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A new way of implementing TV contribution & distribution networks

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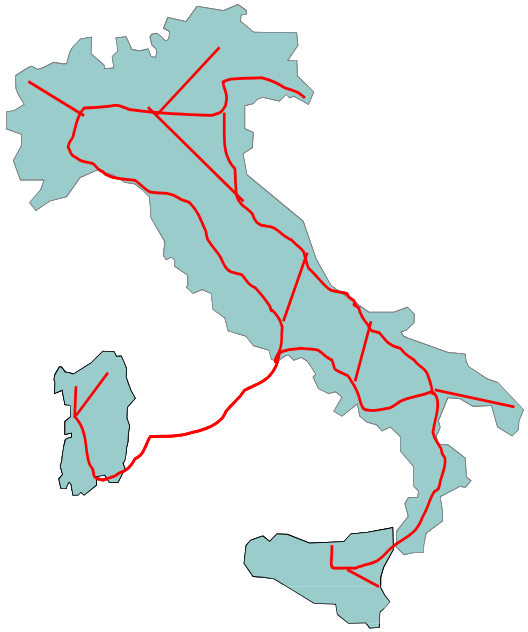
Rai contribution and distribution network
Topology and transported services

- The Rai transport network for audio/video contribution and distribution services (WayNet) is developed on the national territory and it is composed of
  - About 120 nodes
  - 5 main trunks
- Contribution services
  - 4 national Production Centres
  - 21 Regional Centres (regional news)
  - 60 insertion points (OB contribution)
- Distribution services
  - To the main transmitting sites

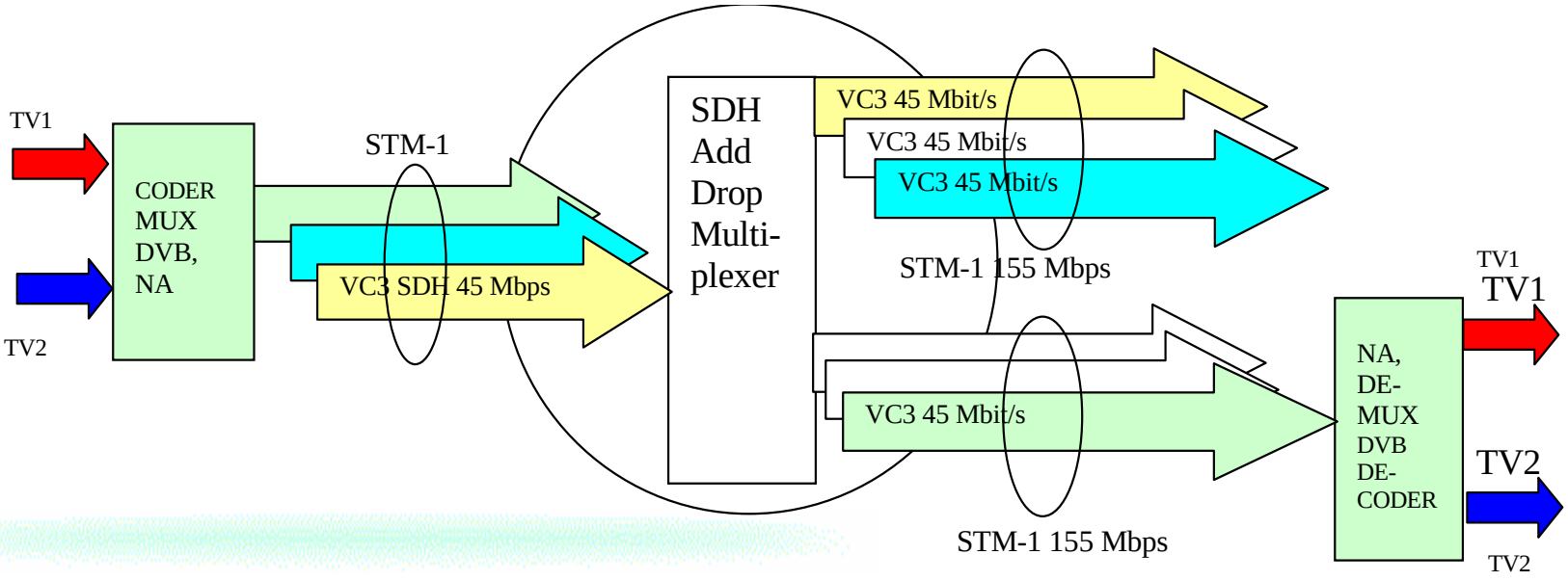


Current network technology (1)

