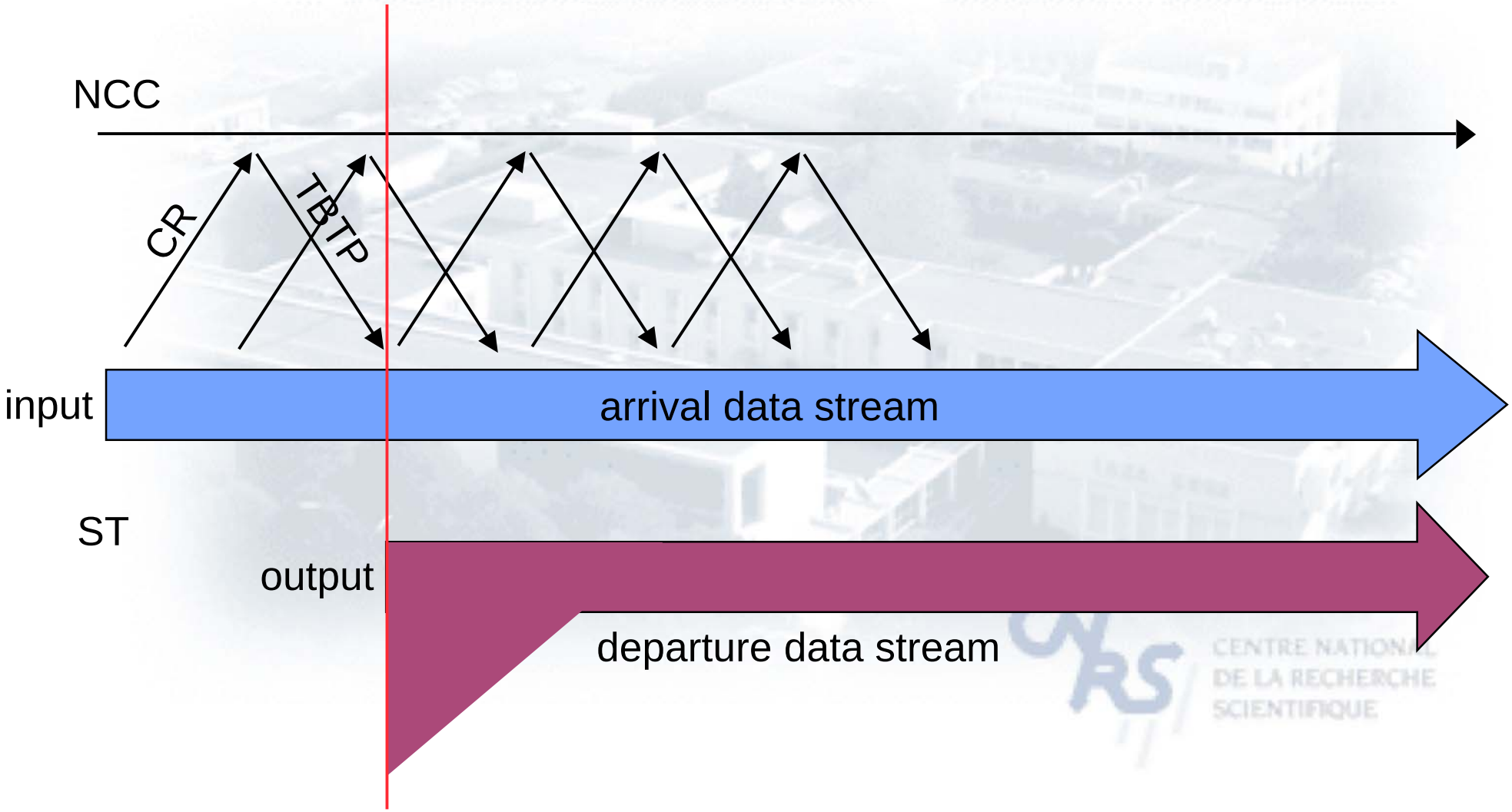

