802.11 multicast testbed and results

Francesco Gringoli (UniBS), Pablo Serrano (UC3M)

Presented by Carlos J. Bernardos *(UC3M)*

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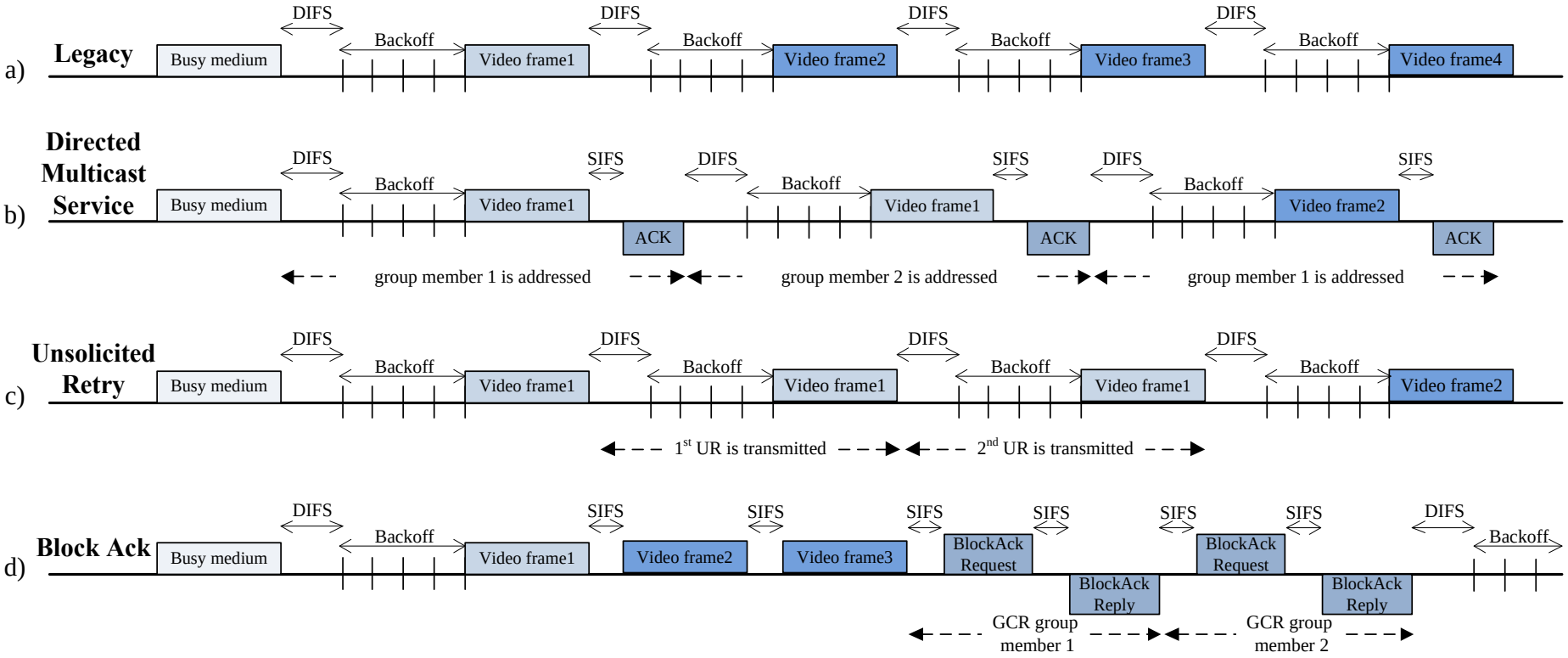
802.11aa GATS in a picture