- SDH (Synchronous Digital Hierarchy) radio links
- Nx155 Mbit/s (NxSTM-1, N varying from 1 to 3), each composed of:
  - Up to 3 VC-3 containers (45 Mbit/s) for TV signals
    - Multiplexed in a single MPEG-2 TS
  - Each VC-3 can carry
    - Contribution services:
      2 TV signals coded at 19 Mbit/s (MPEG 4:2:2 profile)
    - Distribution services:
      3 TV signals coded at 12 Mbit/s (MPEG MP@ML profile)
  - 21 VC-12 containers (2 Mbit/s) for audio (radio and telephony) and data streams

Current network technology (2)

- Signal switching is carried out by ADMs (Add-Drop Multiplexer) or DXCs (Digital Cross Connect)
  - At VC-3 or VC-12 level
  - Limitation in the network flexibility: it is not possible to route independently video signals carried in the same VC-3 to different destinations



Evolution in the services carried by the network

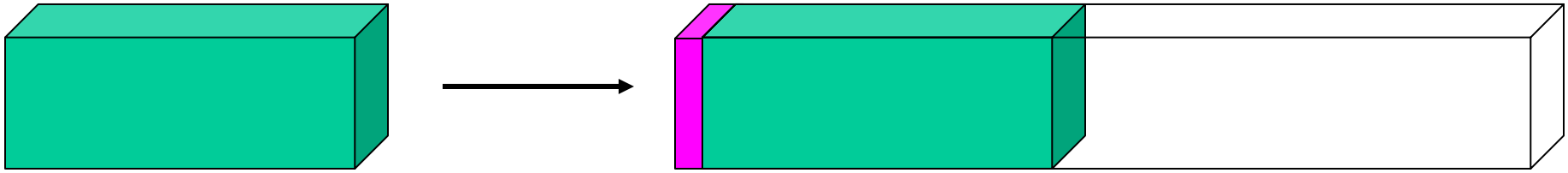
- Launch of two DTT MUXes
  - Distribution of the national programmes from Rome to the 20 Regional Centres, and distribution of the aggregate bouquets with regional insertions from the Regional Centres to the main DTT transmitters
- Gradual migration to video-file transfer
  - Foreseen increase in the future of IP-based traffic for non real-time video-file transfer (server-to-server)
    - Accompanied by an increasing emphasis, in the production area, on server-based storage and file-based distribution of media
  - Likely reduction in the real-time video traffic
- Higher network flexibility will be required

Increasing network flexibility

- The main current limitation is due to the VC-3 granularity
- Flexibility could be increased by adding an intermediate switching layer to the network
  - A certain number of technologies have been evaluated in laboratory and on real links
    - ATM
    - IP
    - DTM
  - Unfortunately, these solutions would require heavy interventions on the existing and operational Rai SDH network, replacing or upgrading most of the nodes, and on a whole trunk at the same time
- A new solution, based on NG-SDH (Next Generation - SDH), allows to improve the SDH network in a gradual and cost-effective way

NG-SDH
Virtual Concatenation (VCAT)

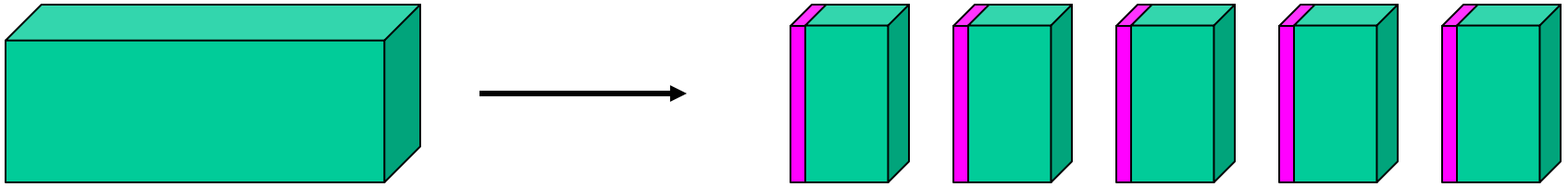
“Classic” use of the bandwidth in SDH networks