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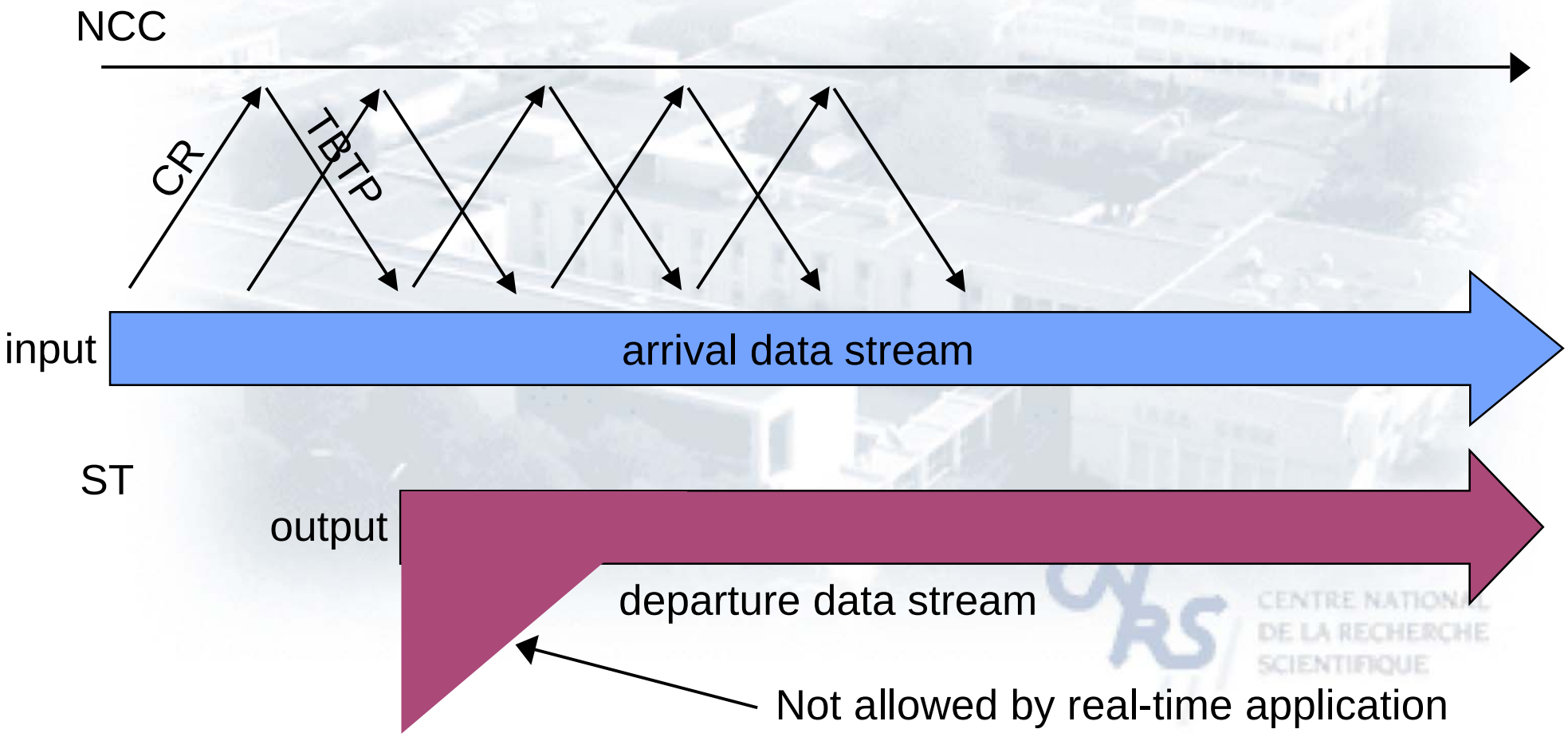
