Aural-Sight

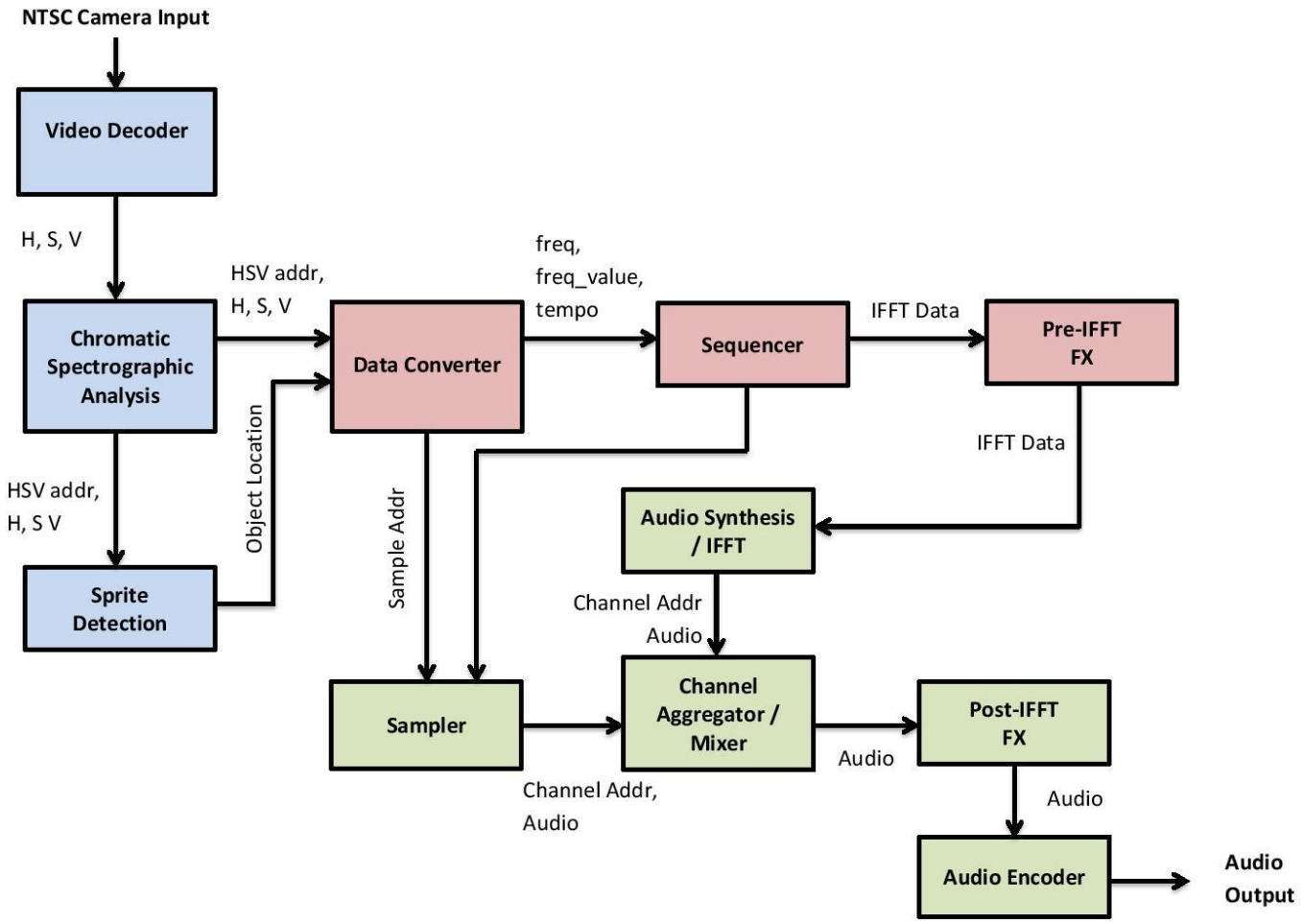
An Auralization of the Visual World

Gabriel Karpman
Clark Della Silva
Adam Suhl

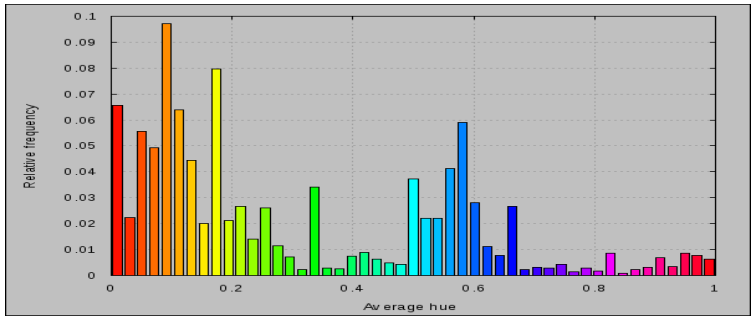
Overview

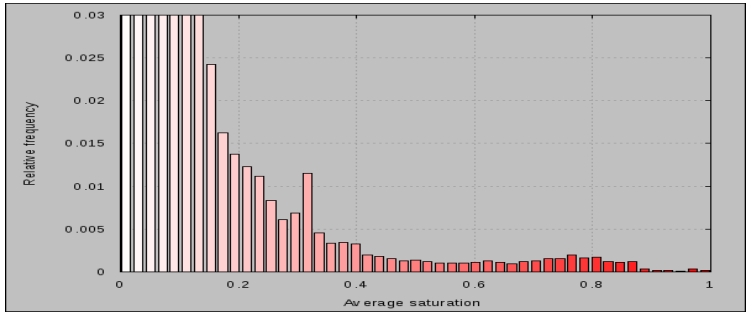
- An interactive system that takes video input and converts it into a representation realized in the audio domain.
- Process video for both ambient and intentioned content
- Controls to allow for augmentation / modification of the signals
- Fast, compact IFFT for precise, parametric audio synthesis

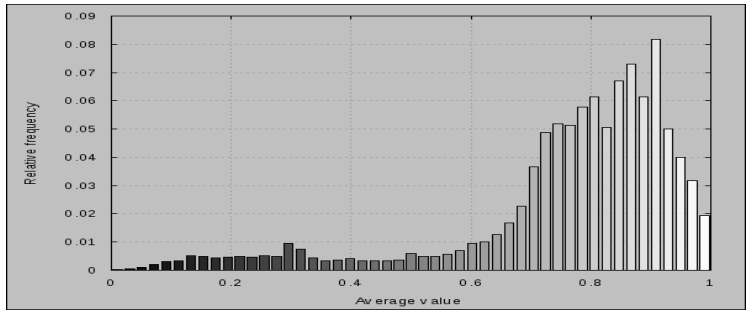
Design Block Diagram



Chromatic Spectrum Analysis







Blob Detection

Identify multiple control objects of predefined types (LEDs of different colors.)

Analyse position and movement.

Generate control parameters.

Blob Detection

In order to achieve manageable computational effort and memory usage

Blob Detection

In order to achieve manageable computational effort and memory usage

first identify pixels which may be in objects:

- Use threshold on distance from target in LogHS space.

Blob Detection

In order to achieve manageable computational effort and memory usage

first identify pixels which may be in objects:

- Use threshold on distance from target in LogHS space.

Then apply approximated Difference of Gaussians to this bitmap.

- cheap, since multiplying powers of two by 0 or 1.