PAYLOAD

VC3 + POH

Virtual Concatenation

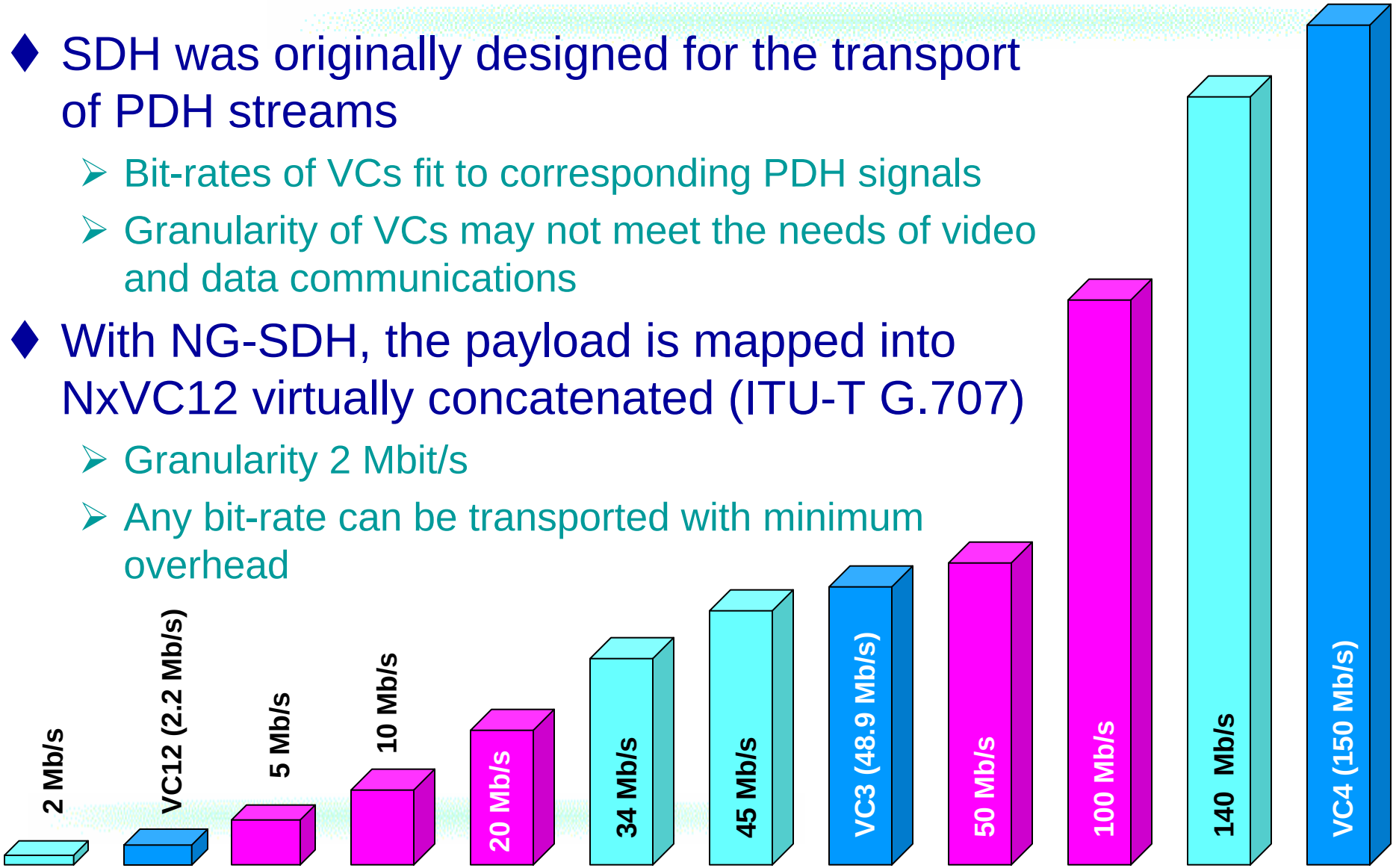


PAYLOAD

VC12#1 + POH | **VC12#2 + POH** | **VC12#3 + POH** | **VC12#4 + POH** | **VC12#5 + POH**

Virtual Concatenation
Transported bit-rates

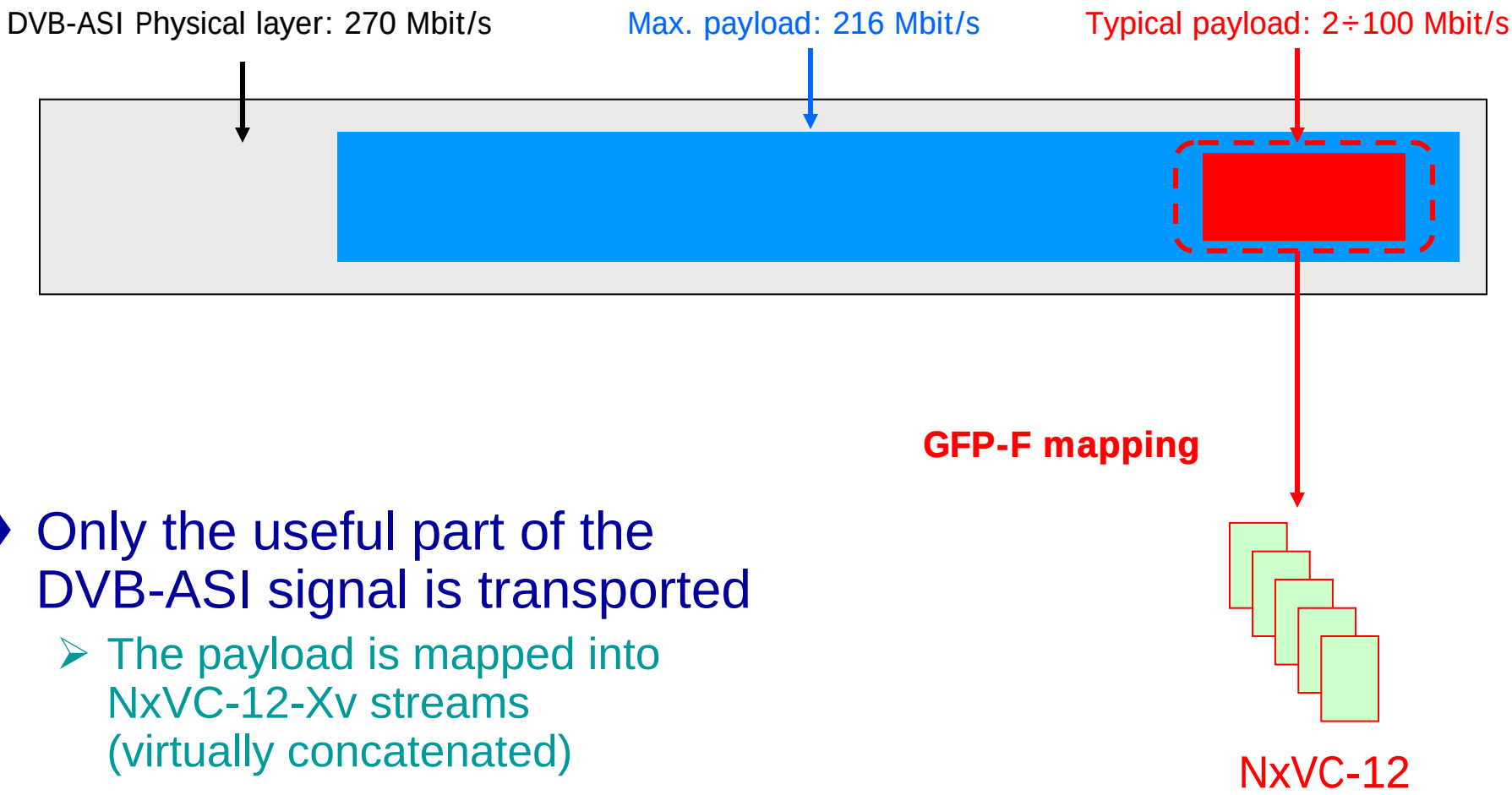
- SDH was originally designed for the transport of PDH streams
  - Bit-rates of VCs fit to corresponding PDH signals
  - Granularity of VCs may not meet the needs of video and data communications
- With NG-SDH, the payload is mapped into NxVC12 virtually concatenated (ITU-T G.707)
  - Granularity 2 Mbit/s
  - Any bit-rate can be transported with minimum overhead



GFP (Generic Framing Procedure)

