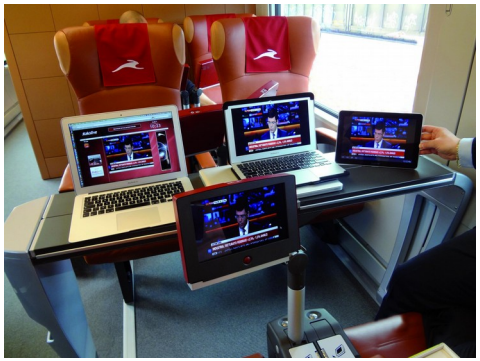

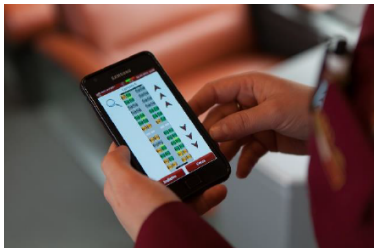

21NET

ENABLER OF THE BEST TRAIN CONNECTIVITY EXPERIENCE

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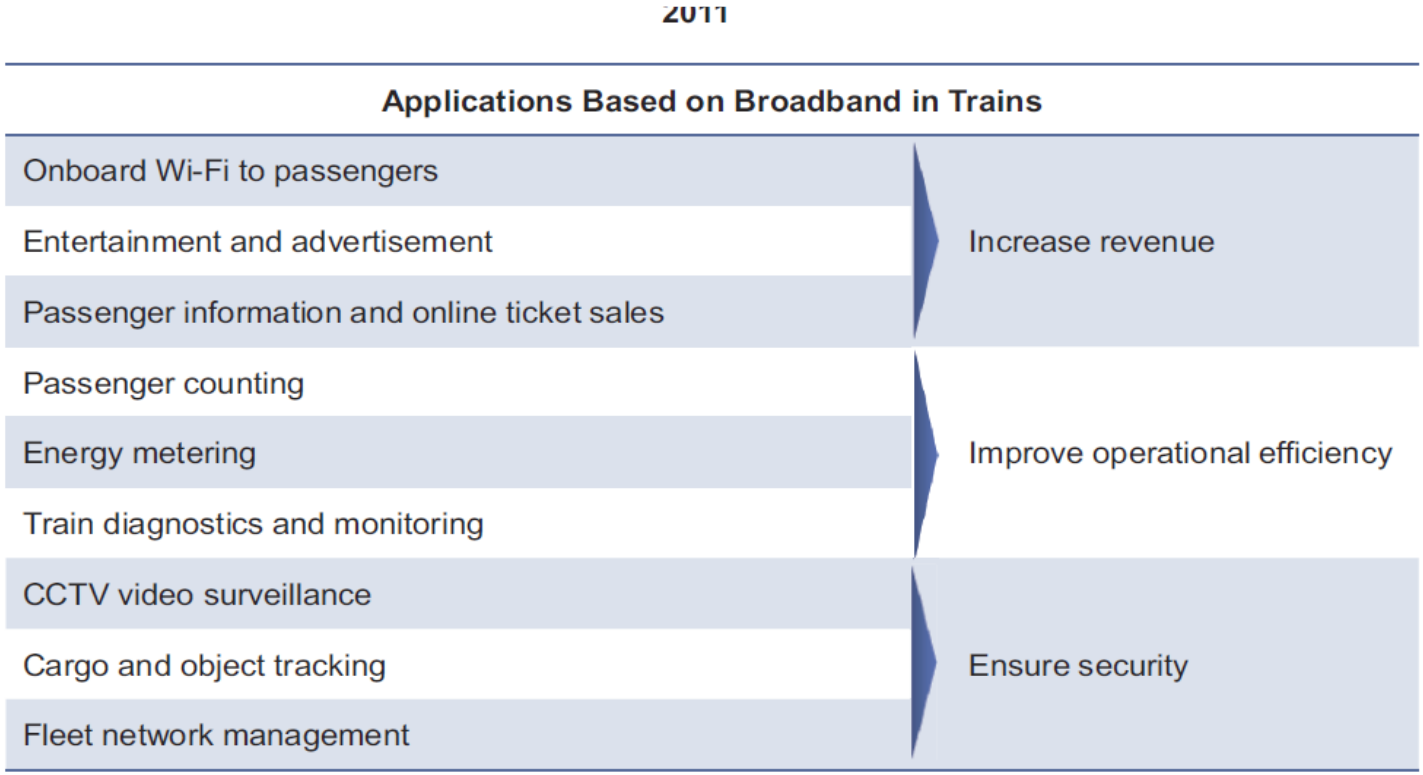
21Net CTO
pierre.eisenmann@21net.com
April 29, 2016