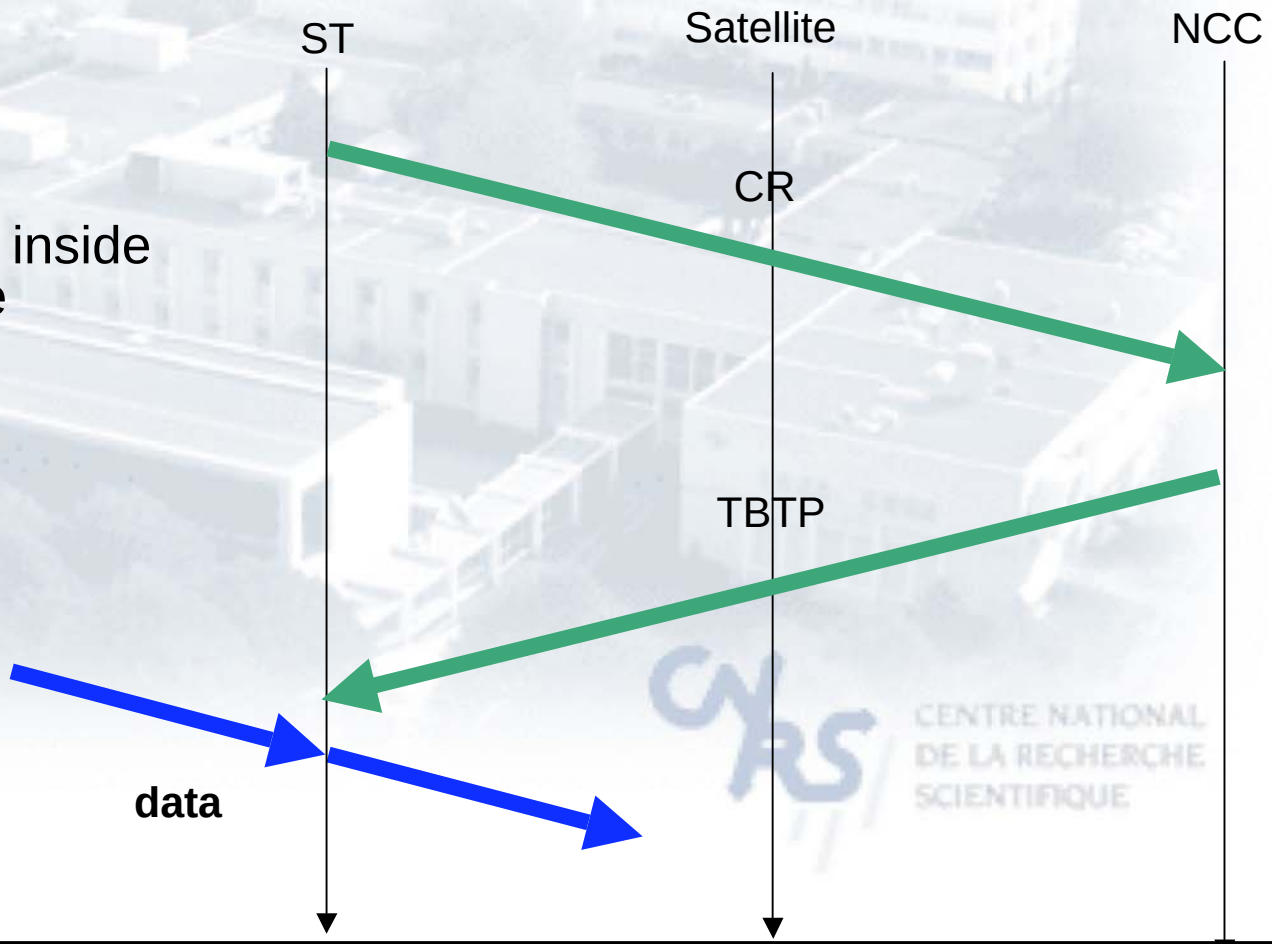


