

Bandwidth

Final paper proposal

- Final ~10 page paper
- Over next week:
 - Pick a topic
 - Find initial research sources
 - Write a proposal

Types of paper

- How does X work?
- History of quantitative knowledge
- Modern techniques for understanding our world

How does X work?

Examples:

- MRI machines
- Quantum dot televisions
- LIGO (gravity waves)
- Radio interferometers (VLA, ALMA, etc.)
- Historical device such as the Antikythera mechanism or the Prague Astronomical Clock

History of quantitative knowledge

Examples:

- Mapping of the Pacific Northwest (including techniques used)
- Birth of computing during the second world war (including how they worked)
- History of medical imaging (X-rays to MRI)
- Development of longitude techniques in the 18th century

Modern techniques for understanding our world

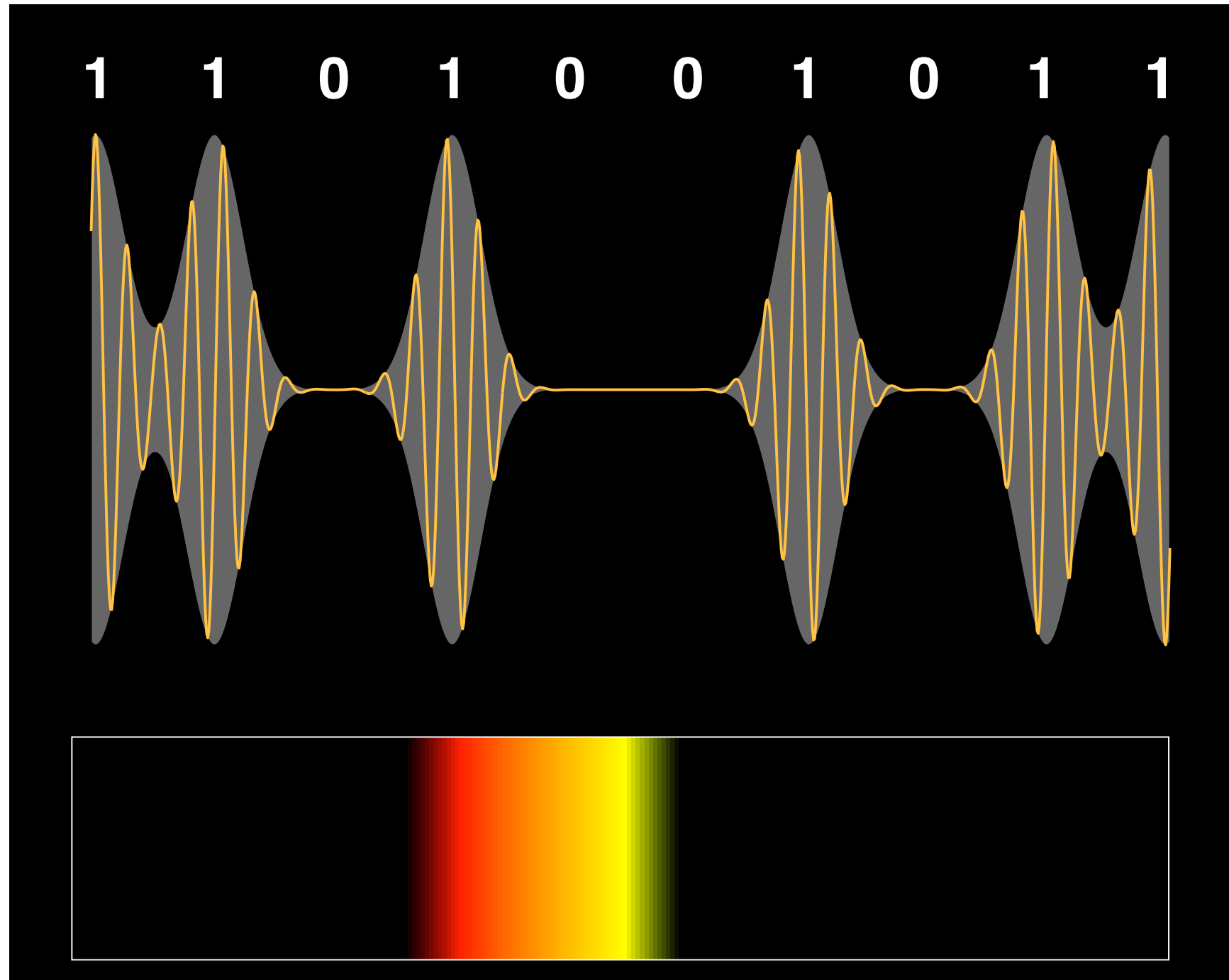
The most challenging to formulate, and will probably require some conversation with me

Examples:

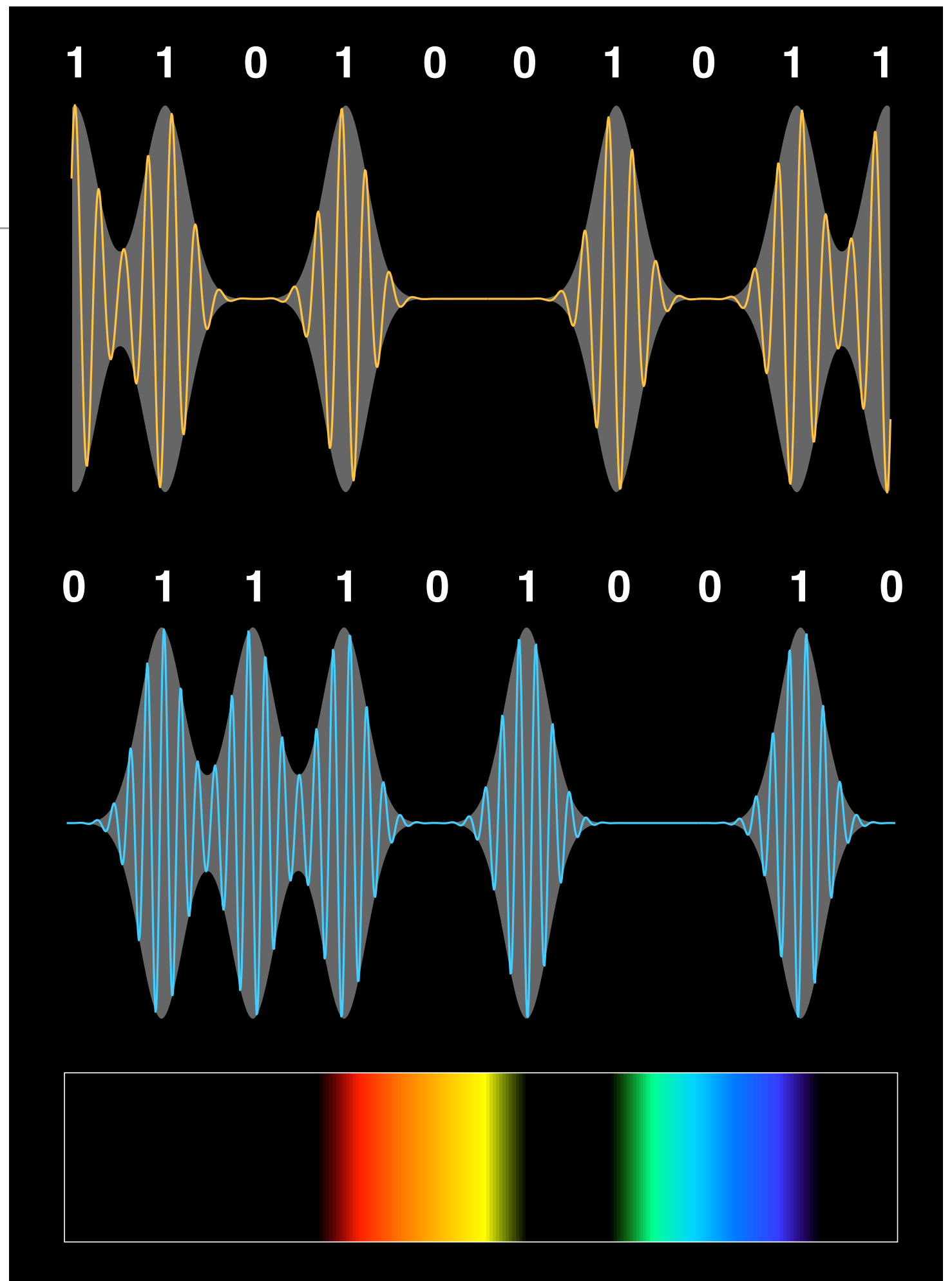
- Imaging the brain in action (fMRI, PET, and other tools)
- Tracking volcanos (GPS, satellite and arial LIDAR, etc.)
- Measuring gravity waves (LIGO, nanoGrav, LISA)

