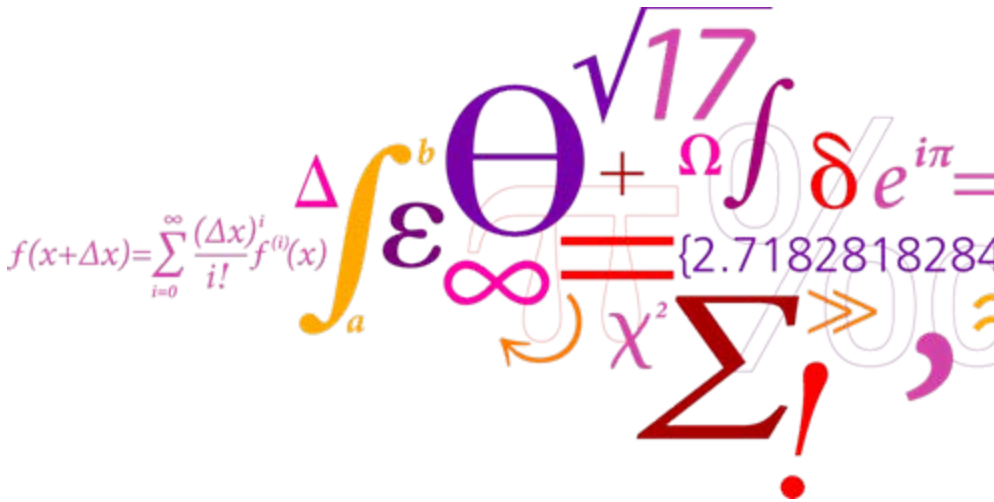
DTU FOTONIK

Ann Ukhanova, Lars Dittmann and Søren Forchhammer

Technical University of Denmark



DTU Fotonik
Institut for Fotonik

TECHNICAL UNIVERSITY of DENMARK
DTU

Established Nov. 5 1829 by H.C. Ørsted

DTU today:

- **4500 employees in 18 department**
- **7000 students (about 10% international students)**
- **Member of ”Nordic 5 Tech”**
  (KTH, Chalmers, NTNU, TKK, DTU)
- **Member of ”European University Alliance in Science and Technology”**
  (TU Münich, TU Eindhoven, DTU)

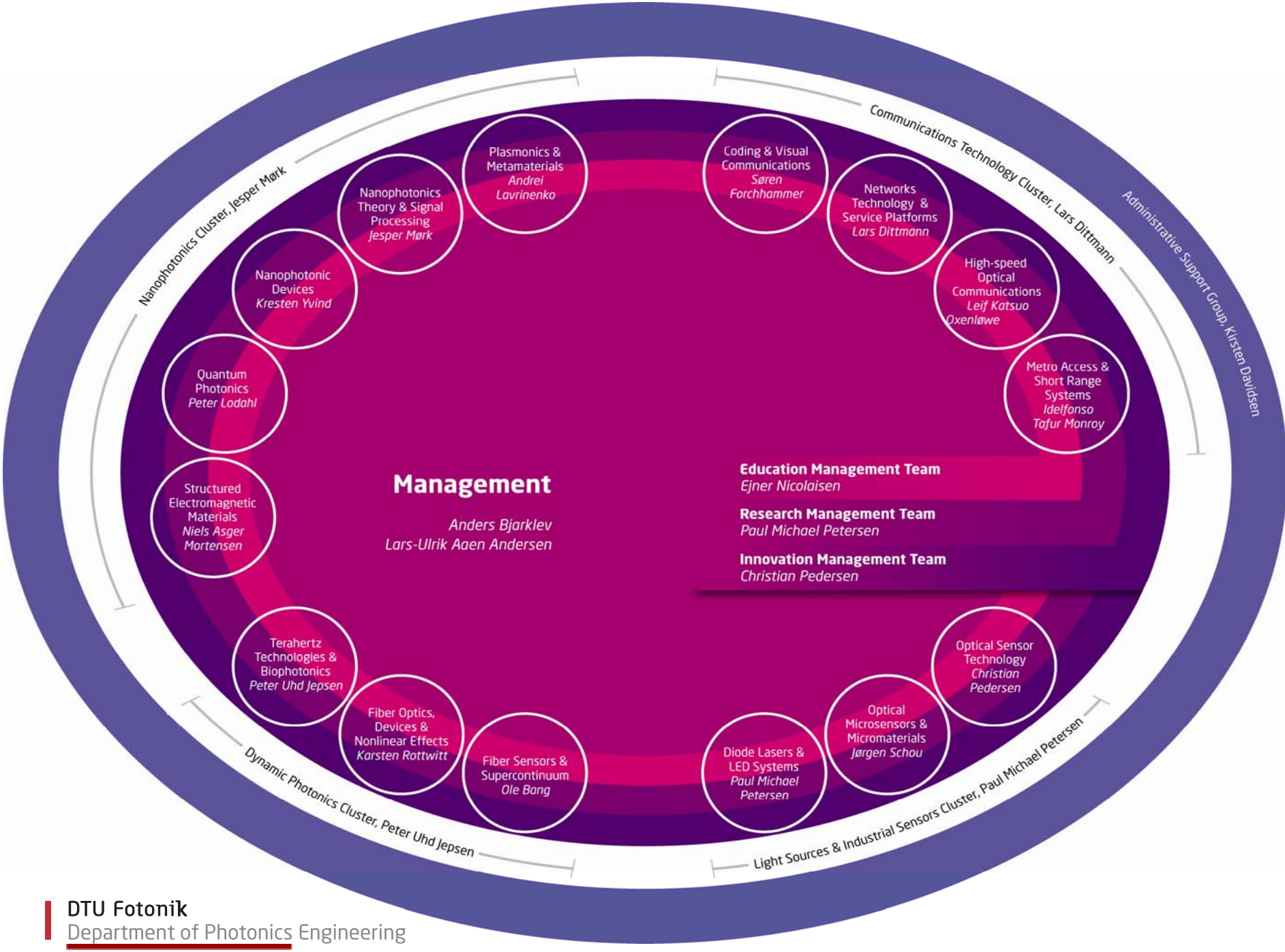
Today DTU FOTONIK is…

DTU FOTONIK =

COM department + Photonic research group from RISØ Research Center (2007).