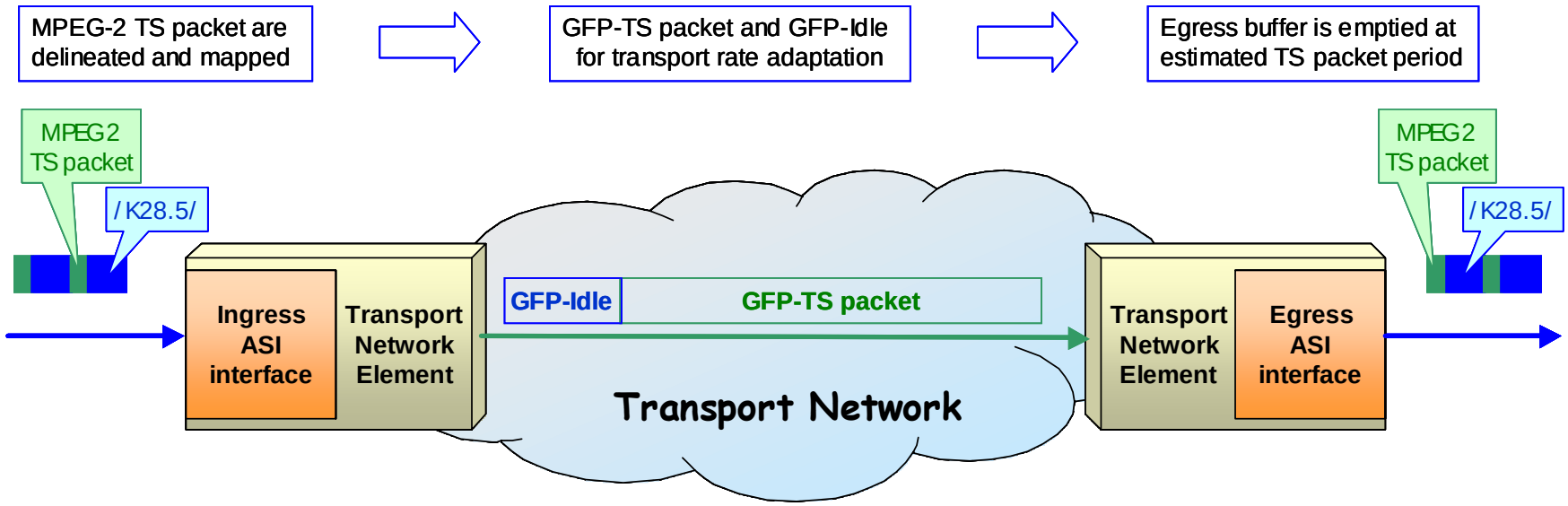
- GFP is a new advanced encapsulation mechanism allowing to transport various payload types over NG-SDH
  - ITU-T G.7041
  - Allows interoperability among equipments from different manufacturers
- GFP-T (Transparent): transport of 8B/10B block-coded client signals
  - Limited bandwidth efficiency
  - Low latency
- GFP-F (Frame mapped): adaptation of client payload using a frame-by-frame mapping
  - Higher bandwidth efficiency

GFP-F mapping of DVB-ASI signals



- Only the useful part of the DVB-ASI signal is transported
  - The payload is mapped into NxVC-12-Xv streams (virtually concatenated)

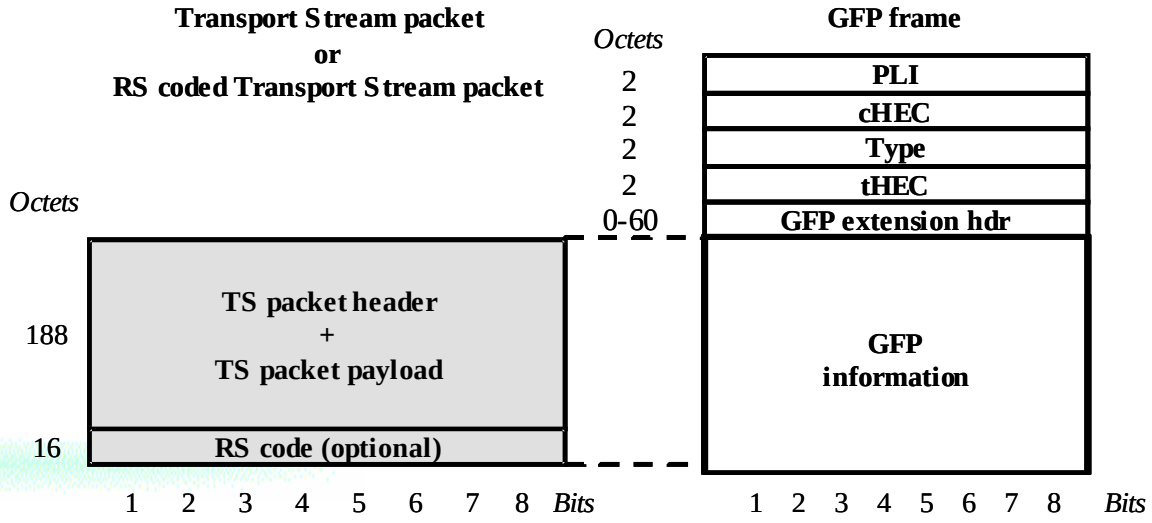
GFP-F mapping of DVB-ASI signals
Operations