How can we reduce the dynamic allocation delay ?

And more specifically, at the beginning of communication.

- Anticipate future needs
  - Minimize the delay inside the DVB-VR queue



- In order to anticipate resource:
  - During the communication:
    - ➔ 2 parameters can be measured and used:
      - Transmission queue length
      - Arrival rate inside the transmission queue [t], [t-1], [t-2]

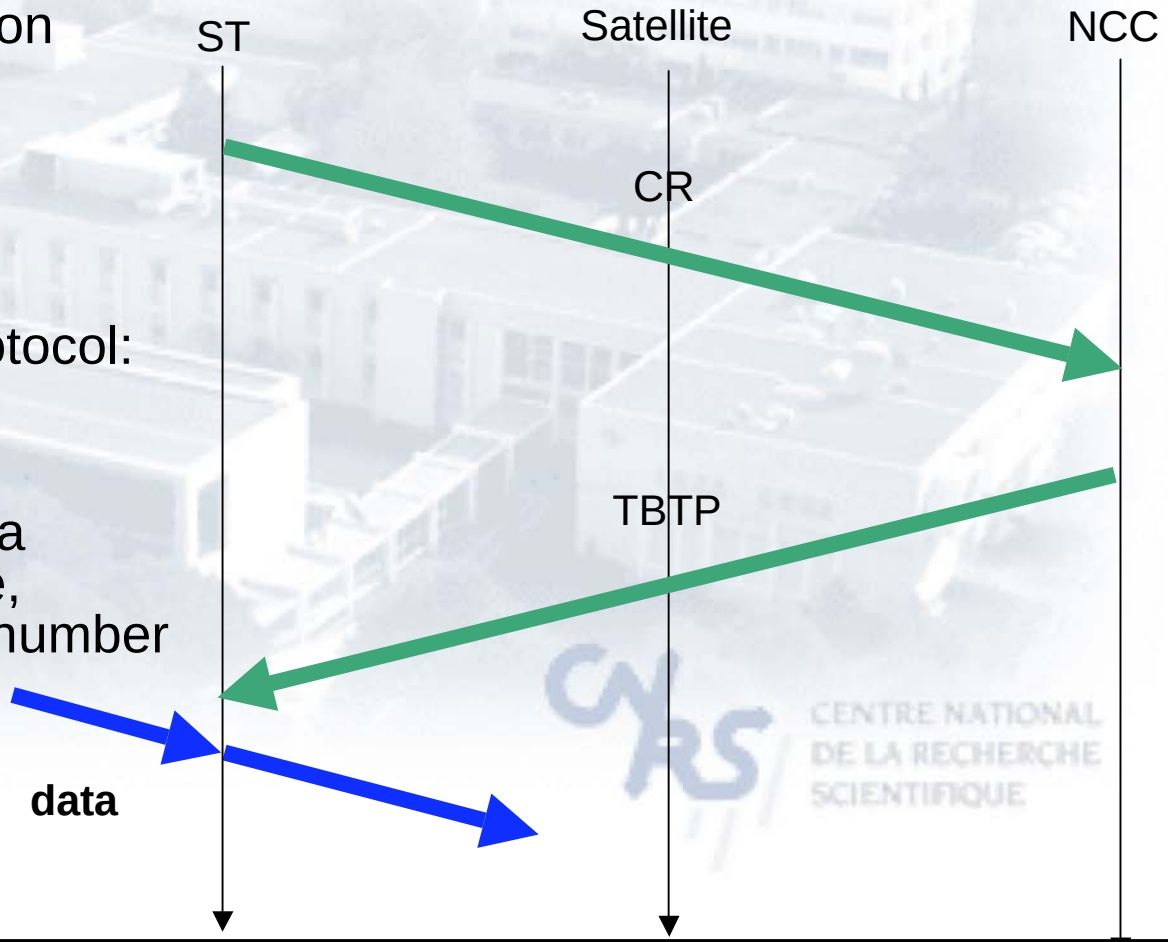
      [Priscoli04] , [Nivor06]
  - At the begining of the communication:
    - ➔ Transmission queue empty
    - ➔ Arrival rate null

How can we reduce the dynamic allocation delay ?

And more specificaly, at the begining of communication.

- Need to know QoS information about the multimedia flow
  - For instance flow bitrate
  - Type of flow
- Use of signalling session protocol:

  SIP
  - Description of multimedia session: application type, codec name, @IP, port number