150 researchers
(including 50 PhD students)

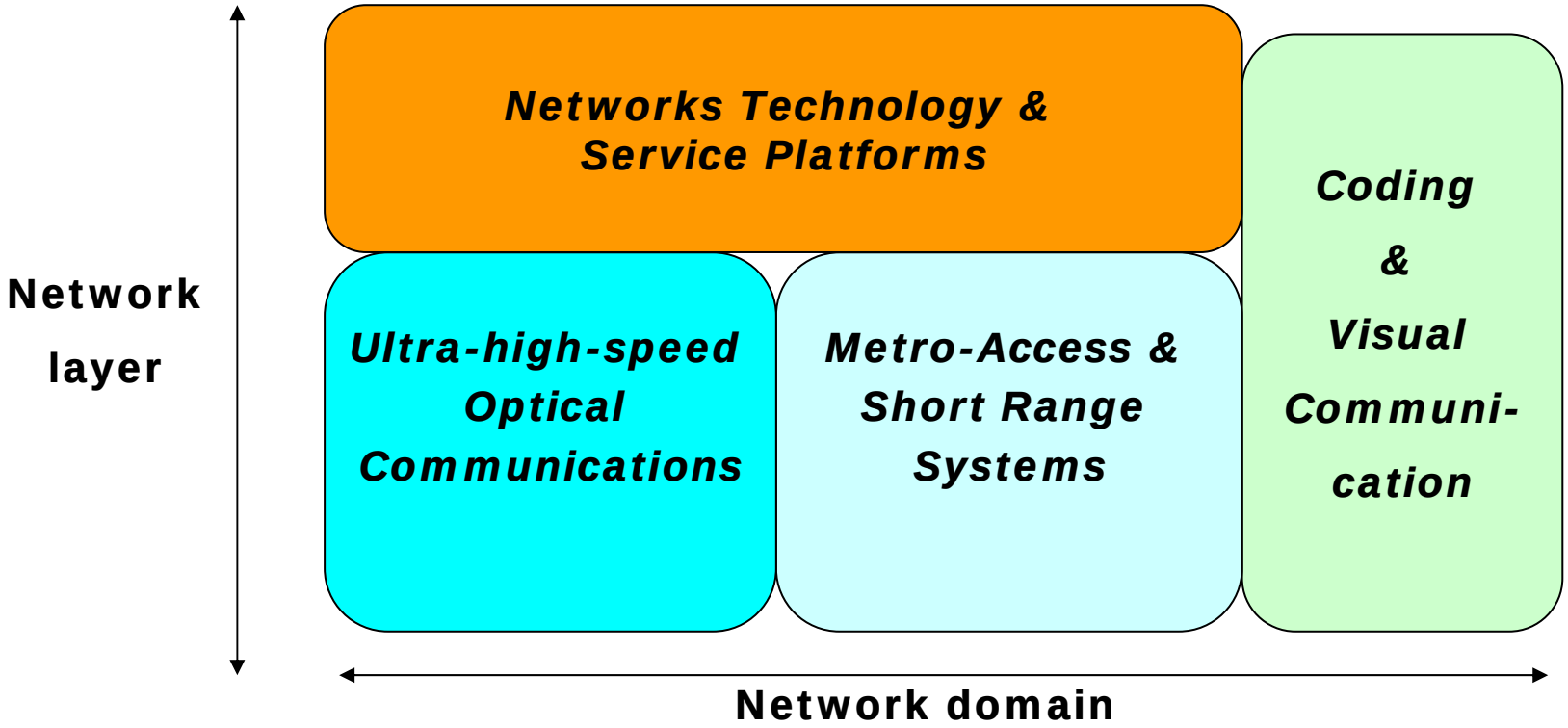
Structured into 18 groups organized as 4 clusters


Nanophotonics Cluster, Jesper Mørk
Communications Technology Cluster, Lars Dittmann
Administrative Support Group, Kirsten Davidsen
Dynamic Photonics Cluster, Peter Uhd Jepsen
Light Sources & Industrial Sensors Cluster, Paul Michael Petersen
Plasmonics & Metamaterials Andrei Lavrinenko
Nanophotonics Theory & Signal Processing Jesper Mørk
Nanophotonic Devices Kresten Yvind
Quantum Photonics Peter Lodahl
Structured Electromagnetic Materials Niels Asger Mortensen
Terahertz Technologies & Biophotonics Peter Uhd Jepsen
Fiber Optics, Devices & Nonlinear Effects Karsten Rottwitt
Fiber Sensors & Supercontinuum Ole Bang
Coding & Visual Communications Søren Forchhammer
Networks Technology & Service Platforms Lars Dittmann
High-speed Optical Communications Leif Katsuo Oxenløwe
Metro Access & Short Range Systems Idelfonso Tafur Monroy
Optical Sensor Technology Christian Pedersen
Optical Microsensors & Micromaterials Jørgen Schou
Diode Lasers & LED Systems Paul Michael Petersen
Management
Anders Bjarklev
Lars-Ulrik Aaen Andersen
Education Management Team
Ejner Nicolaisen
Research Management Team
Paul Michael Petersen
Innovation Management Team
Christian Pedersen

Research Groups within the Communication Cluster

(aprox. 60 researchers incl. PhD students)

Research and education in wired and wireless communication infrastructures and services.