Bandwidth

Sending information

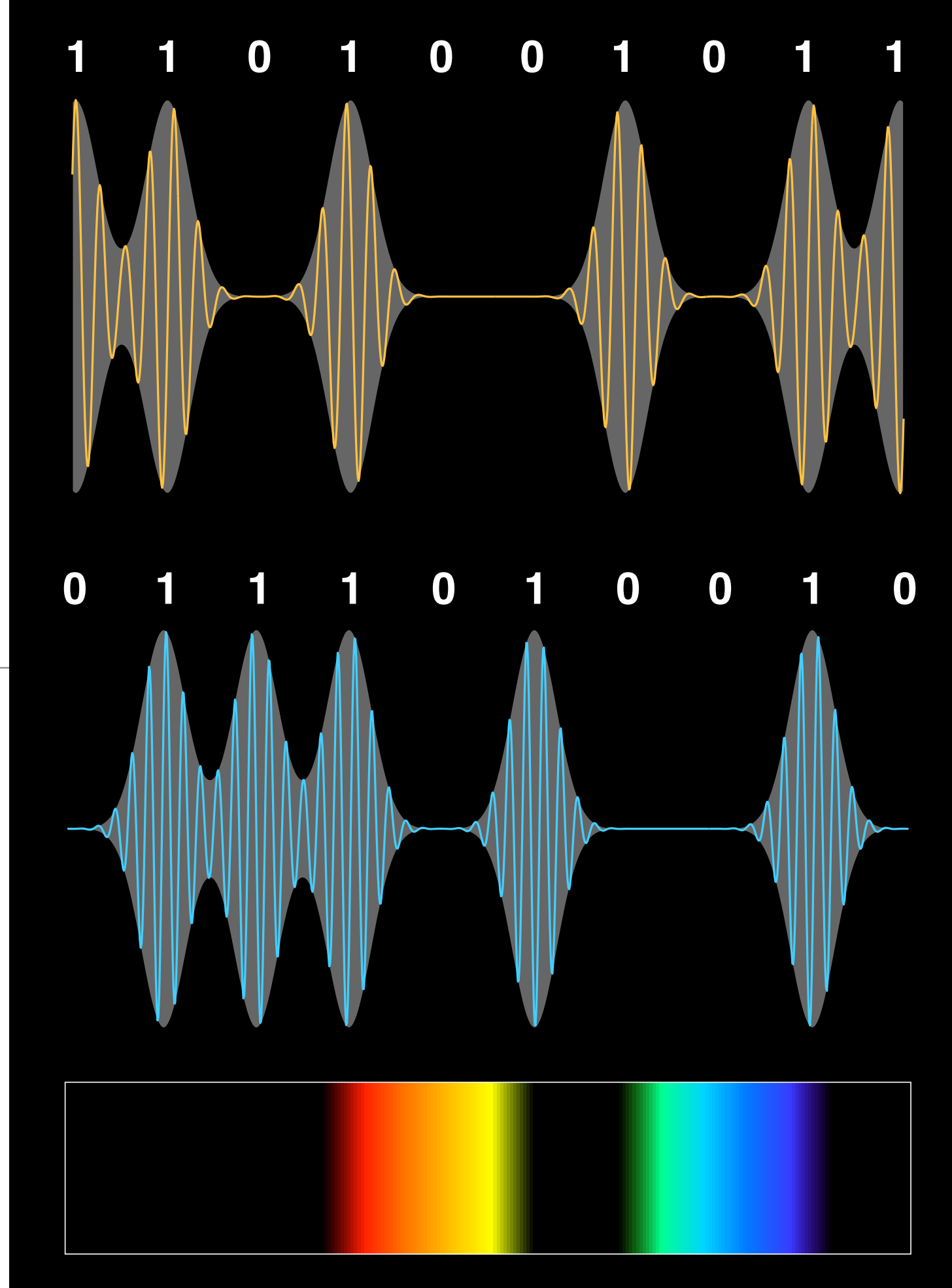


Sending information with different colors

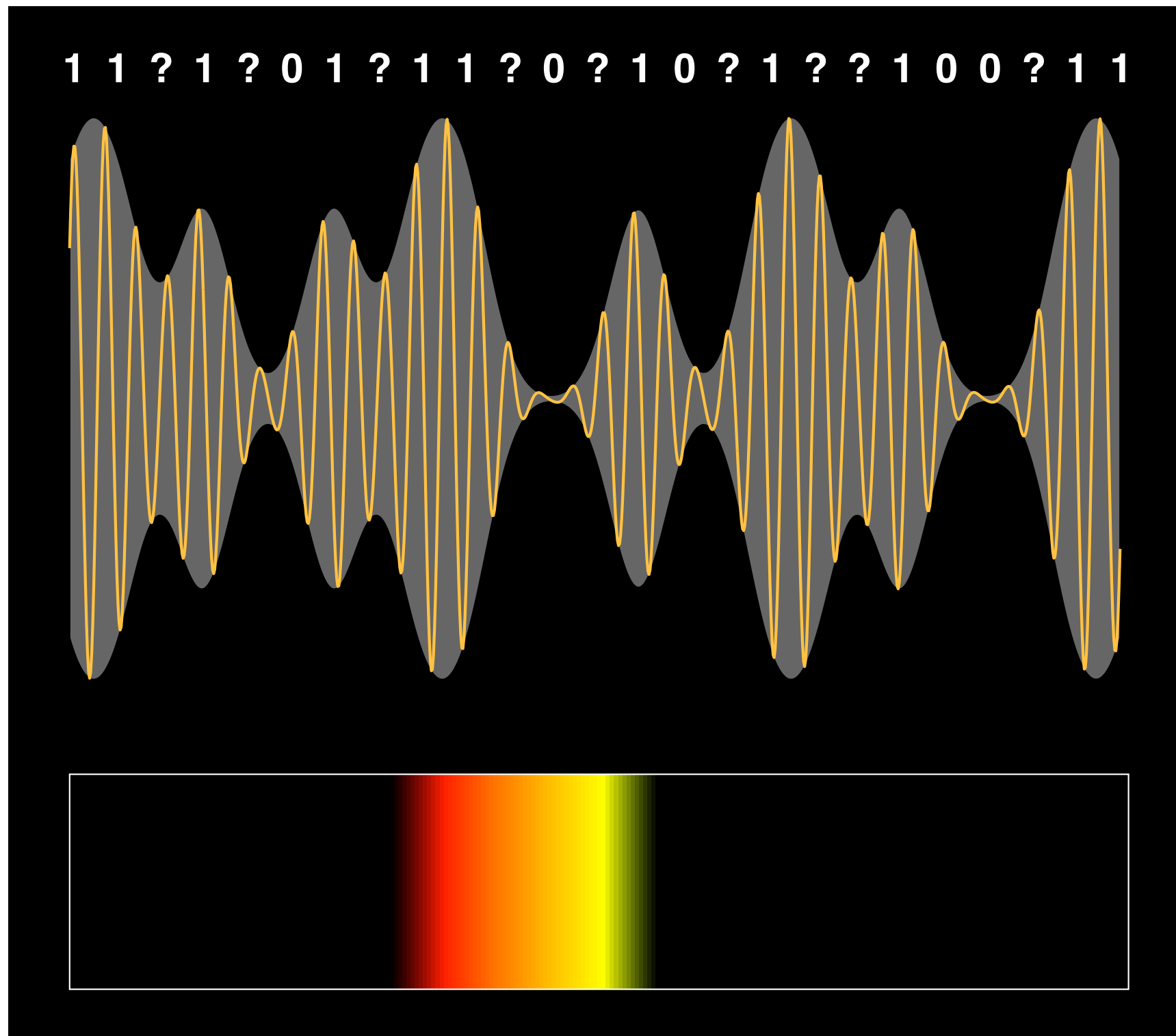