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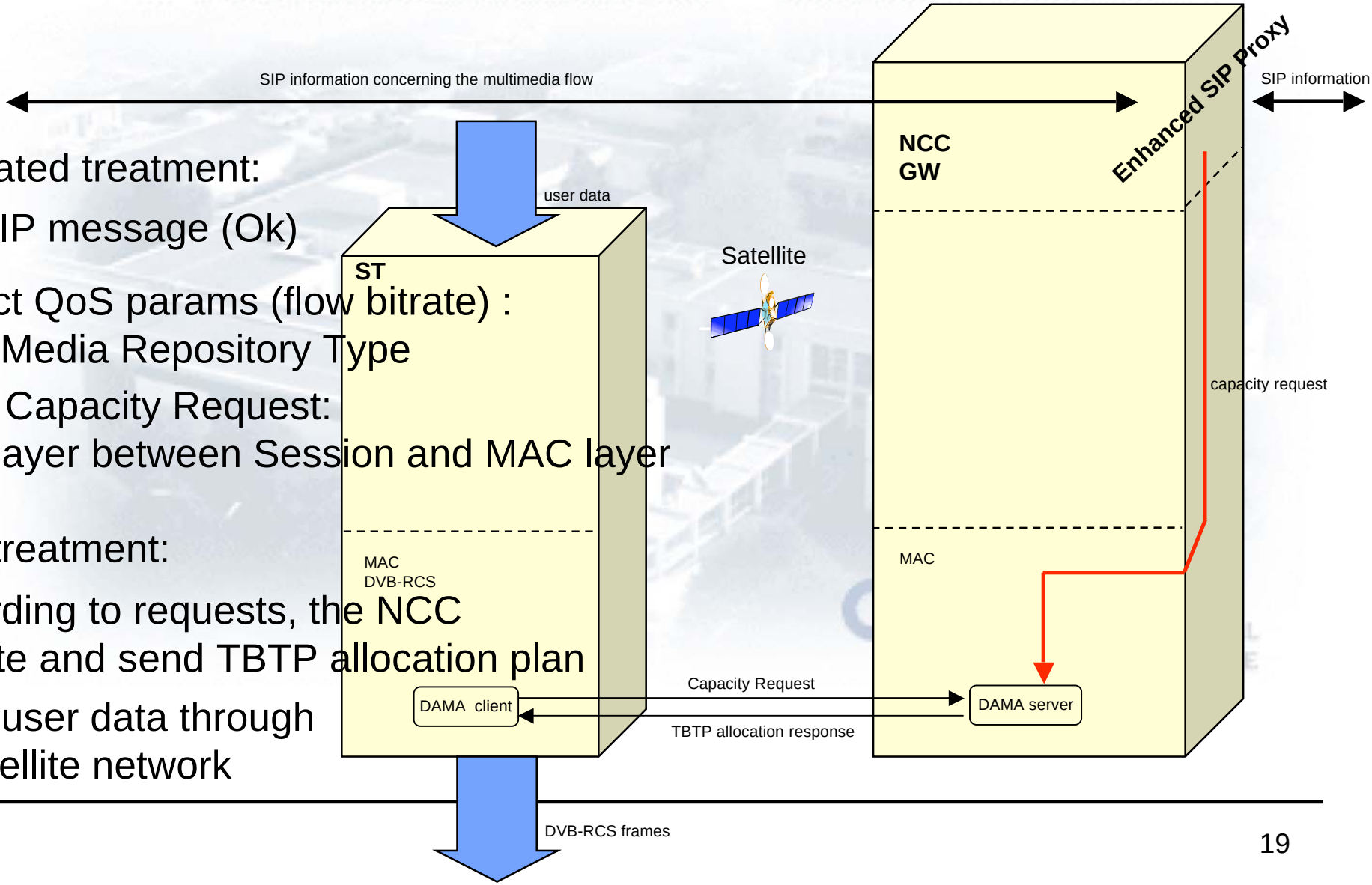
Cross-Layer signaling inside the NCC

Anticipated treatment:

- Get SIP message (Ok)
- Extract QoS params (flow bitrate) : Use of Media Repository Type
- Send Capacity Request: Cross-layer between Session and MAC layer