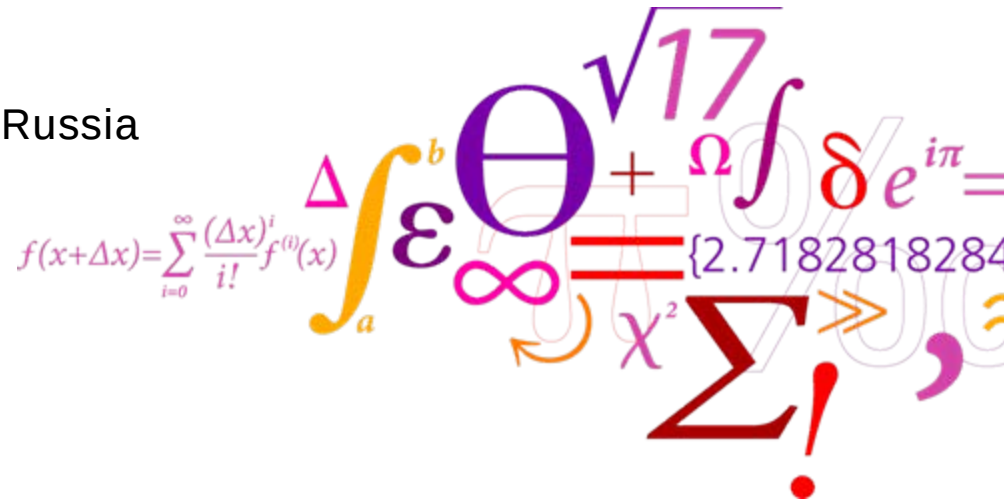


Temporal Scalability Comparison of the H.264/SVC and Distributed Video Codec

Xin Huang[1], Ann Ukhanova[1], Eugeniy Belyaev[2] and Søren Forchhammer[1]

[1]Technical University of Denmark

[2]State University of Aerospace Instrumentation, Saint-Petersburg, Russia



DTU Fotonik
Institut for Fotonik

Outline

- Scalable video coding
- H.264/SVC and DVC
- Temporal scalability
- Efficiency comparison

The main goal

Compare the performance of the temporal scalability for the two scalable solutions and investigate the implementation efficiency for the approximately equal computational complexity:

- Video Codec based on H.264/SVC[1]
- Video Codec based on Distributed Video Coding(DVC)[2]
  - DISCOVER[3]
  - Proposed codec

---

[1]H. Schwarz, D. Marpe, and T. Wiegand, Overview of the Scalable Video Coding Extension of the H.264 / AVC Standard, IEEE Transactions on Circuits and Systems for Video Technology, vol. 17, No. 9, pp. 1103-1120, 2007.

[2]B. Girod, A. Aaron, S. Rane and D. Rebollo-Monedero, Distributed Video Coding, Proceedings of the IEEE, vol. 93, no. 1, pp. 71-83, 2005.

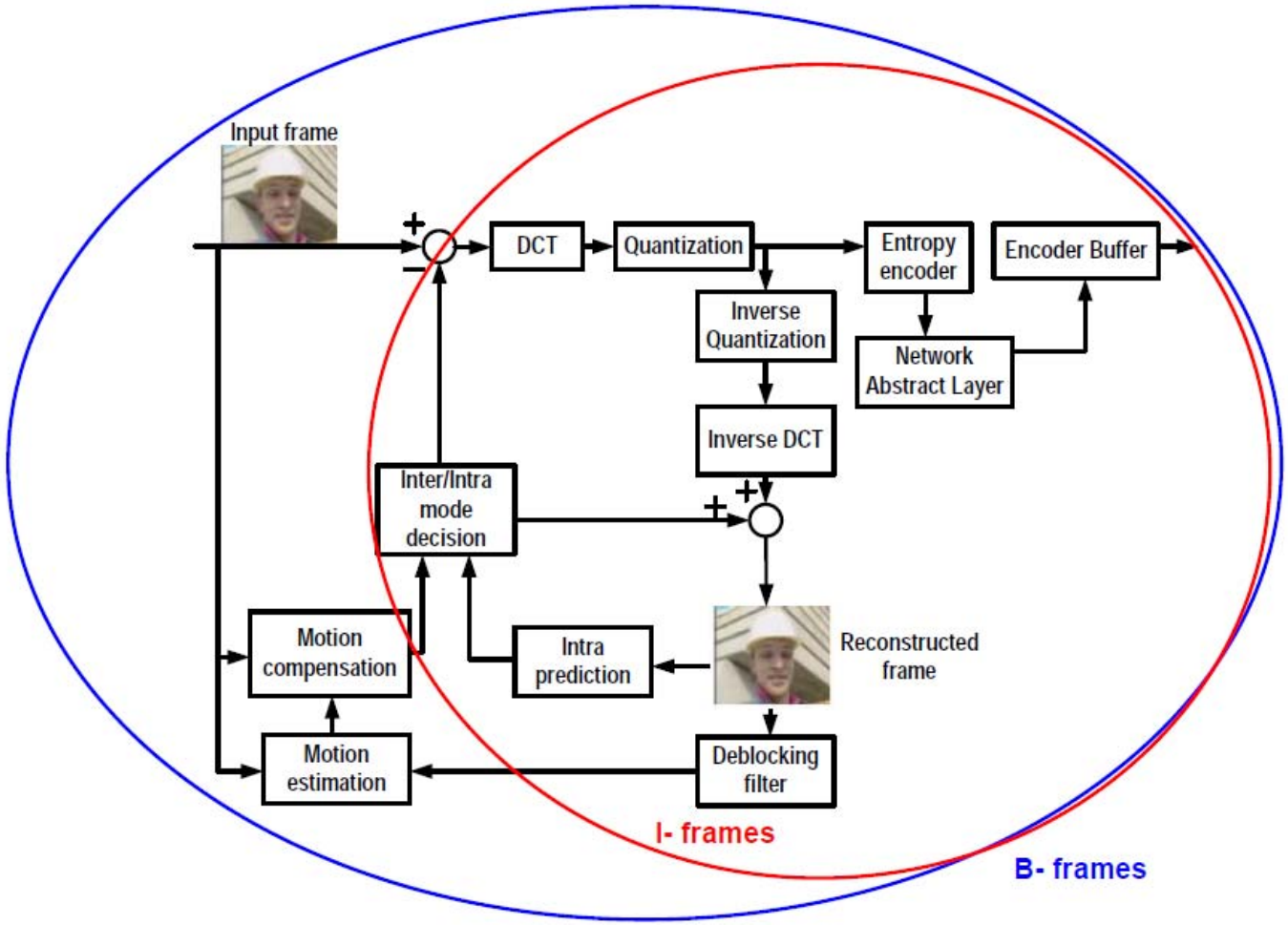
[3]Available on: www.discoverdvc.org.