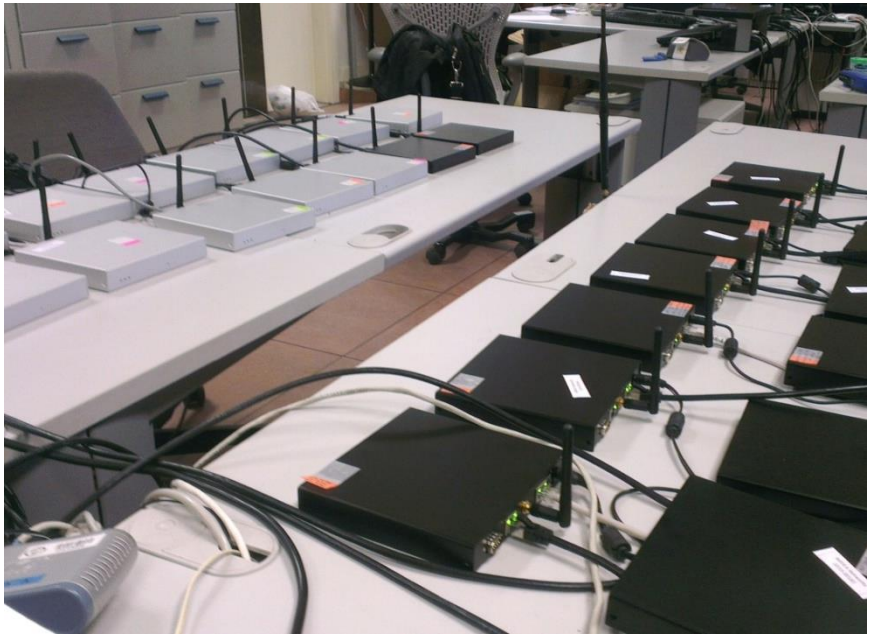
802.11aa GATS in a table

DMS	GCR UR	GCR Block-Ack
- Highly dependent on the number of stations	+ Independent on the number of stations	/ Depends on the number of stations
+ Excellent reliability	/ Moderate reliability	+ Good reliability
+ **Simple**	+ **Simple**	- **Complex**
- **Lot of overhead**	- **Overhead**	+ **Some overhead for poll procedure**
		+ Retransmit only what is missing