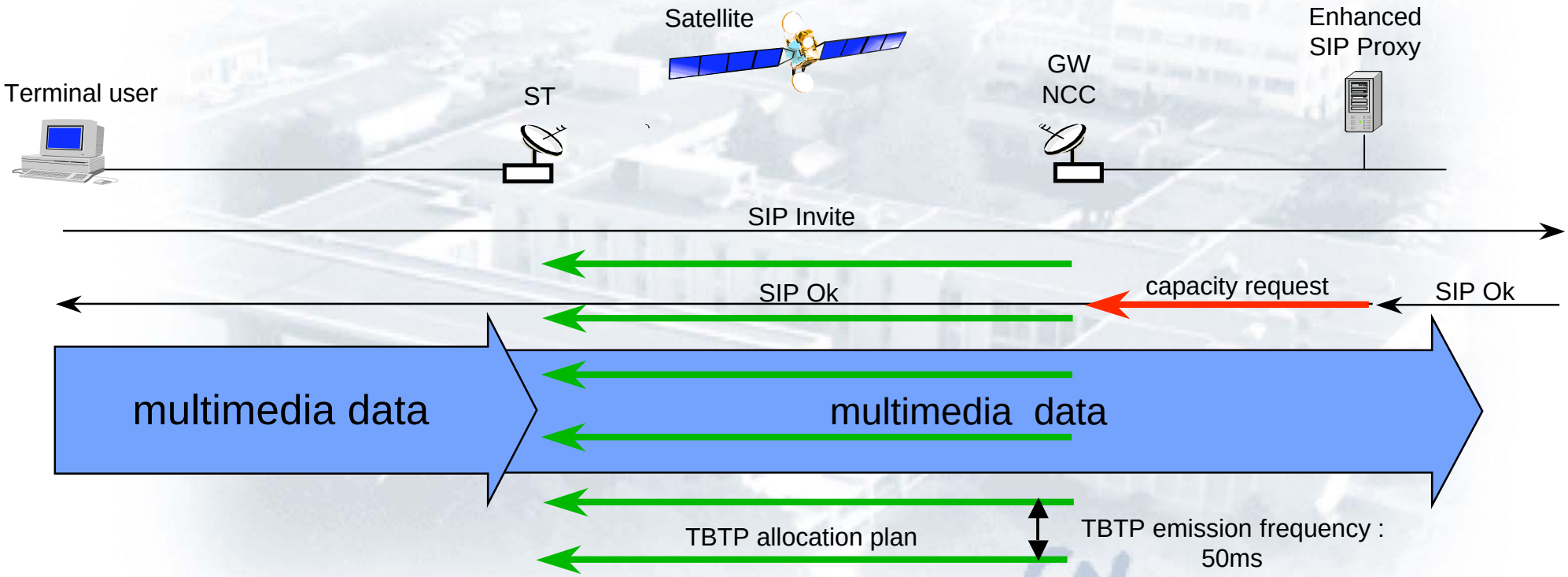
Usual treatment:

- According to requests, the NCC compute and send TBTP allocation plan
- send user data through the satellite network



Resource provisioning through cross-layer signaling: scenarios

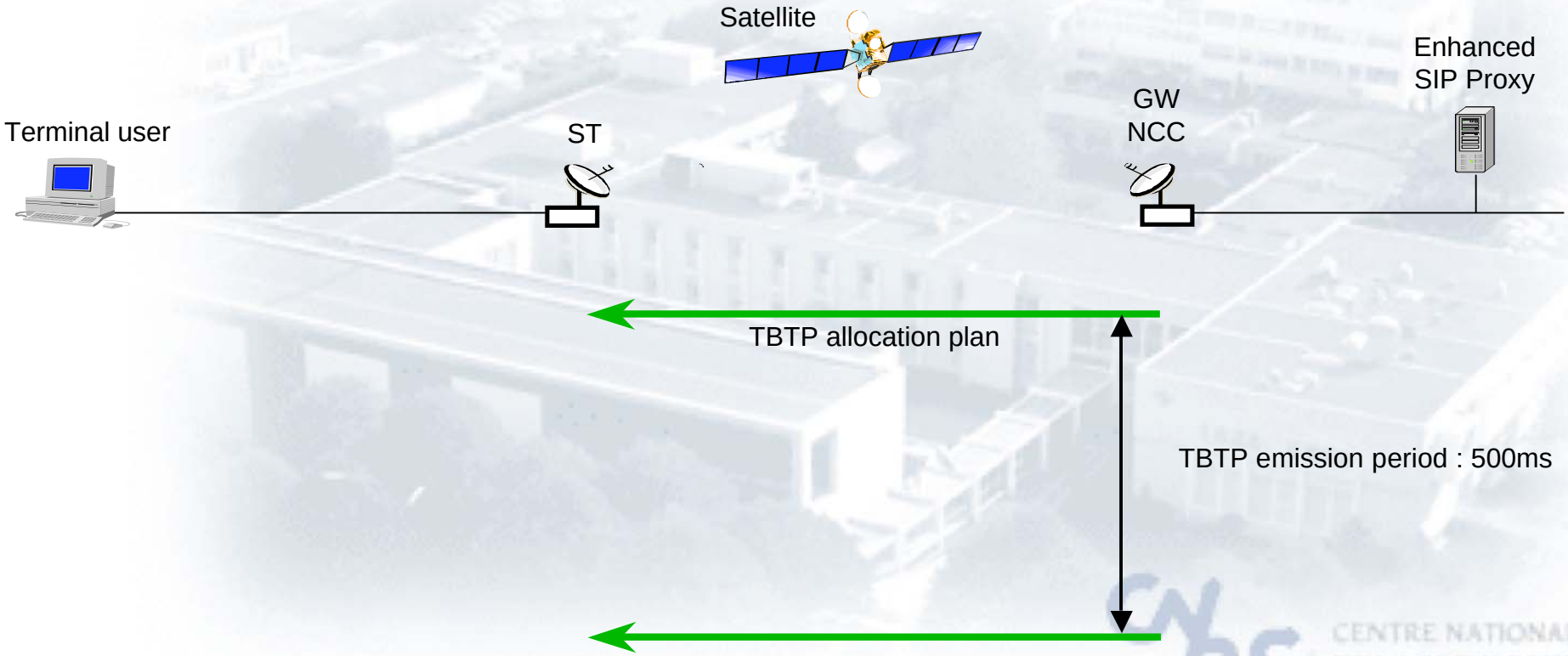
Cross-layer Capacity Request with Period of TBTP emission : 50ms.