21NET HISTORY

- 2004: Successful satellite tests (Renfe) with ESA funding
- 2005-2008: Research & development incl. tests on SNCF & THALYS
- 2008: THALYS – 26 trains
- 2009: Successful demo in India
- 2011: Successful demo in Russia
- 2012: NTV – 25 trains
- 2013: 3 Luxury trains in India.
- 2014: New solution (21NetBox™)
- 2015-2016:
  - EUROTUNNEL
  - UTA (Utah transit Authority)
  - **CAF/Caledonian Sleepers (SERCO)**
  - SNCF

21NET MARKET: INTERNET ON TRAINS

- Railways operators leverage broadband Internet on trains with multiple applications



Source: Frost & Sullivan analysis.

MAIN TRAIN-GROUND CONNECTIVITY TECHNOLOGIES

	Cellular	Satellite	Track-side
Coverage (capex)	already there	already there	to be deployed
On-train equipment	small, industrial	complex antenna	small, specific
Bandwidth (opex)	subscription with several operators	bandwidth purchase	dedicated
Suitability for Internet access	variable, uncontrolled bandwidth	fleet dedicated train shared	dedicated
Suitability for TV broadcast	No broadcast savings	Broadcast once for all fleet	No savings but large bandwidth

Nice complementarity!

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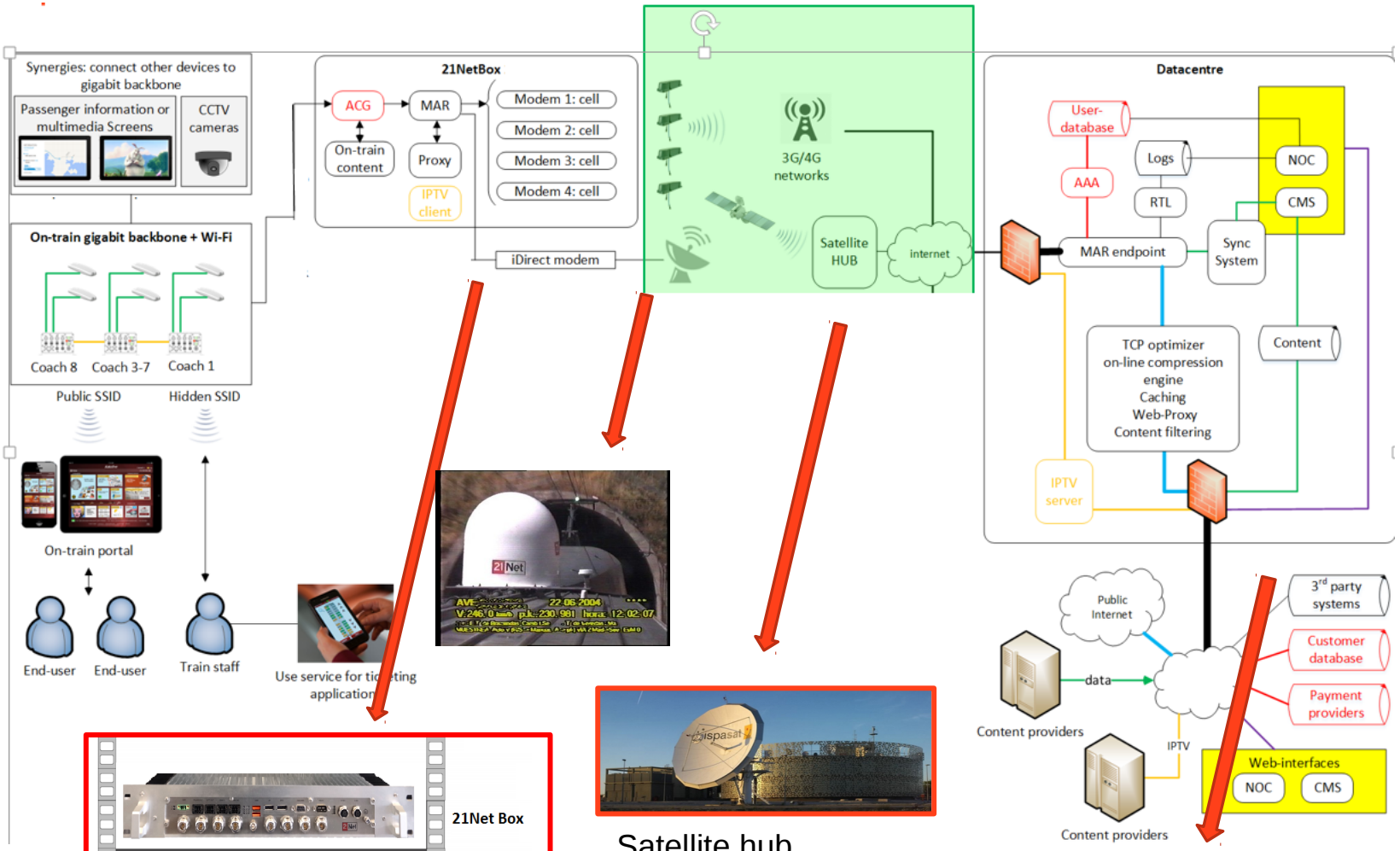
EOMST : END-TO-END OPTIMIZATION OF MOBILE SATCOM TO TRAINS

- Duration:
  - 2014-2015
- Cost:
  - approx. 1.8M€ funding 50% by BELSPO/ESA
- Objective:
  - develop the 3rd generation Mobile Access Router (MAR3)
- Pilot:
  - One test train and three commercial trains.