- Tradeoff
  - Complexity (backwards compatibility)
  - Overhead, Performance

Testbed

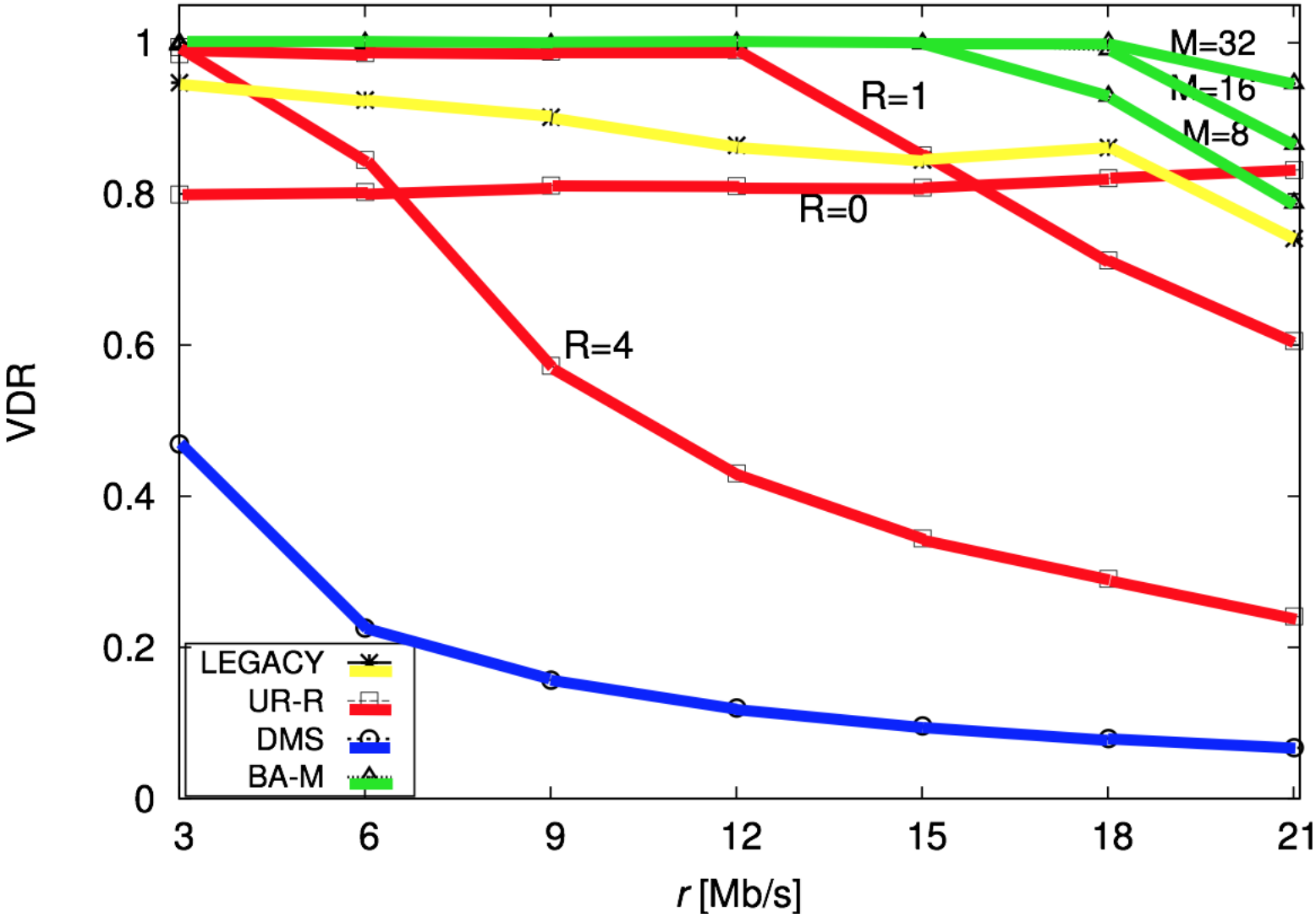
- Video and Data stations
  - Alix 2d2 nodes
  - All tests done at UC3M
- Tests on channel 14 (interference free) and 11
- For GCR-BA
  - Explored M=[8, 16, 32]
- For GCR-UR
  - Explored R= [0, 1, 4]
- MCS choice:
  - GATS: fixed to 54Mb/s
  - Legacy: fixed to 24Mb/s