e2e initial delay =
TBTP period (50ms max) + propagation delay ≈ 350ms

Resource provisioning through cross-layer signaling: scenarios

Cross-layer CR + Acknowledgement with Period of TBTP emission 500ms



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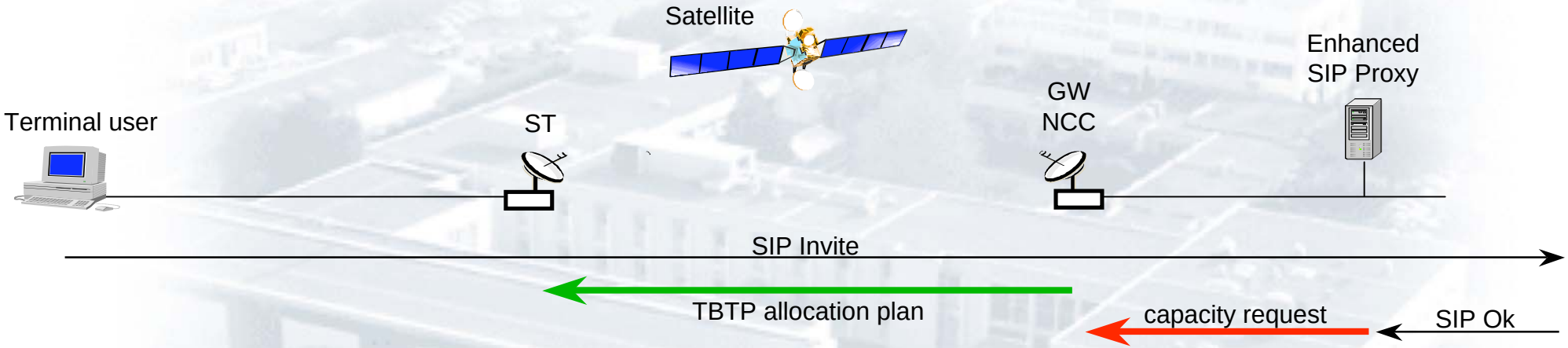
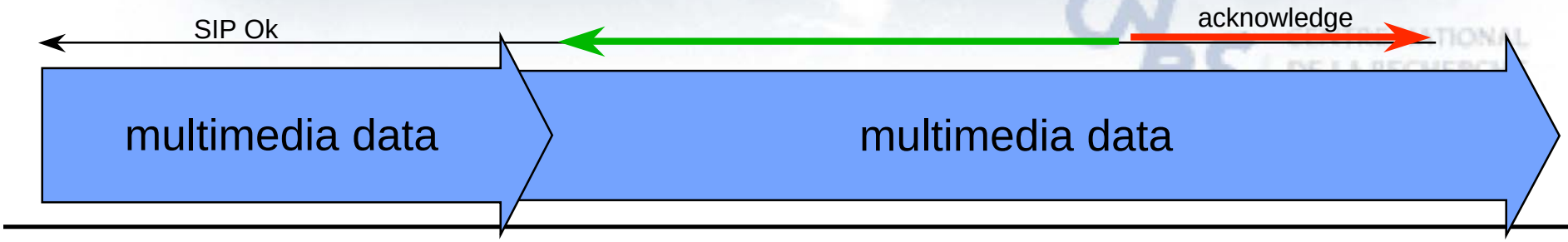
Cross-layer CR + Acknowledgement with Period of TBTP emission 500ms