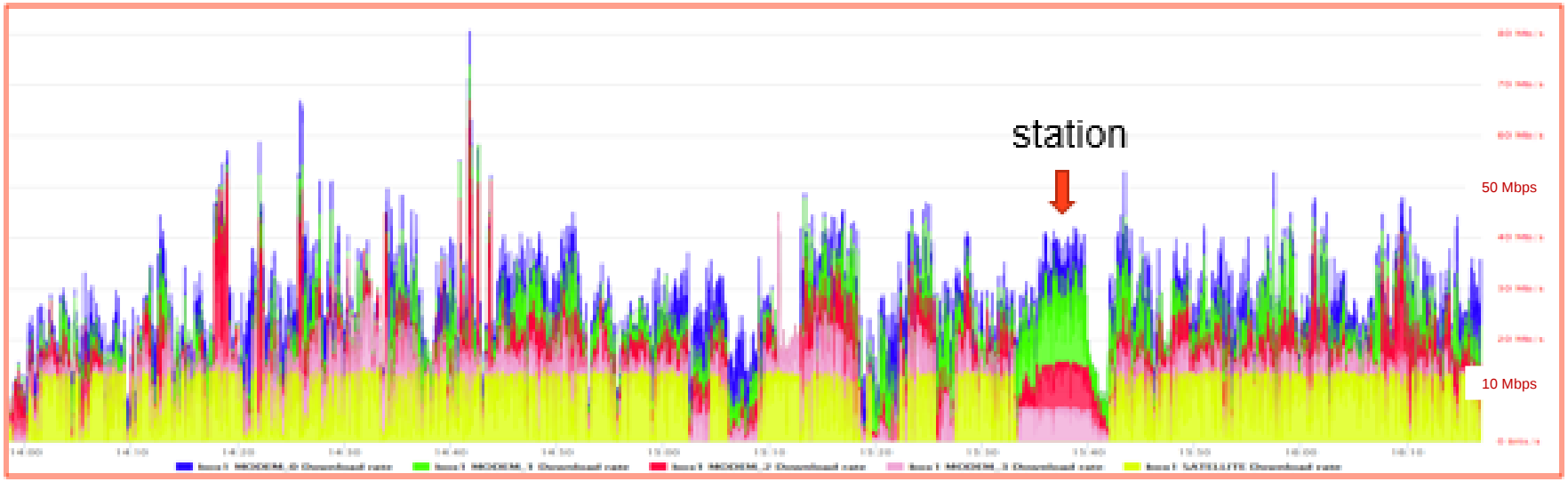
ARCHITECTURE OF THE PILOT SOLUTION



Satellite hub
Idirect technology
Ku Band

Back-end datacentre in Belgium

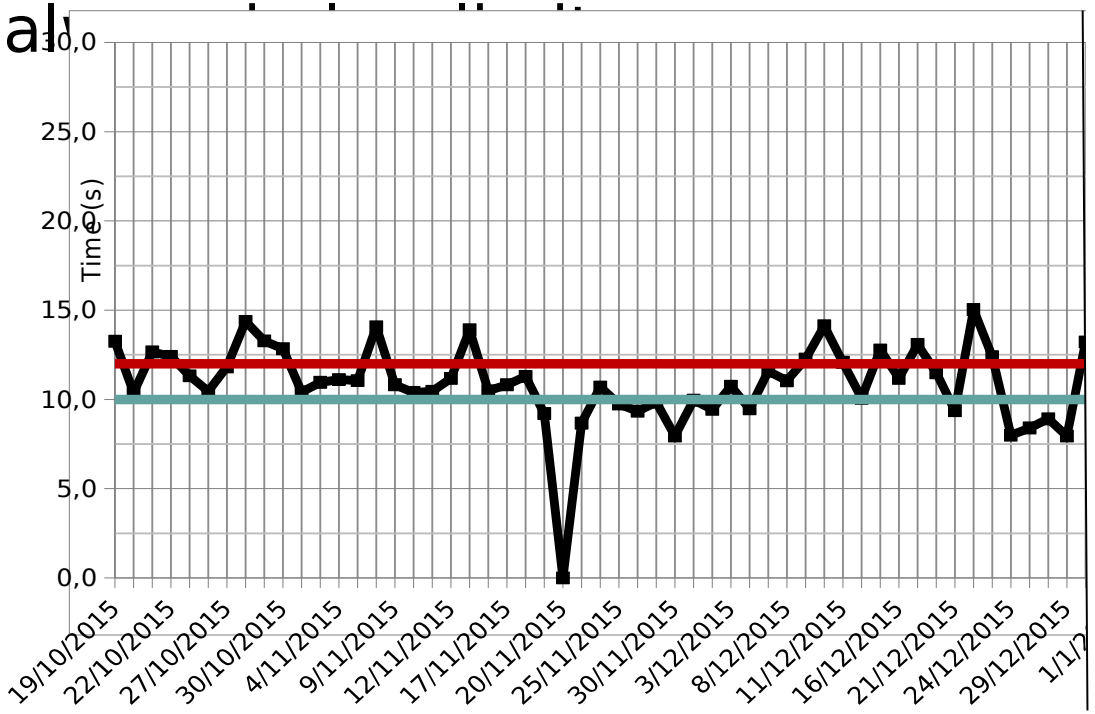
SATELLITE & CELLULAR PERFORMANCE



- Trip with satellite (yellow) and cellular connectitivity
  - Download throughput values are superimposed
  - In station, satellite not provided but high cellular performance
    - Note: the satellite bandwidth was dedicated to one train