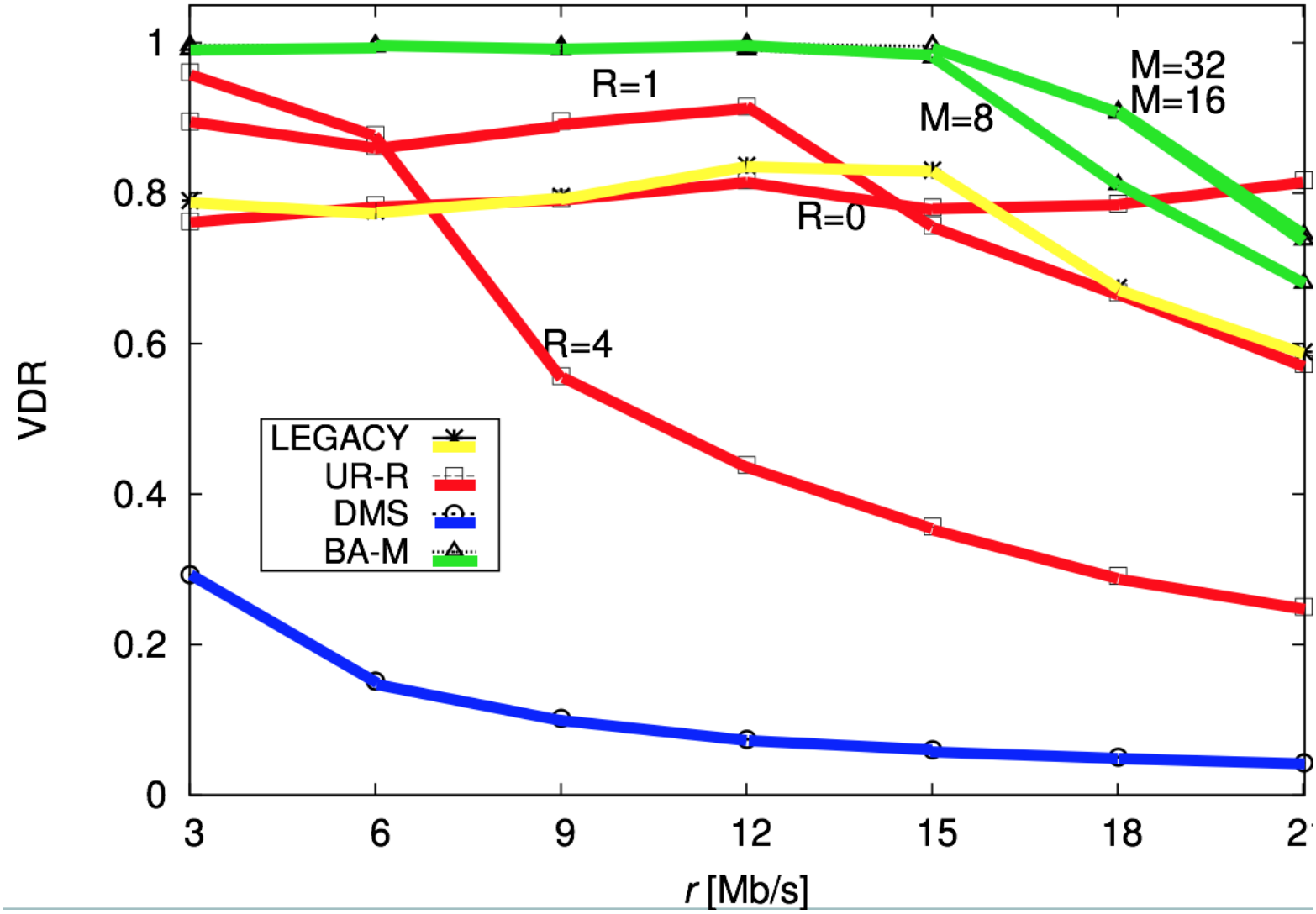
Experiments

- Multicast is CBR, fixed rate *r*
  - mgen, UDP over IPv4
  - All frames are 1400 bytes
- Nv = 10 multicast receivers
- Nd = 10 data stations (UDP, saturation)
- Two performance figures
  - Video Delivery Rate (VDR)
    - Average % throughput received by each Nv
  - Aggregated Data Throughput (ADT)
    - Sum of data throughput at AP (resources left)

