

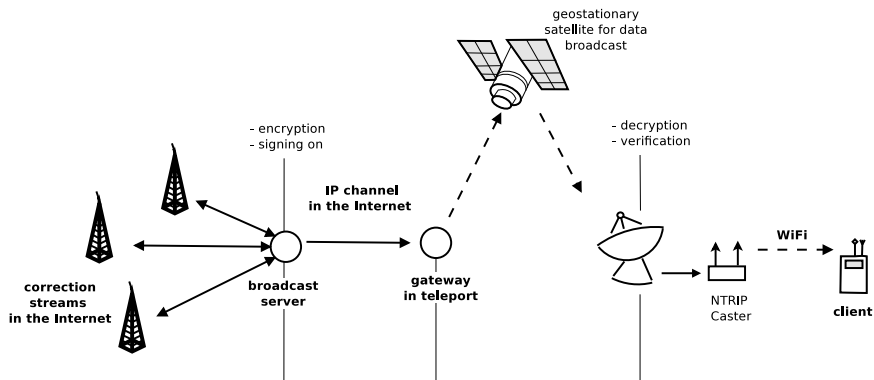
Lossless RTCM data compression for broadcasting via TV satellite links

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Target system, motivation



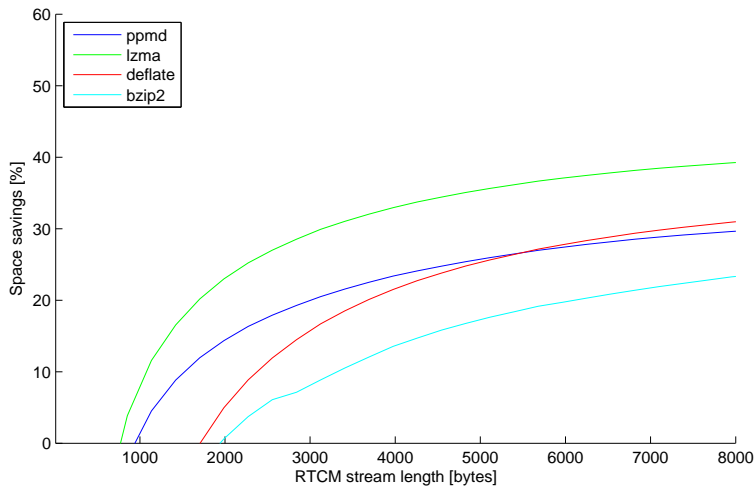
Motivation

- expensive satellite link capacity
- investigation of RTCM SC-104 format

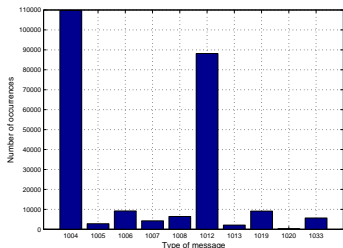
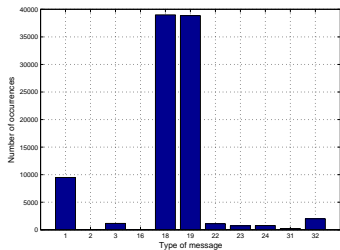
Expected results

- reduction of transmission costs
- reduction of serialization delay

Results for general compression methods



RTCM SC-104 format usage

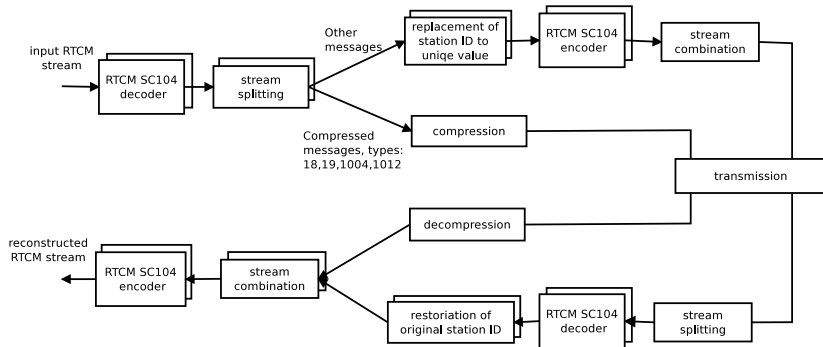


- 200 streams from BKG in Germany inspected
- RTCM 2 - 12%
- RTCM 3 - 88%
- type 18 and 19 - 23.5%
- type 1004 and 1012 - 59.7%
- RTCM 3 format is at least 30% less verbose than RTCM 2, parity bits, "6 of 8" format

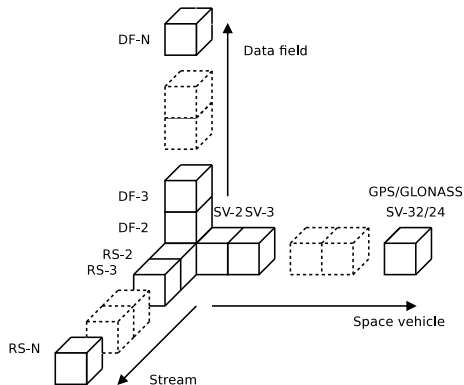
Compression work

- compression “losslessness”
 - not allowed
 - missing messages
 - modified values
 - allowed
 - reordering of messages
 - local replay of messages
- time restrictions
 - delay of decompression start is allowed
 - real-time compression/decompression