Use cases: SVC and DVC

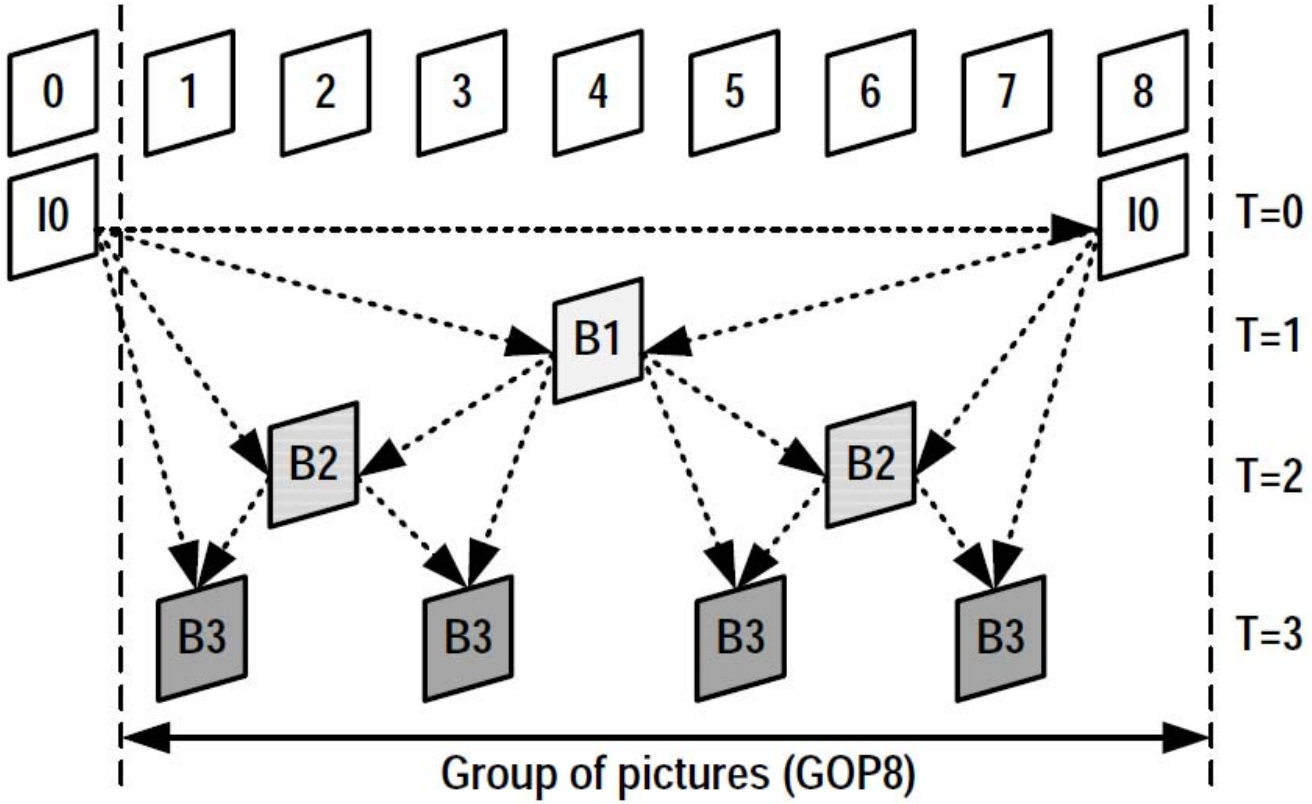
Compare the cases where SVC and DVC are both used:

- **SVC:**
  - video transmission over Internet for the users with different receiving rate
  - digital TV (DVB-T, DVB-H, ATSC, DTMB, ISDB, SBTVD)
  - wireless transmission (on the base of Wi-MAX, WiFi)
- **Including scalable DVC codecs:**
  - wireless video surveillance
  - low-power video sensors
  - wireless digital cameras and camera embedded mobile phones