Sending information
with different colors

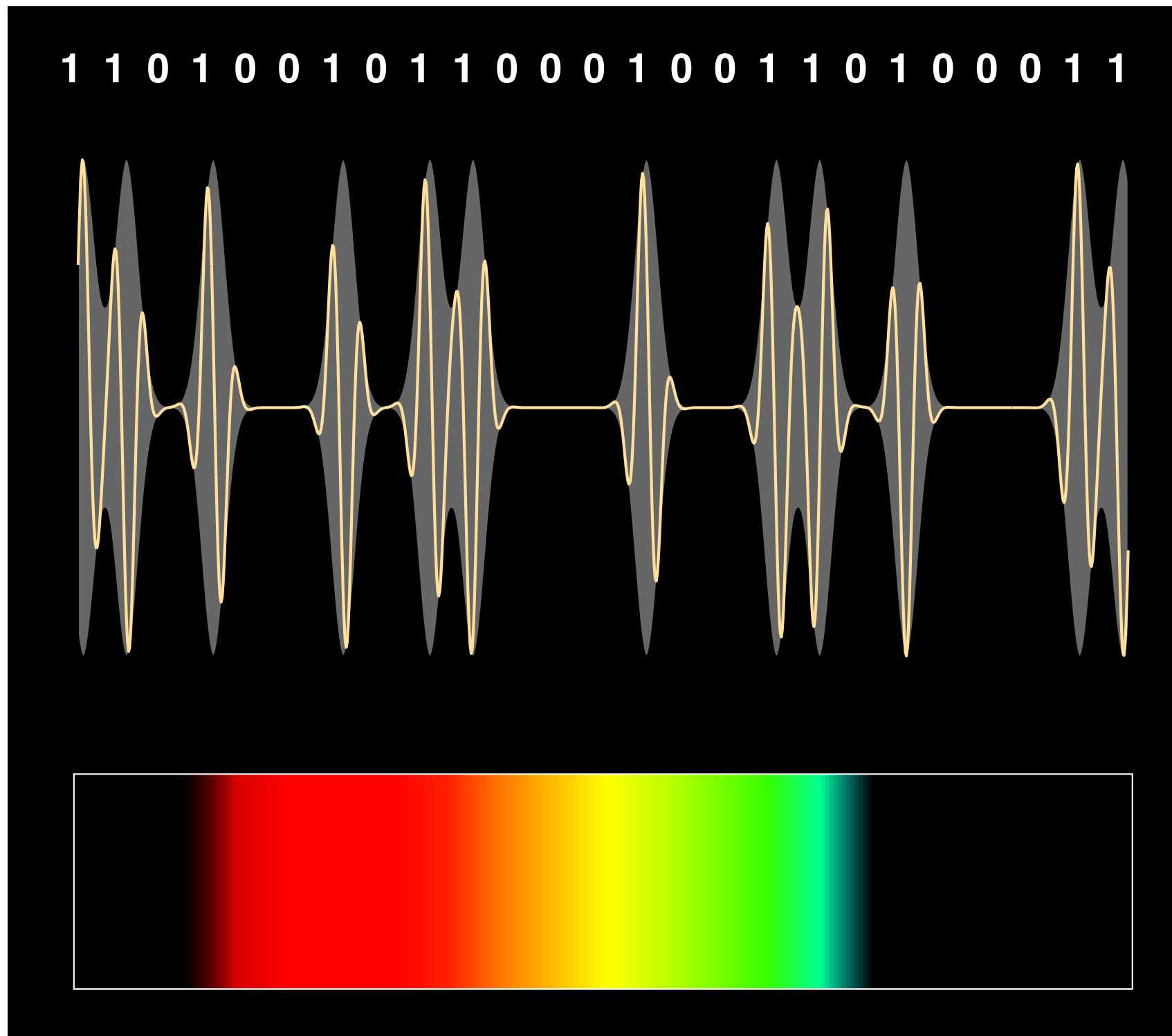
Prism used
to separate
colors or
'channels'