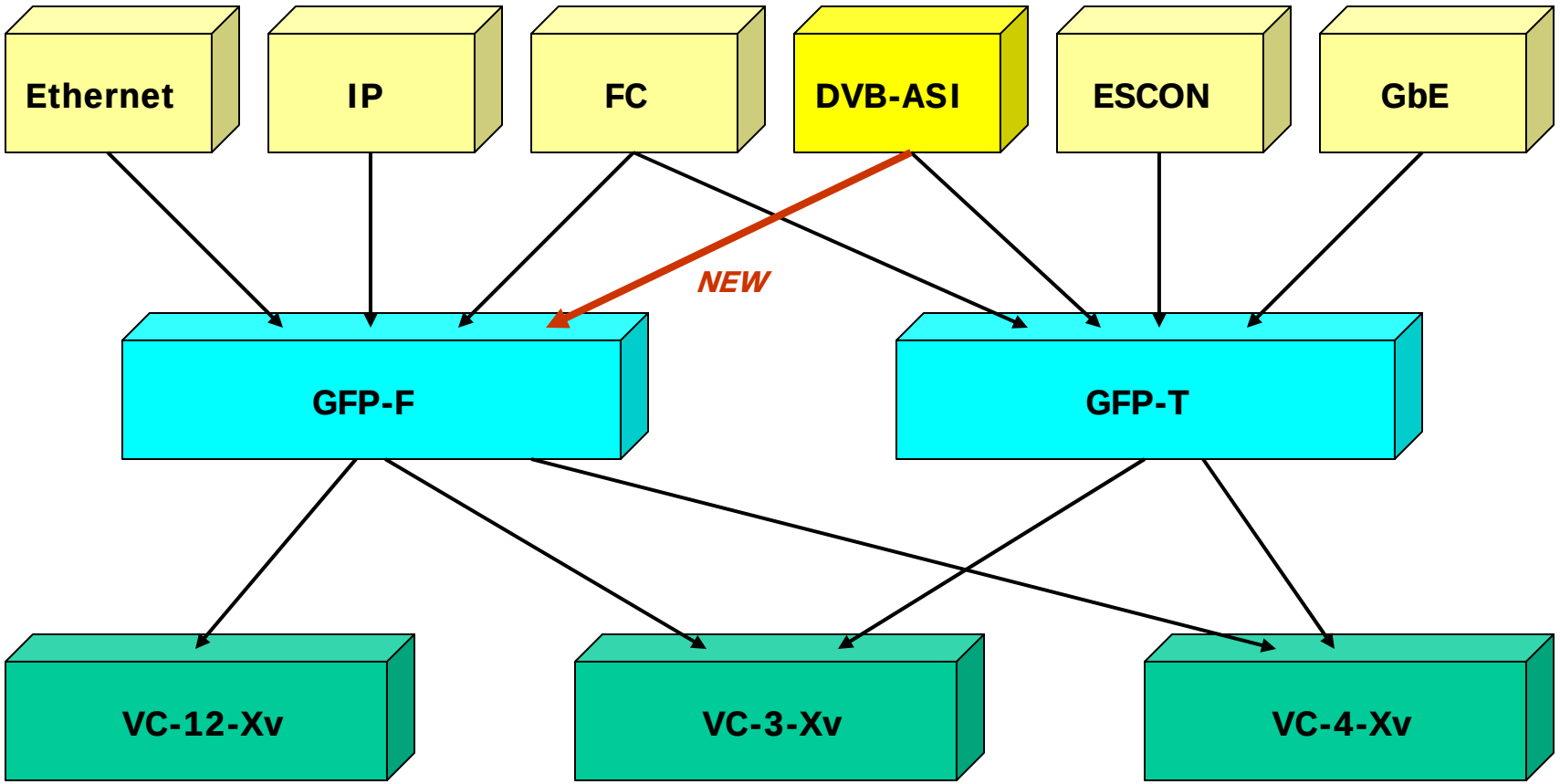
- GFP idle frames are used to adapt the MPEG-2 TS rate to the Transport Network rate
- The arrival time of the client GFP frames is used to estimate the original TS packet period

GFP-F mapping of DVB-ASI signals
Integration to the ITU-T G.7041 standard

- Mapping of 188 or 204 bytes TS packets
- The proposal has been discussed and approved during the ITU-T SG15 meeting in May 2005
  - Document presented by Italy
  - Equipment specifications expected in February 2006
    - Fault management, etc.
    - ITU-T standards G.783, G.784, G.774.x



GFP (Generic Framing Procedure)