Compression construction



Single timestamp compression



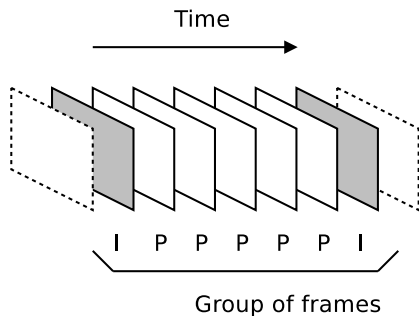
- 3 dimensional representation of messages
- easy navigation using an index
- data fields compression, the horizontal plane
- compression task reduced to a compression of vectors

Vector compression algorithms

- bad performance of dictionary methods
- methods used
 - optimal coding
 - modal value
 - dedicated for data field
- row-by-row or column-by-column
- a profile for every message type

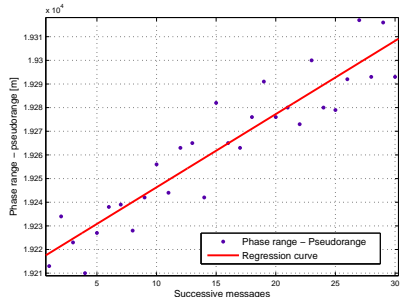
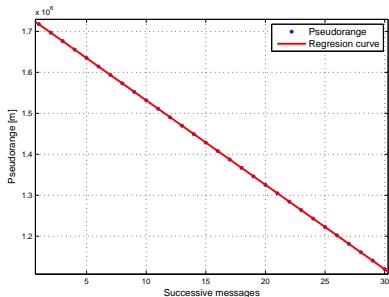
Message type	18	19	1004	1012
Space savings	59.1%	58.2%	24.6%	26.2%

Differential coding in time



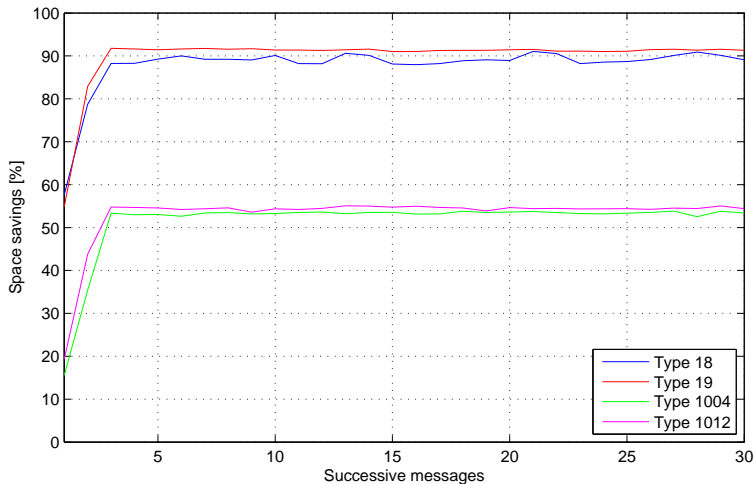
- technique used, e.g., in video codecs
- only difference between successive frames is sent
- minor change
- works in real time
- satellite list update

Time analysis of message content

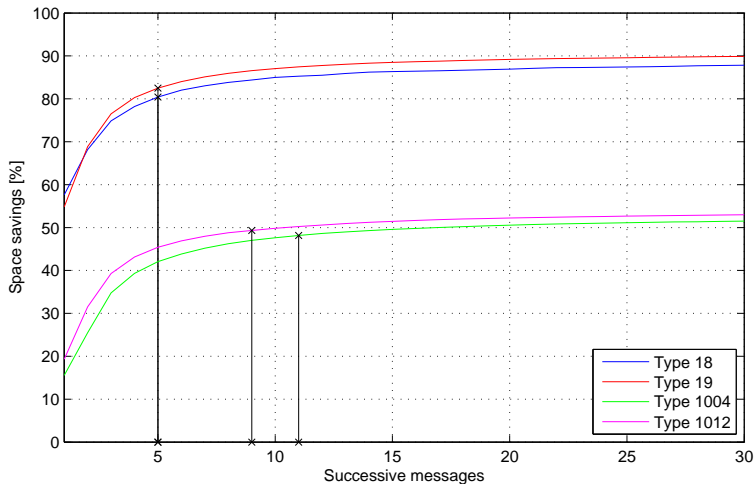


- some values change linearly
- linear error model
- outlier detection

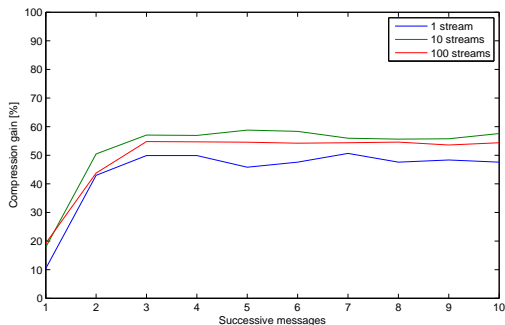
Space savings of I and P frames



Space savings within a time window



Packetizing



no. of streams	I-Frame size B	P-Frame size B
1	127	52
10	1034	554
13	1356	725
38	3982	2141
100	10439	5651

Summary and suggestions for future research

- defined compression/decompression construction
- found and implemented compression techniques for most frequently sent messages
- performed offline tests on two data sets

- check if numerical calculations with precise orbital information improve compression ratio
- perform integration and online tests
- perform field tests with satellite

The End

Thank you for your attention!