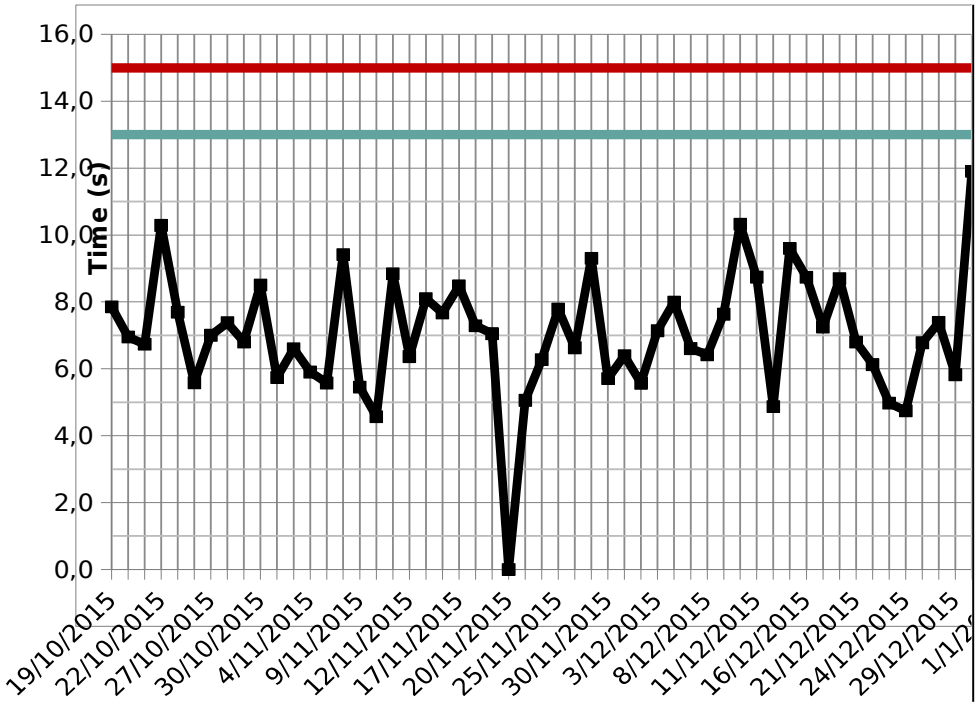
RESULTS OF THE PILOT
BANDWIDTH TO INTERNET

- Every 5 mins a 1MB file is downloaded from backend
  - $8*10^6$ / download time = throughput seen by end-users
- Almost al



RESULTS OF THE PILOT
RESPONSE TIME

- Every 5 mins www.google.com downloaded
- Almost always below limit



MARKET PROSPECTS

- All major railways operators in Europe will implement Internet on board in the next coming years:
  - SNCF, DB, RENFE, DSB, SNCB, etc…
- Some regulators are imposing Internet/Wi-Fi on board as a free service and are imposing QoS standards (UK).
- Mobile Internet is now expected on every transportation system: trains, metro, buses, airplanes, boats cruise.

WHAT FUTURE FOR SATELLITE COMMUNICATIONS ON BOARD TRAINS?

- Has been an obvious choice of telecommunications system on airplanes and boats cruise.
- Satellite communications will be chosen when it provides services not provided by other cheaper communications technologies:
  - Coverage when no cellular coverage is available
  - Broadcast of data (IPTV)
- The business case for use of satellite communications depends on:
  - Competitive pricing on satellite bandwidth (Ku, Ka)
  - Powerful, reliable, small footprint antennas,
  - Technology (Mobile Access Router) to aggregate seamlessly all available technologies.

PRELIMINARY CONCLUSION

- Thanks to ESA and BELSPO support 21NET has built an essential brick to bring internet on the move.
- To further establish satellite communications as part of the pool of telecommunication technologies used to bring internet on terrestrial transportation requires further work involving multiple parties:
  - satellite bandwidth providers, antenna manufacturers and 21Net as the Mobile Access Router provider.

THANK YOU