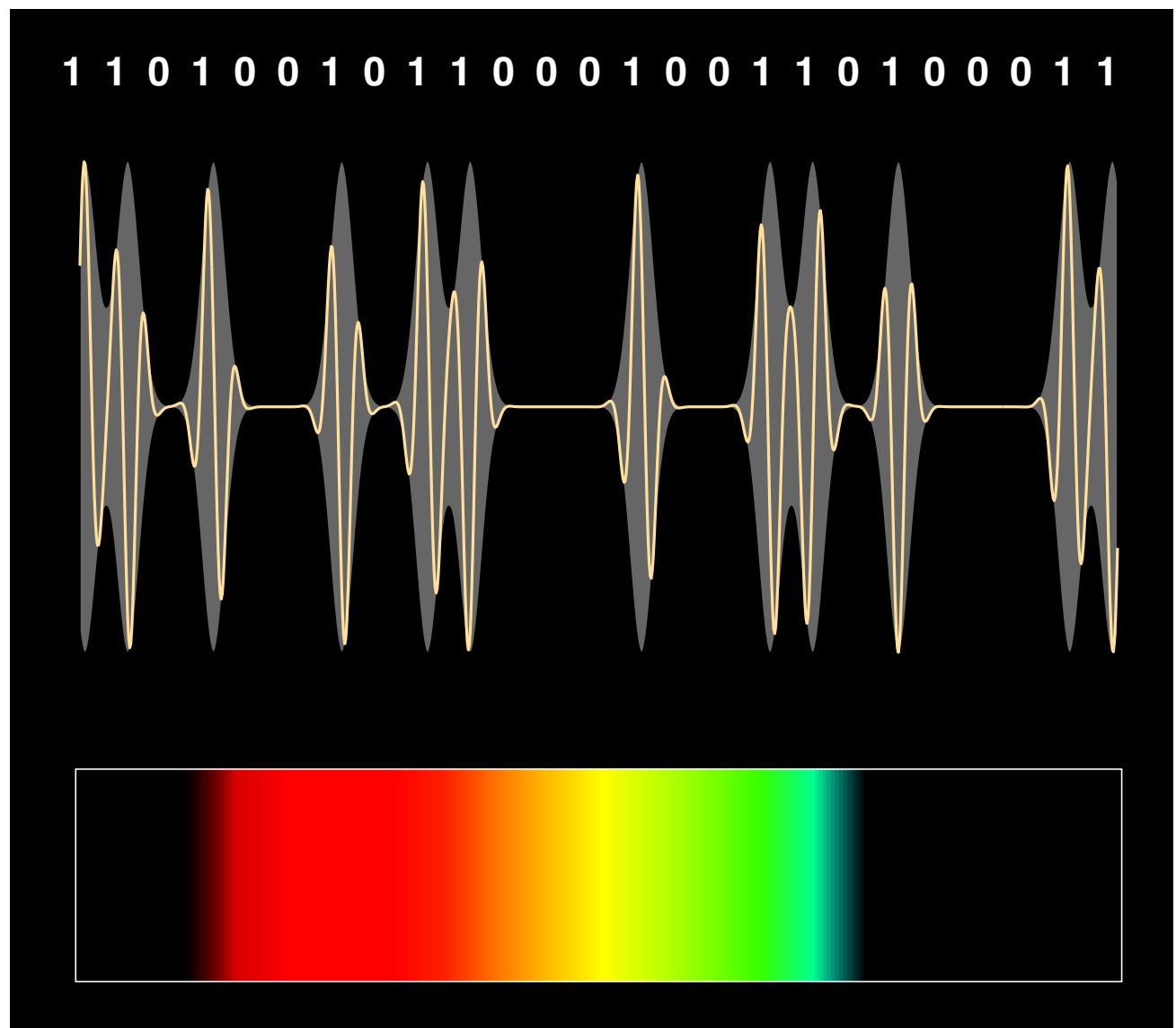
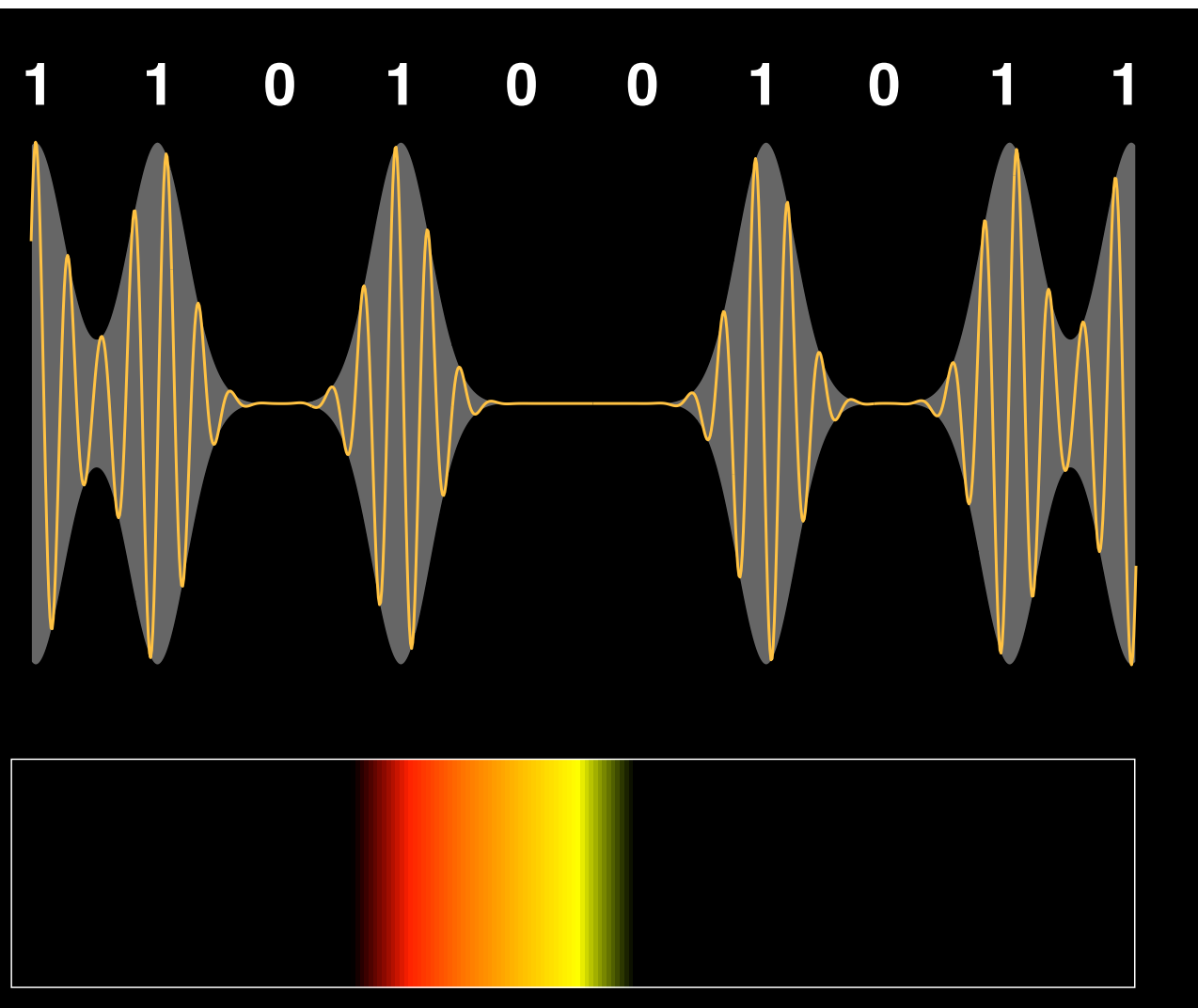
If I try to send pulses too fast, message is garbled