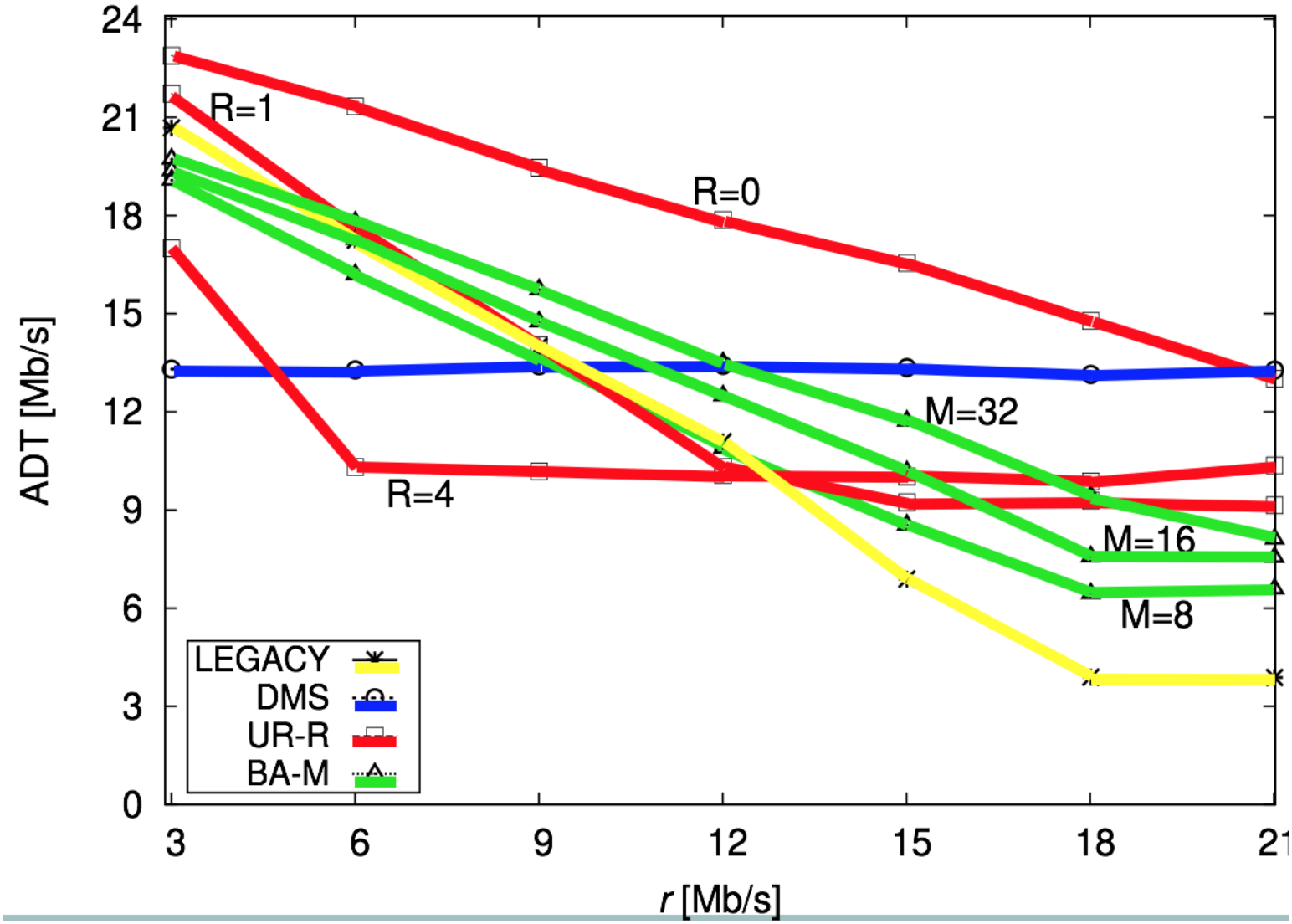
VDR – Channel 14



VDR – Channel 11



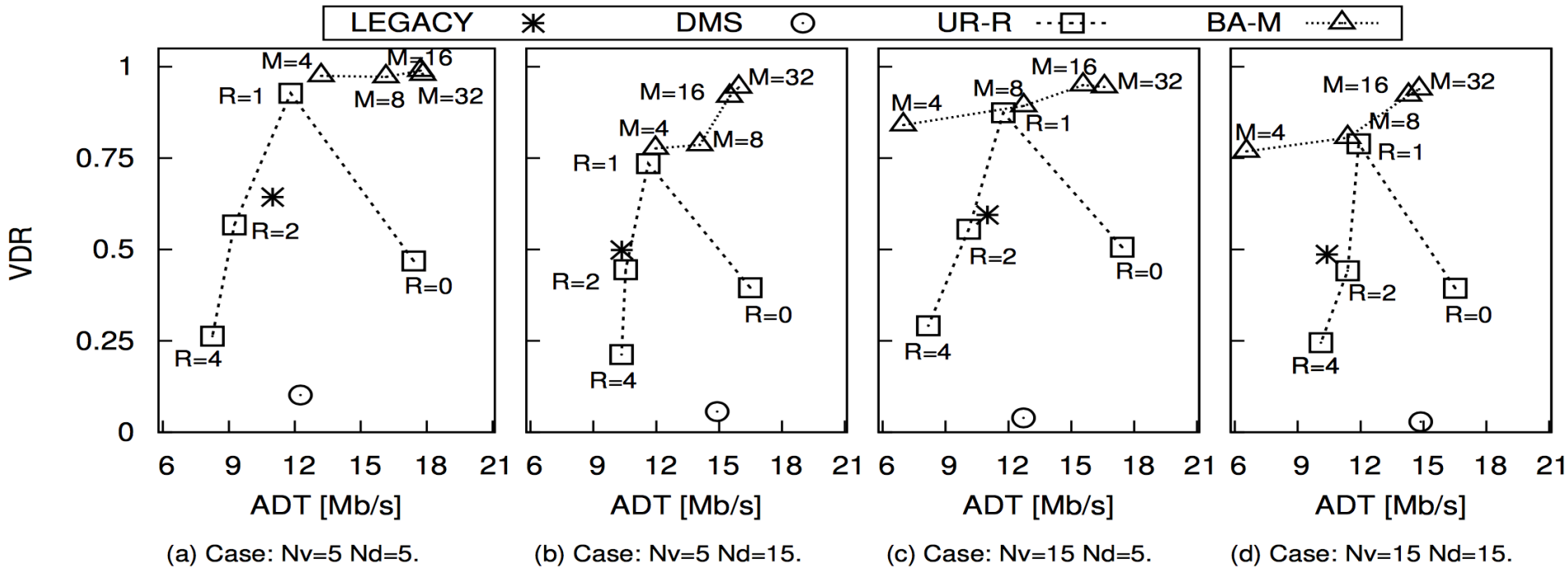
ADT – Channel 14



Experiments, 2

- "Big Buck Bunny" video in full HD (1920x1080)
  - encoded with AVI MPEG 4
  - average bitrate of 12 Mb/s
- Data: (again) saturated UDP traffic
- Nv = {5, 15}, Nd = {5, 15}
- Same performance figures
  - Video Delivery Rate (VDR)
    - Average % throughput received by each Nv
  - Aggregated Data Throughput (ADT)
    - Sum of data throughput at AP (resources left)

Results with real video

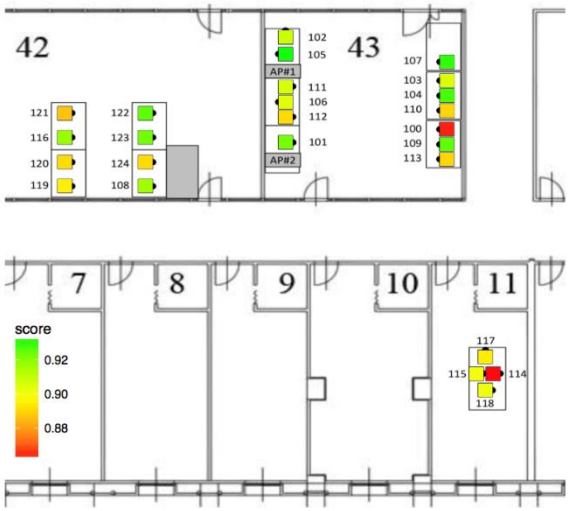


- DMS: poor performance in all cases
- UR: need to adapt the R value, better than legacy
- BA: improves both ADT and VDR,

Summary and Ongoing work

- First experimental evaluation of 802.11aa standard
  - Each GATS mechanism offers specific improvement WRT legacy multicast
  - All sources as open-source

- Ongoing (new deployment @ Brescia)
  - QoE-based evaluation of video
  - One-way delay (control traffic)
  - MAC enhancements
    - Improve bursts (AMPDU)
    - Rate adaptation



References and pointers

- **Paper**: P. Salvador, L. Cominardi, F. Gringoli, P. Serrano, “A First Implementation and Evaluation of the IEEE 802.11aa Group Addressed Transmission Service”, ACM Computer Communication Review, 2014
- http://dx.doi.org/10.1145/2567561.2567567

- **Code**: GATS page at OpenFWWF site
- http://netweb.ing.unibs.it/~openfwwf/GATS.php