e2e initial delay = propagation delay ≈ 300ms



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Evaluations

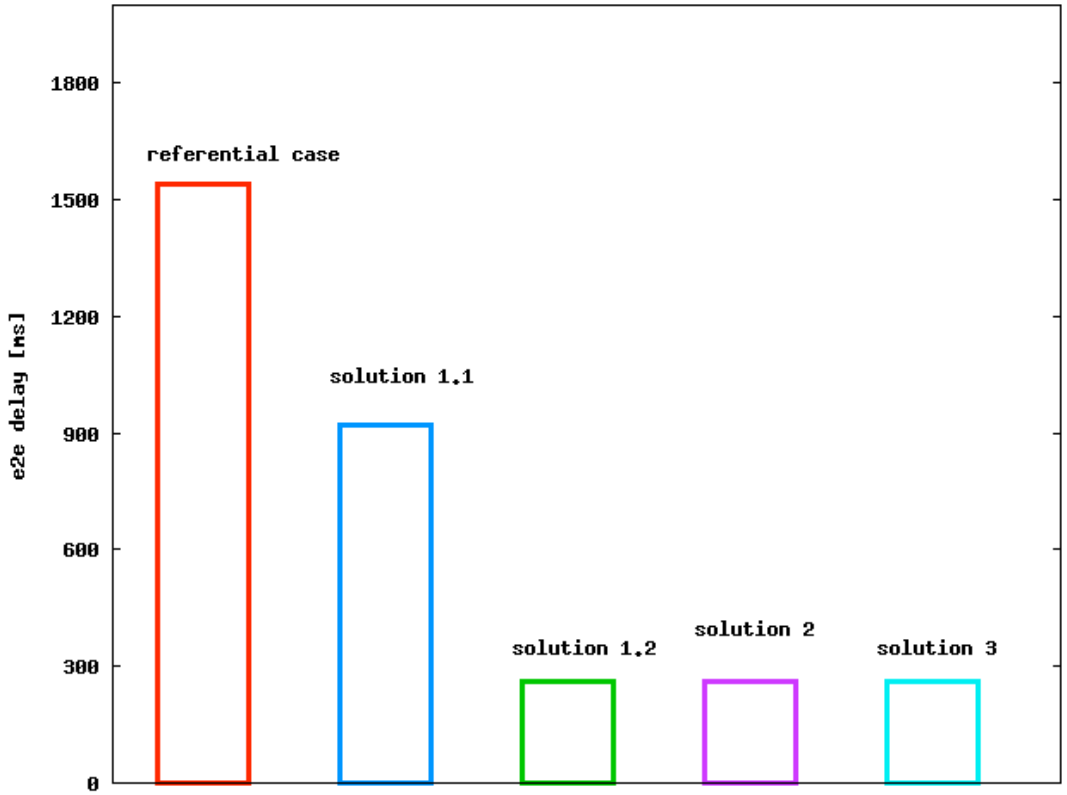
Implemented and Tested on Platine Satellite Network Emulator from SATSIX Project

Config : unidirectional video conferencing flow, Xvid codec, $bitrate_{peak}$ = 128kbps

- Referential case: without anticipation
- Solution 2:
  - Anticipation through Cross-Layer CR with TBTP period of 50ms:

    e2e initial delay 350ms
- Solution 3:
  - Anticipation through Cross-Layer CR with TBTP period of 500ms:

    e2e initial delay 300ms



e2e initial delay with DVB-VR CoS (RBDC) [ms]

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Conclusion

- DVB-S/RCS Satellite system
- Multimedia applications (audio/video conferencing) support
- Cross-Layer anticipation of resource allocation based on SIP signalling
- e2e initial delay ≈ 300ms - 350ms