To send a message faster I need shorter pulses



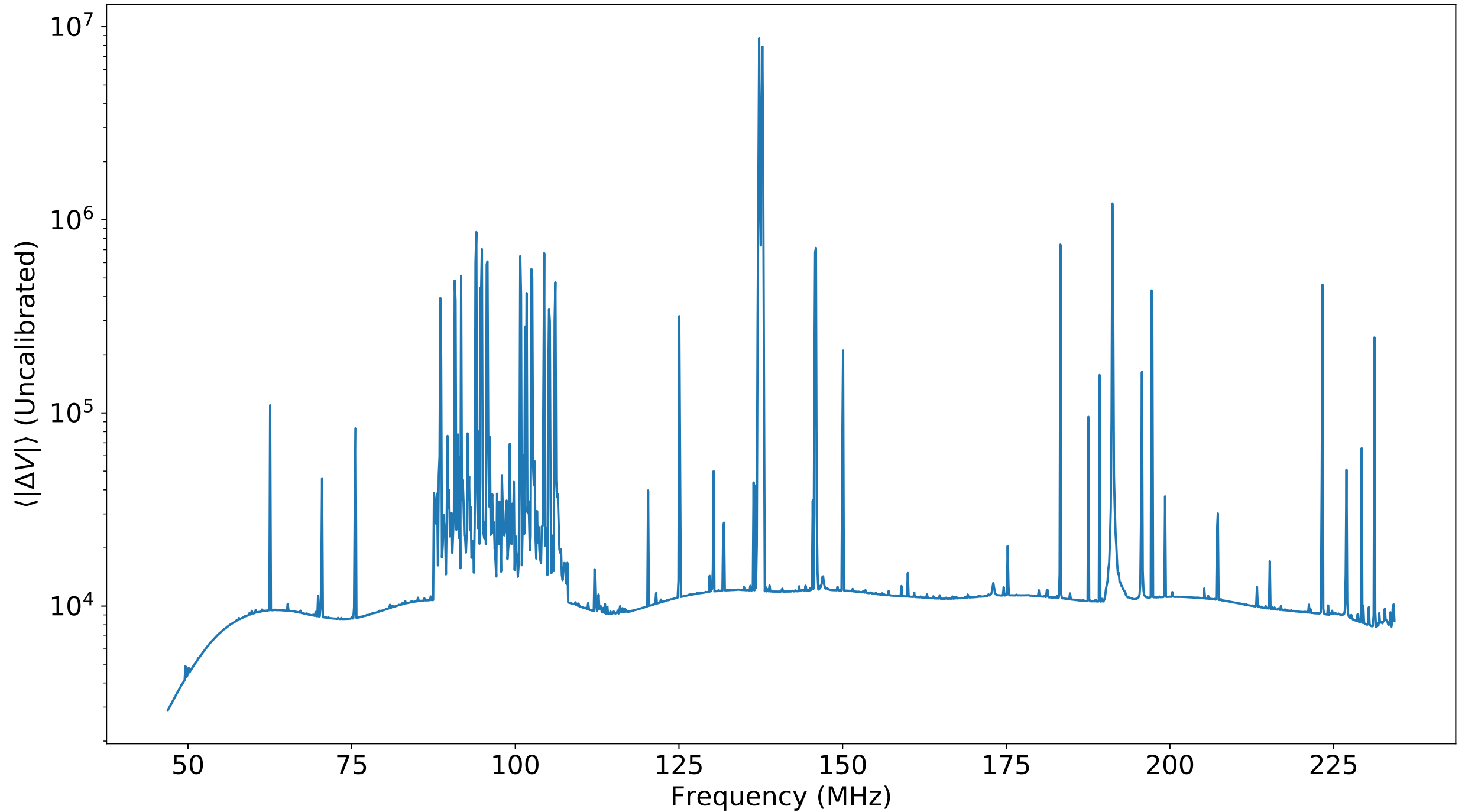
Speed depends on ***range*** of color (bandwidth)



Key ideas

- More color (bandwidth), the ***faster*** the data can be sent
- Each user can get their own ‘color’ range
- Users don’t really care what color they have, but do care about how wide the color range is (bandwidth)
- Can have many slow users, or a few fast users, but color range is preserved
- You buy a color range (bandwidth)

Spectrum Analyzer



RADIO SERVICES COLOR LEGEND

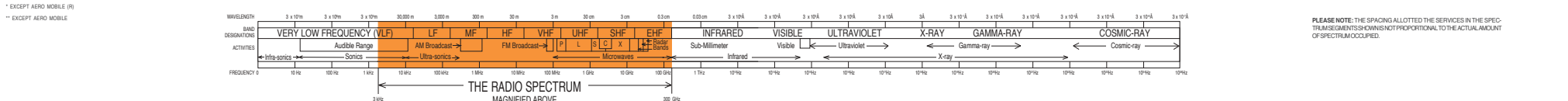
		
		
		
		
		
		
		
		
		
		

 GOVERNMENT EXCLUSIVE
 GOVERNMENT/NON-GOVERNMENT SHARED

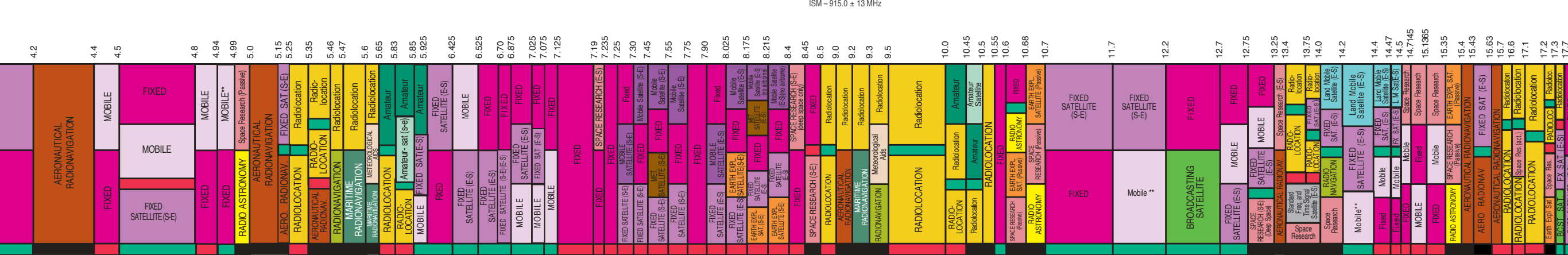
 NON-GOVERNMENT EXCLUSIVE

SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letters
Secondary	Mobile	1st Capital with lower case letters