Main operations for H.264/SVC encoding

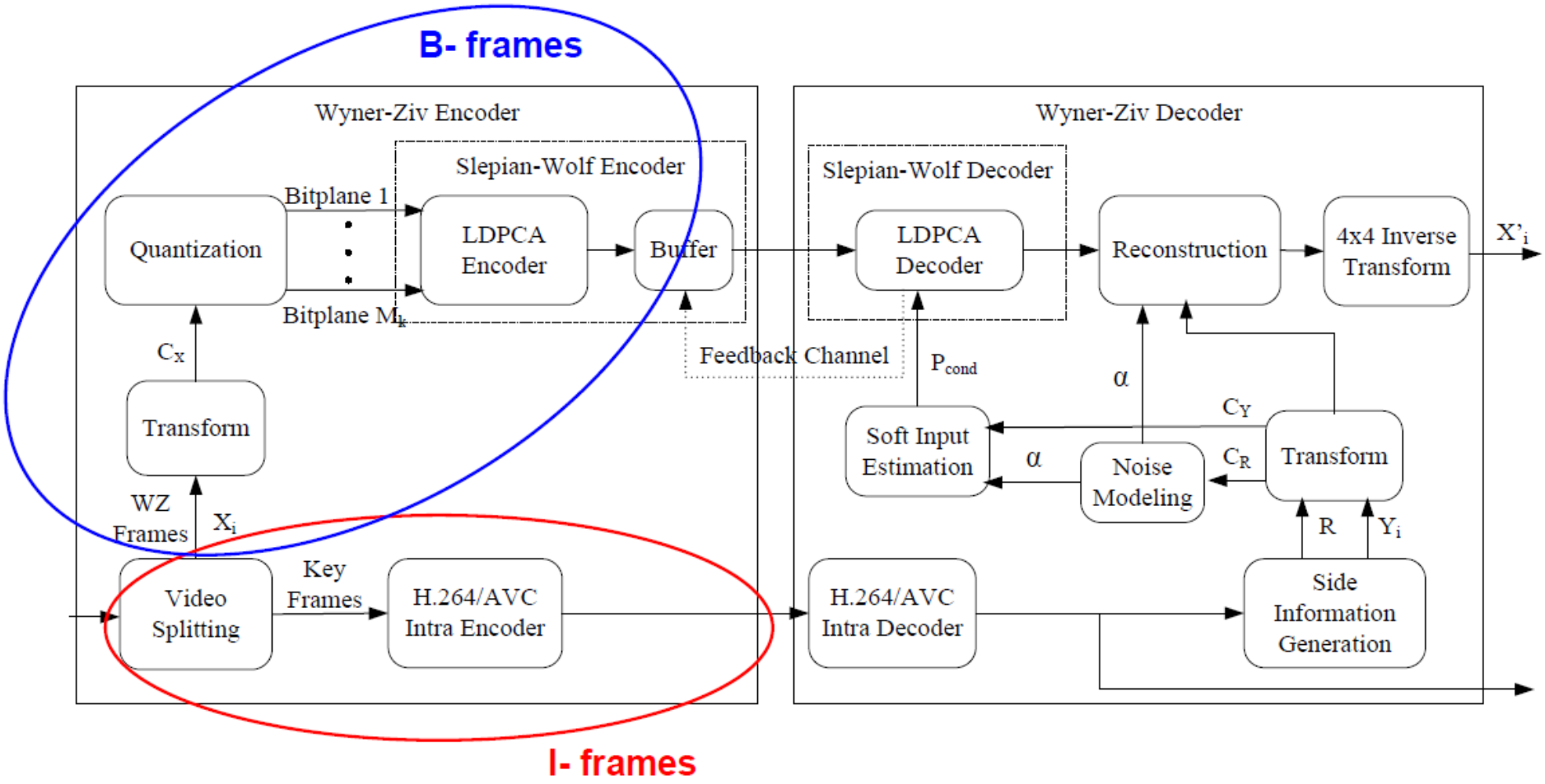


Temporal scalability in H.264/SVC

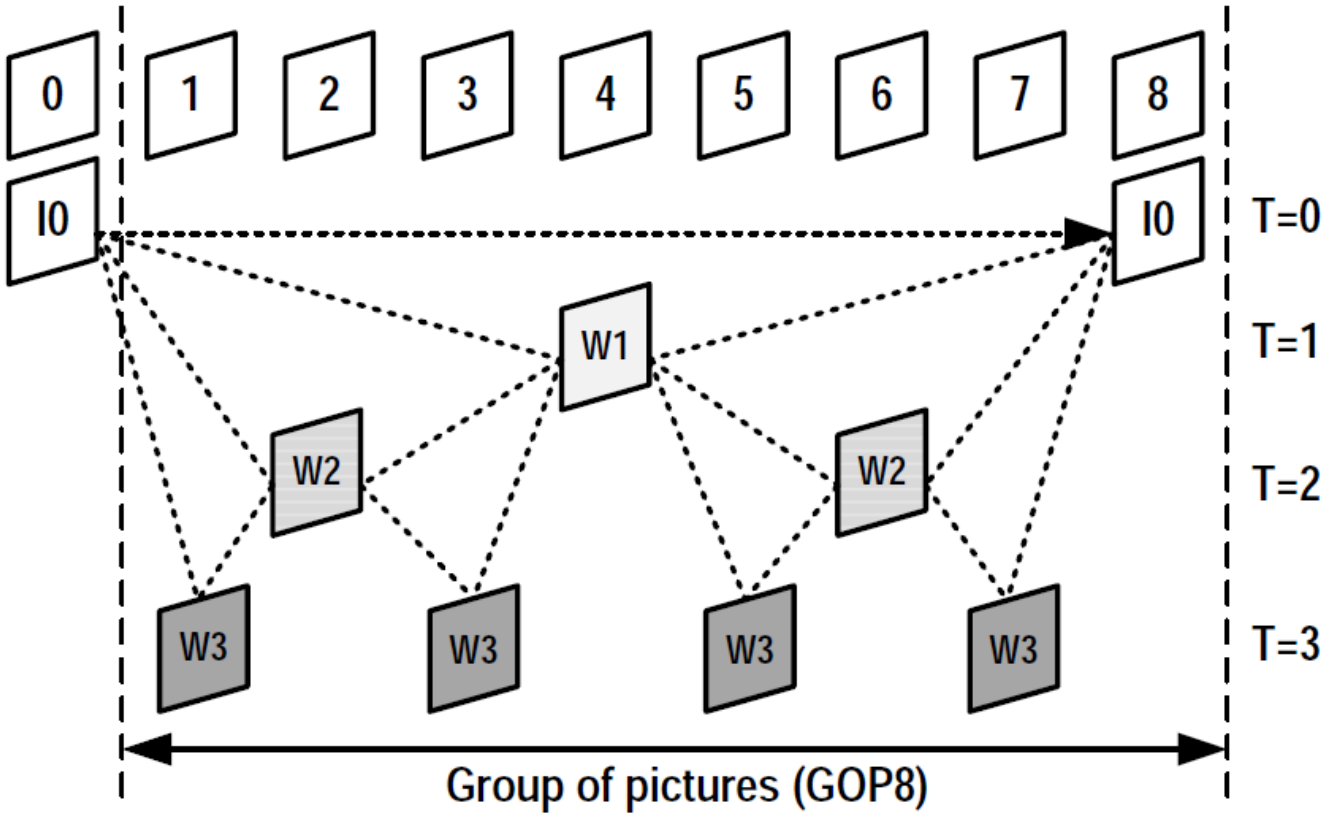


- The pictures of the temporal base layer are only predicted from previous pictures of this layer