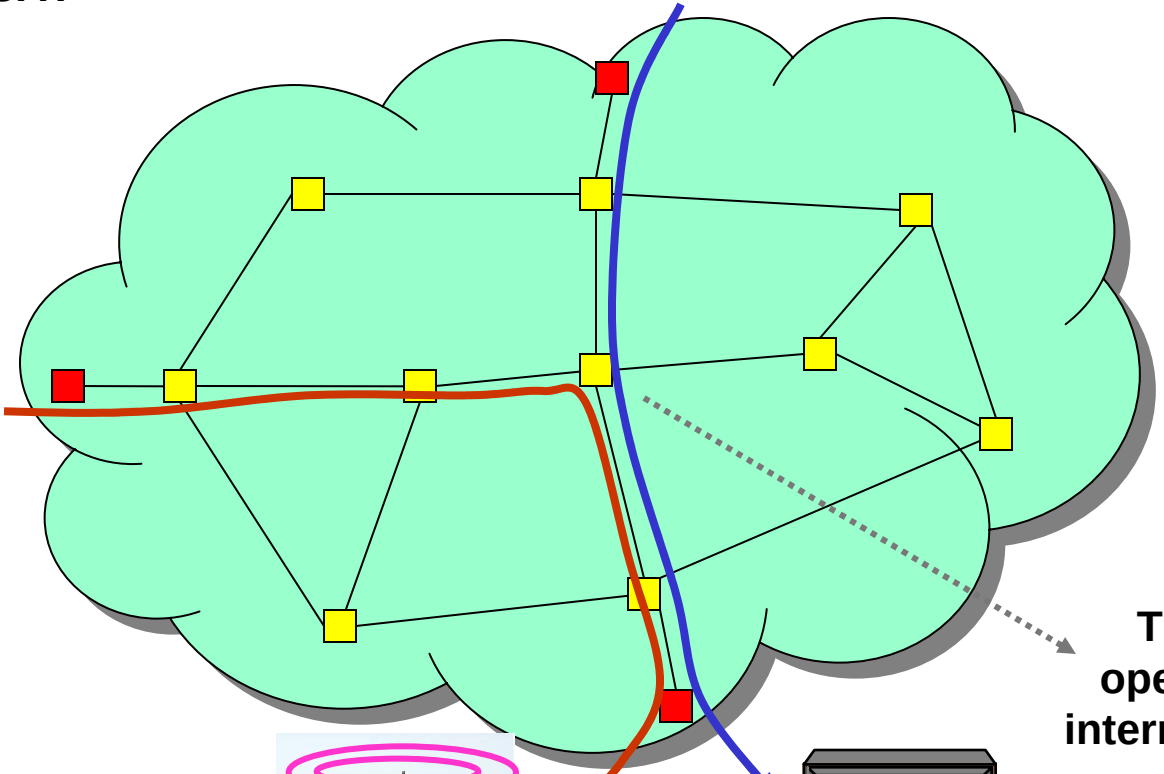


Evolution of the network towards NG-SDH

- Current TV contribution and distribution networks based on SDH can easily and gradually evolve towards NG-SDH
  - Video streams are set-up as VCAT circuits
  - Only (some of) the terminal nodes (video insertion and extraction) have to be replaced
  - The existing trunk ADMs are transparent with respect to virtually concatenated streams
    - Switched as standard VC-12 streams
- New services can be efficiently transported by the same network
  - I.e. video-file transfer over IP connections