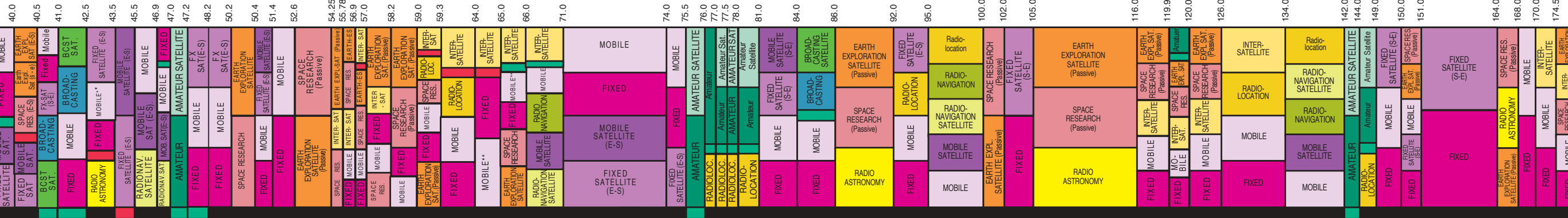
 **U.S. DEPARTMENT OF COMMERCE**
National Telecommunications and Information Administration
Office of Spectrum Management
October 2003



PLEASE NOTE: THE SPACING ALLOTTED THE SERVICES IN THE SPECTRUM SEGMENTS SHOWN IS NOT PROPORTIONAL TO THE ACTUAL AMOUNT OF SPECTRUM OCCUPIED.

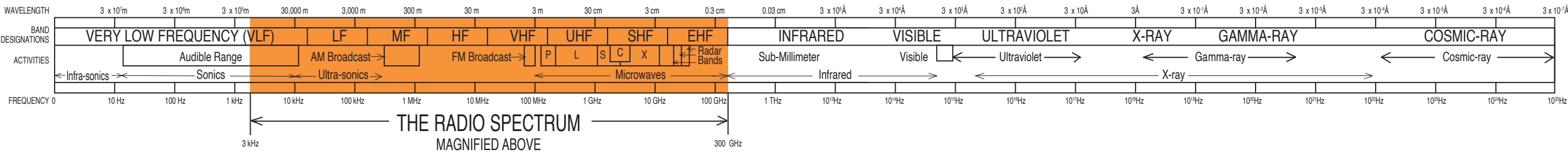


ISM - 5.8 ± .075 GHz



ISM - 61.25 ± .250 GHz
59-64 GHz IS DESIGNATED FOR
UNLICENSED DEVICES

ISM - 122.5 ± .500 GHz



UNITED STATES FREQUENCY ALLOCATIONS THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

AERONAUTICAL MOBILE	INTER-SATELLITE	RADIO ASTRONOMY
AERONAUTICAL MOBILE SATELLITE	LAND MOBILE	RADIO DETERMINATION SATELLITE
AERONAUTICAL RADIONAVIGATION	LAND MOBILE SATELLITE	RADIOLOCATION
AMATEUR	MARITIME MOBILE	RADIOLOCATION SATELLITE
AMATEUR SATELLITE	MARITIME MOBILE SATELLITE	RADIONAVIGATION
BROADCASTING	MARITIME RADIONAVIGATION	RADIONAVIGATION SATELLITE
BROADCASTING SATELLITE	METEOROLOGICAL AIDS	SPACE OPERATION
EARTH EXPLORATION SATELLITE	METEOROLOGICAL SATELLITE	SPACE RESEARCH
FIXED	MOBILE	STANDARD FREQUENCY AND TIME SIGNAL
FIXED SATELLITE	MOBILE SATELLITE	STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

ACTIVITY CODE

GOVERNMENT EXCLUSIVE	GOVERNMENT/NON-GOVERNMENT SHARED
NON-GOVERNMENT EXCLUSIVE	

ALLOCATION USAGE DESIGNATION

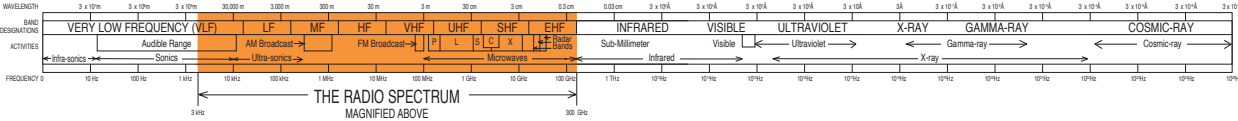
SERVICE	EXAMPLE	DESCRIPTION
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This chart is a graphic single-point-in-time portrayal of the Table of Frequency Allocations used by the FCC and NTIA. As such, it does not completely reflect all aspects, i.e., footnotes and recent changes made to the Table of Frequency Allocations. Therefore, for complete information, users should consult the Table to determine the current status of U.S. allocations.



* EXCEPT AERO MOBILE (R)

** EXCEPT AERO MOBILE



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