- The enhancement layer pictures can be bidirectionally predicted by using the two surrounding pictures of a lower temporal layer as references

Main operations for DVC encoding and decoding



Temporal scalability in DVC



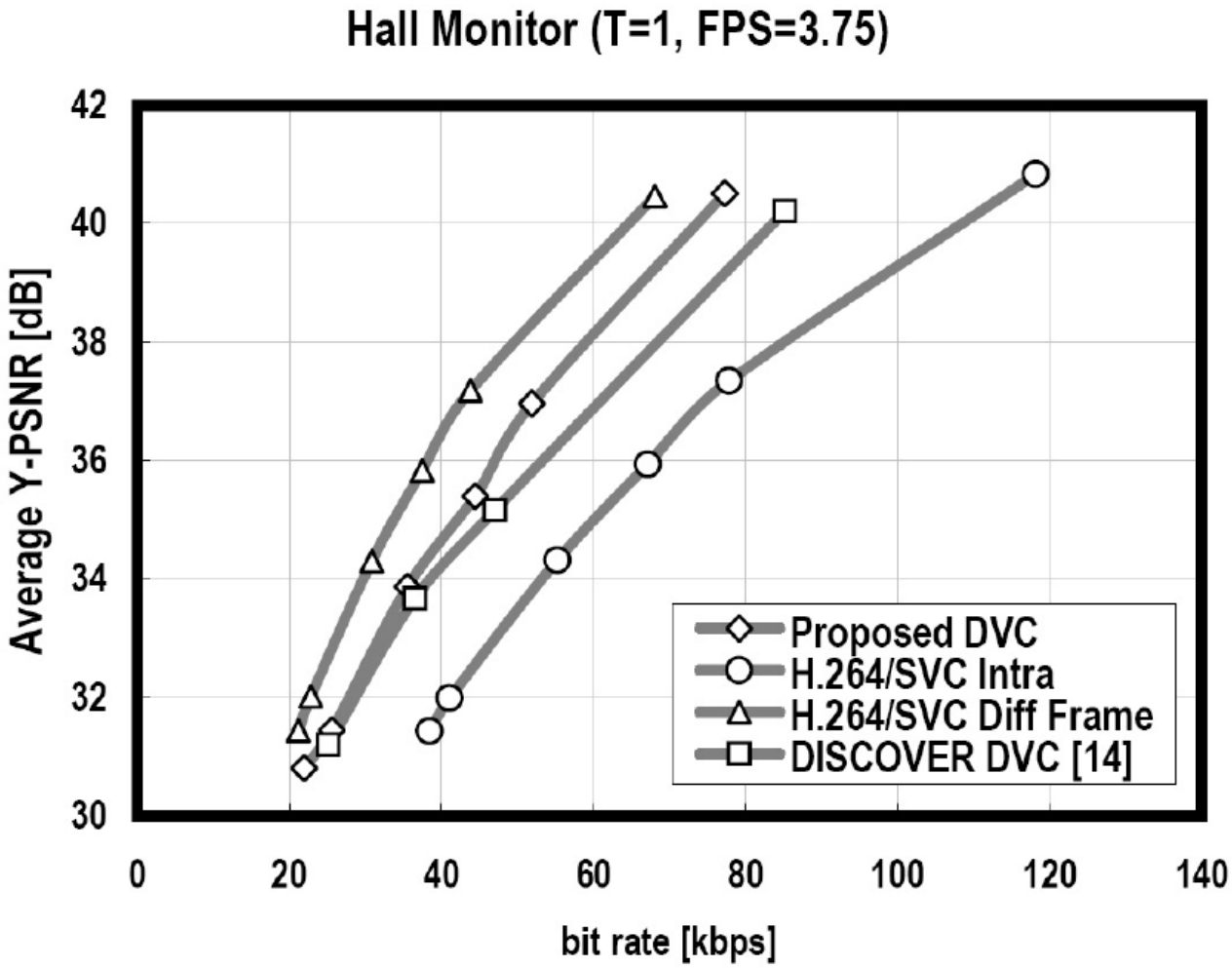
- **Quite similar to the SVC temporal scalability, isn't it?**

