

## Part 1: Introduction

Vincent Roca and Christoph Neumann  
{firstname.name}@inrialpes.fr

Planète project; INRIA Rhône-Alpes  
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## Introduction

- streaming means...
  - “instantaneous” play of video content
    - in fact there’s a small delay (a few tens of seconds)
    - due to jitter compensation, packet erasure recovery
  - video content can be *live* (e.g. sport event)...
  - ... or *recorded* (e.g. film)
- two viewpoints
  - *video coding* viewpoint
  - *networking* viewpoint
  - they are complementary, not opposed

## Introduction... (cont’)

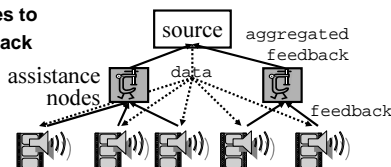
- this tutorial focuses on “Large scale video streaming techniques for the Internet”...
  - a subset of streaming techniques
    - e.g. we don’t cover unicast streaming
  - we try to be as general as possible concerning the underlying network
    - we don’t limit ourselves to specialized networks (e.g. DVB)
  - we clearly identify scalability as a key aspect... but two other challenges will be discussed!
  - we follow both the video and networking viewpoints

## Challenges

- challenge 1: *scalability*
  - 1, 100s, 1000s, 100000s of receivers
  - how to accommodate it ?
  - at *routing* level...
    - goal is to reduce the amount of data sent over the network or over some links
  - at *control* level...
    - goal is to reduce the amount of feedback sent to the source(s)

## Challenges... (cont’)

- ...possible solutions
  - at the routing level...
    - multicast routing and other group communication services
    - hierarchy of streaming servers
    - see Parts 3 and 4
  - at the control level...
    - RTCP feedback limitation
    - assistance nodes to aggregate feedback
    - see Part 4



## Challenges... (cont’)

- challenge 2: *heterogeneity*
  - group members can be largely different
    - low speed access network versus xDSL
    - congested networks versus over-provisioned networks
  - unavoidable with large groups of receivers
  - how to accommodate this heterogeneity ?

## Challenges... (cont')

- ...possible solutions
  - *solution 1*: adjust transmission rate to the slowest receiver without going below a threshold `min_rate`
    - look for slow receivers...
    - ... but good receivers won't be happy!
    - requires a group management scheme to remove bad receivers
    - see Part 4
  - *solution 2*: use various homogeneous reception groups
    - better but at the cost of extra traffic
    - requires a group management scheme to move receivers to the appropriate groups
    - see Part 4

## Challenges... (cont')

- ...possible solutions (cont')
- *solution 3*: use multi-rate transmissions
  - addressed by the congestion control protocol itself
  - elegant and excellent solution to the problem
  - see Parts 3 and 4

## Challenges... (cont')

- challenge 3: **robustness**
  - users need robust transmissions
    - ...or they will altogether give up the technology!
  - more important than intrinsic stream quality
  - problems due to network defects
    - losses (random, per burst, long cut-offs)
    - jitter

## Challenges... (cont')

- ...possible solutions
  - use robust audio/video coding
    - see Part 2
  - use of Forward Error Correction (FEC)
    - see Part 3
  - use other forms of redundant transmission
    - see Part 3
  - ... or a mixture of the above techniques!

## Goals of this tutorial

- This tutorial covers
  - video coding
  - networking aspects
  - streaming solutions
  - some existing tools
- This tutorial does not...
  - cover any of the previous aspects in details
  - focus on any commercial solution