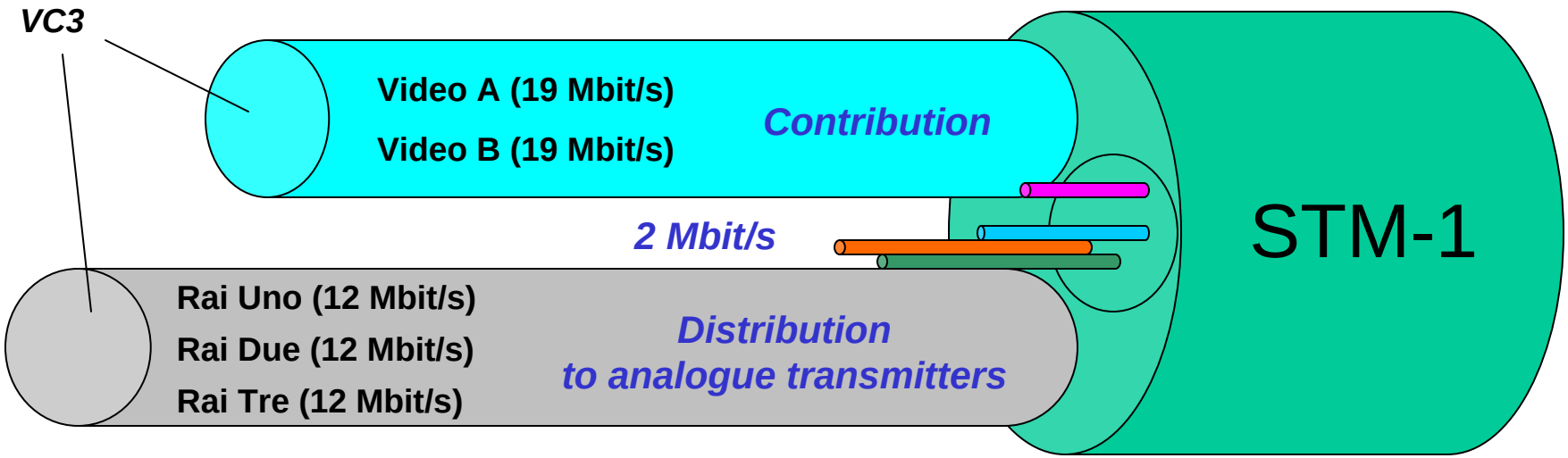
Evolution of the network towards NG-SDH

- **"Classical" ADMs**
- **ADMs with VCAT**



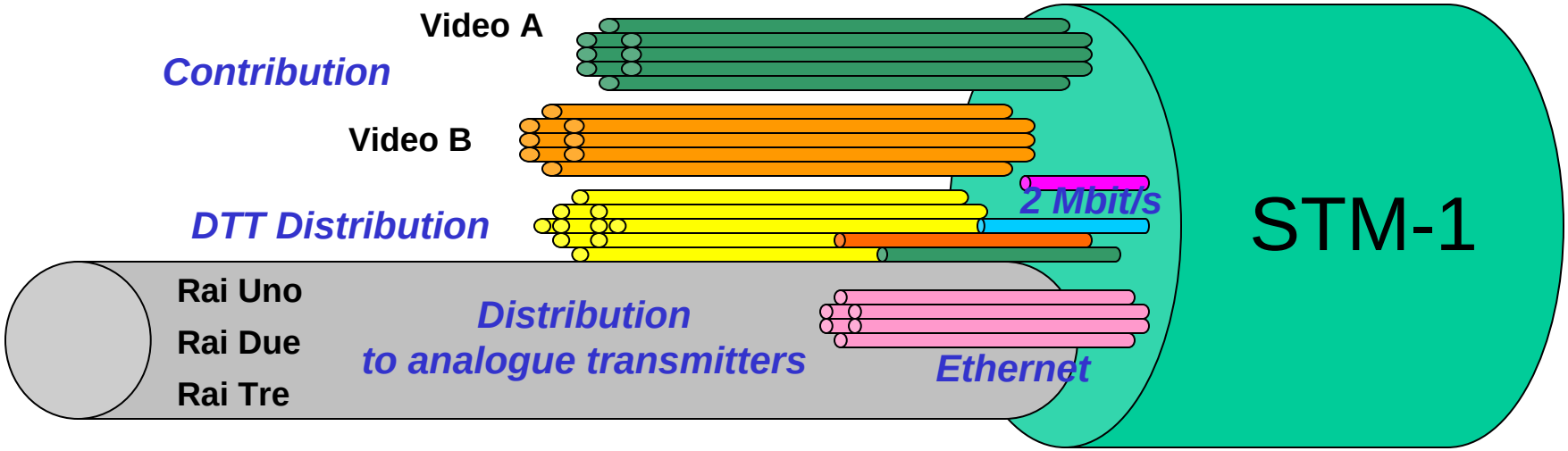
Transparent operation in the intermediate nodes

Rai contribution and distribution network
Current capacity allocation



- Video A and Video B have to share source and destination
- A whole VC3 has to be dedicated to 2 Mbit/s circuits, if needed
- A whole VC3 has to be dedicated in case of DTT distribution

Rai contribution and distribution network
Possible capacity allocation using VCAT



- Video A and Video B can be routed independently
- DTT distribution and 2 Mbit/s streams use only the needed portion of the bandwidth
- Part of the bandwidth can be dedicated to IP (Ethernet)
- VC3 switching can still be used, if needed

Evolution towards NG-SDH
Rai activities

- Contribution to the standardisation process (ITU-T)
  - GFP-F mapping (G.7041, May 2005)
- Contribution to specification and design of DVB-ASI / GFP-F interface cards
  - Co-operation with an equipment manufacturer
- Laboratory tests on first prototypes
  - Planned in Q4 2005
- Trials on real connections
  - Starting Q1 2006

Conclusions

- NG-SDH technology allows to build flexible networks for TV contribution and distribution
  - Alternative solution to ATM, IP, DTM
  - Payload mapped into NxVC12 virtually concatenated
  - Bandwidth can be shared with new services (e.g. IP)
- GFP-F mapping of DVB-ASI signals recently standardised in ITU-T
- Easy and gradual evolution towards NG-SDH of existing networks based on SDH
  - Cost-effective solution
    - Only the terminal nodes have to be replaced
    - The existing trunk ADMs are transparent
- Rai is actively working on this technology