Complexity and memory size comparison for GOP8

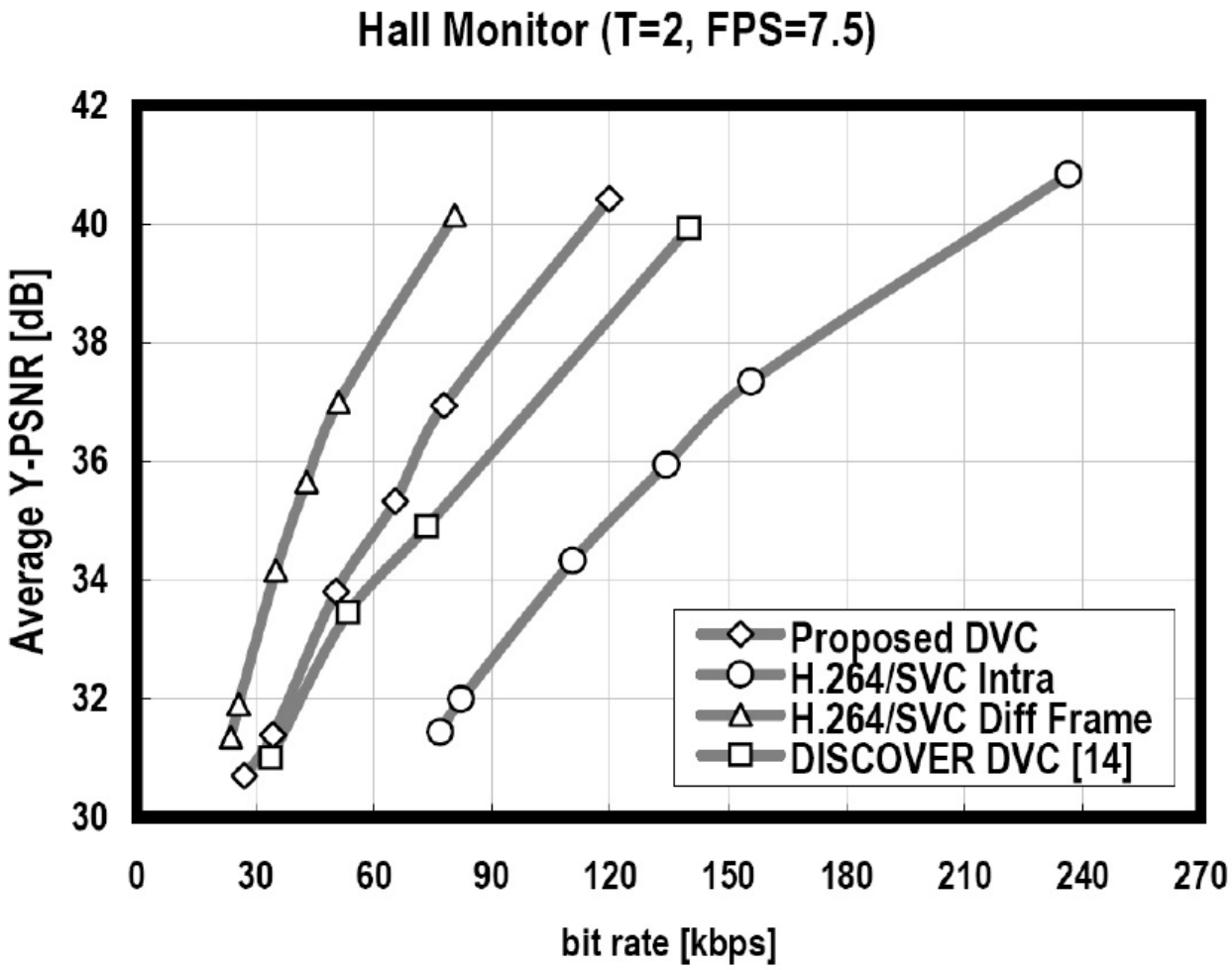
- **Goal: compare for approximately equal encoder complexity**

Encoder type	Computation complexity	Memory
H.264/SVC Intra	Intra prediction, DCT, Quantization, Entropy encoding, IDCT, De-quantization	Less than 1 frame
DVC	DCT, Quantization, LD-PCA encoder, CRC	Equivalent to 1 frame
H.264/SVC Differential frame coding	Inter/Intra mode decision, DCT, Quantization, Entropy encoding, IDCT, Dequantization	More than 8 frames

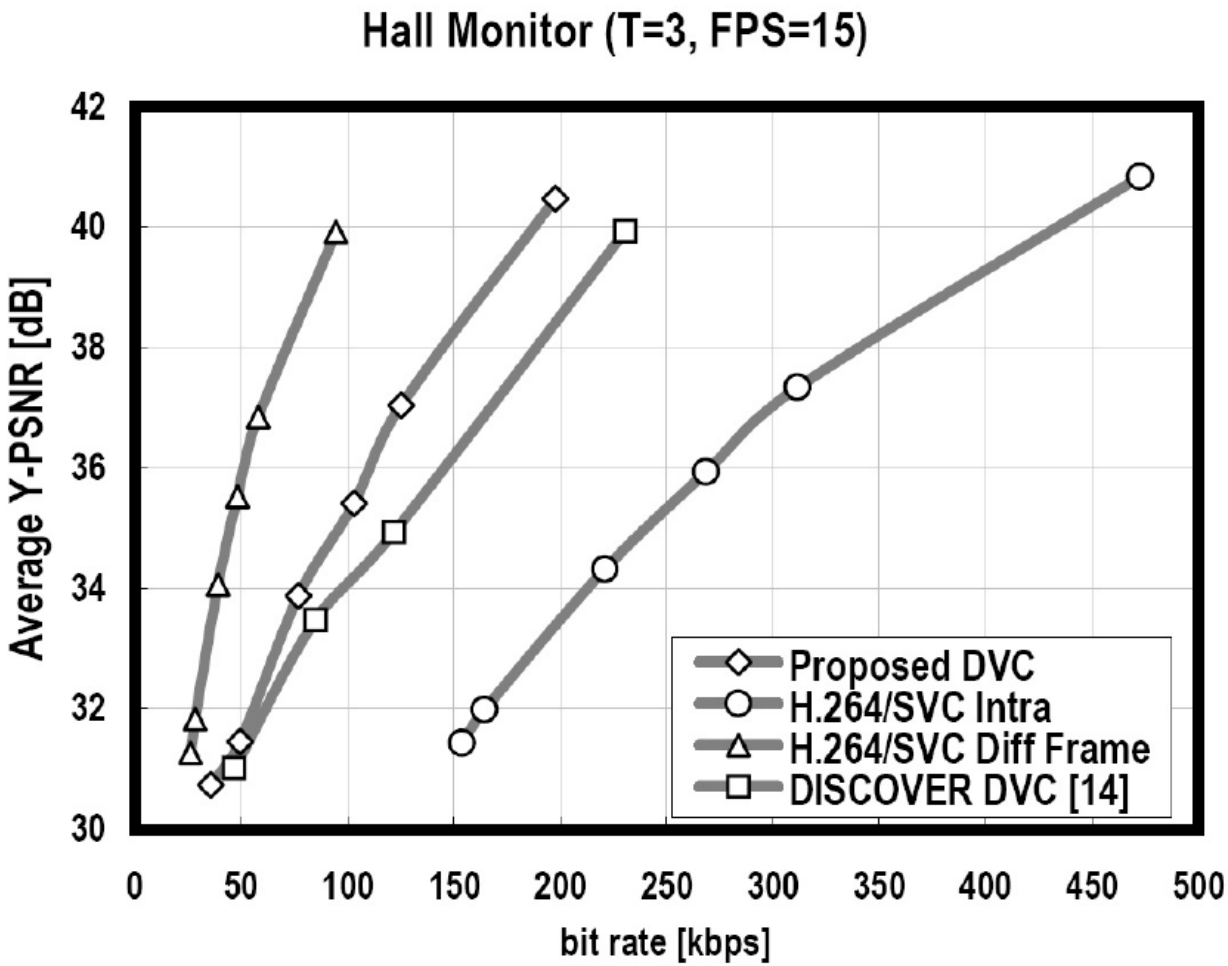
RD comparison for temporal layer = 1



RD comparison for temporal layer = 2



RD comparison for temporal layer = 3



The choice of scalable solution

- If there are strong restrictions on the encoder memory and complexity then only H.264 in the Intra-frame mode can provide temporal scalability

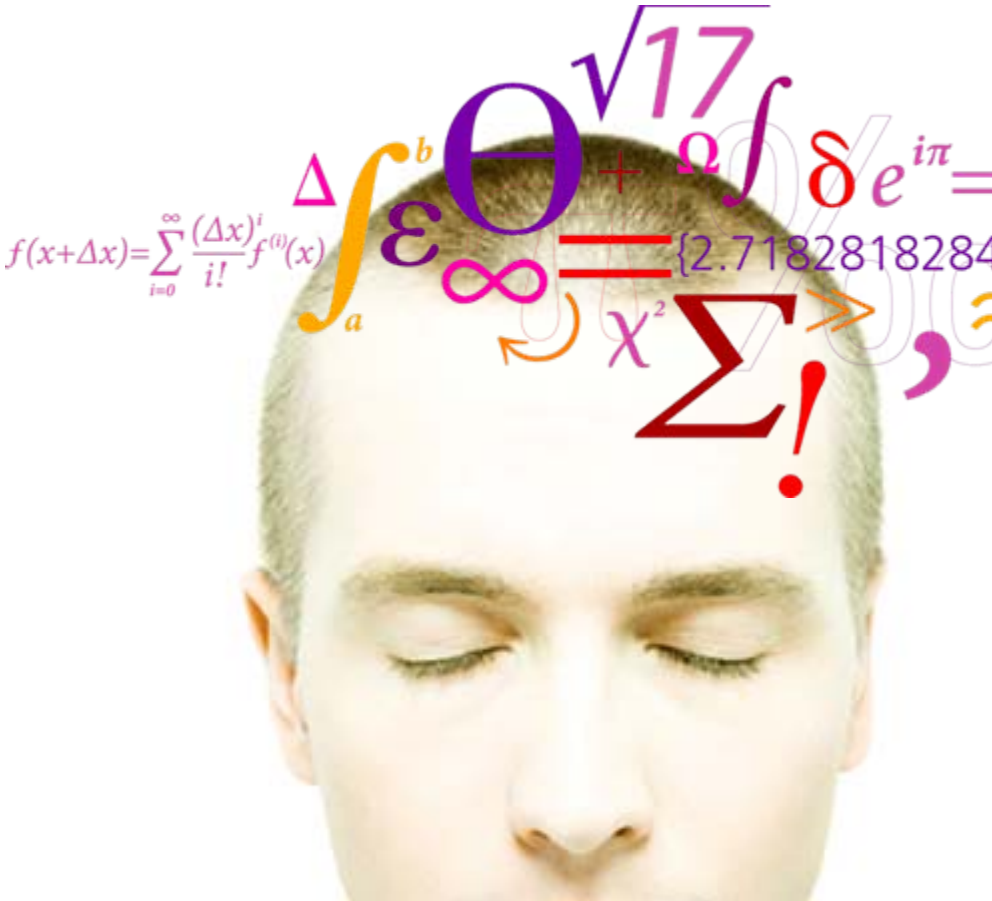
- If the encoder memory is close to one frame and we have complexity restrictions at the encoder then DVC shows better results

- If there are no encoder memory restrictions, but only restriction for the complexity, it is better to use H.264 in the Differential Frame Coding mode

Conclusion

It is shown that with the encoder memory restrictions and availability of the temporal scalability the best method of the encoding should be chosen taking into account the memory restrictions

Thank you


$f(x+\Delta x)=\sum_{i=0}^{\infty}\frac{(\Delta x)^i}{i!}f^{(i)}(x)$
$\int_a^b$
$\sqrt{17}$
$e^{i\pi}=$
{2.7182818284

Proposed codec

There are generally two novelties compared to DISCOVER codec:

- Adaptive weighted Overlapped Block Motion Compensation (OBMC) based side information generation
- Improved coecient level noise model with adaptive Laplacian parameter estimators