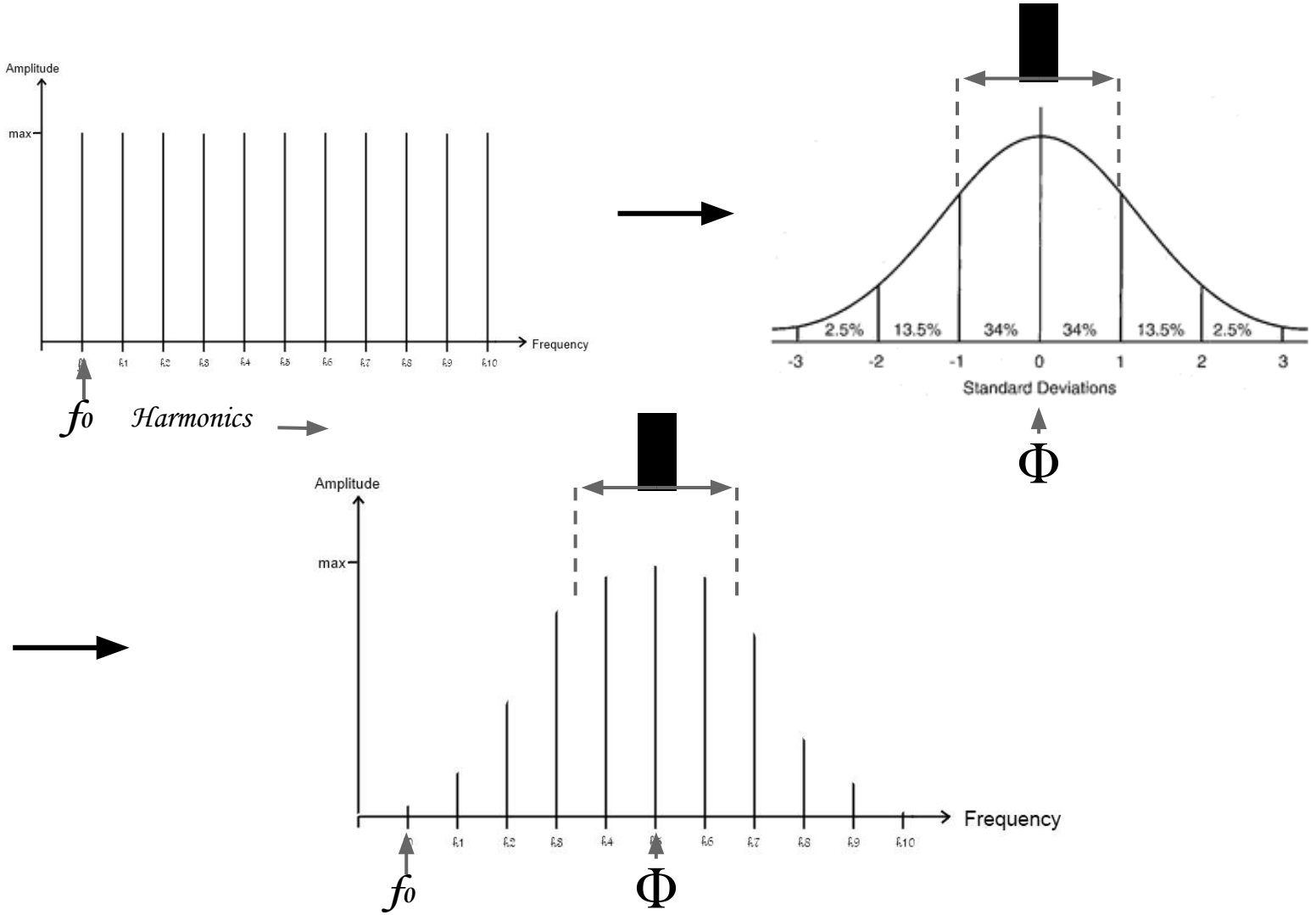
Video to Audio Conversion

Hue (0-360) → f_0 (100Hz -- 2kHz) Fundamental Frequency

Saturation (0-1) → Φ (f_0 -- 11*f_0) Center of Gaussian

Brightness (0-1) →  (f_0 -- 5*f_0) Std dev of Gaussian

Video to Audio Conversion



Sequencing

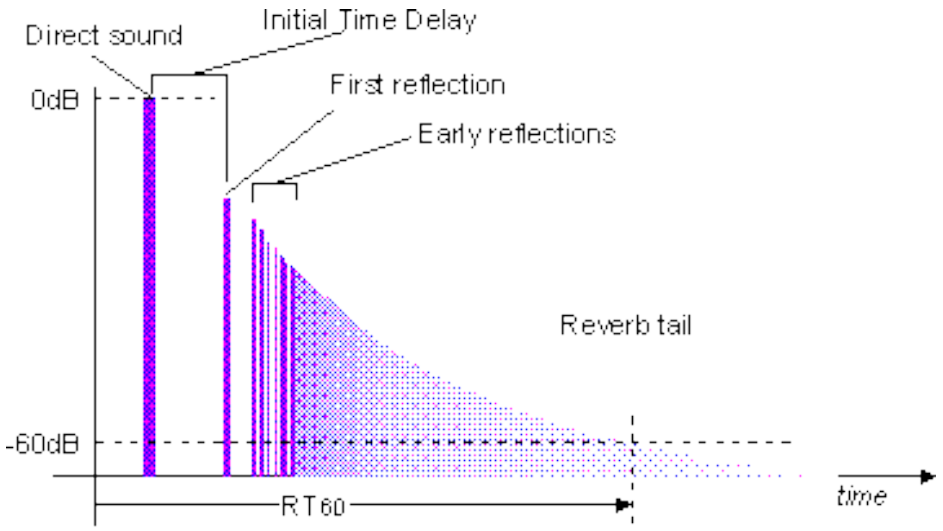
Frequency Domain Reverb

$$S_{out}(n) = S_{in}(n) + S_{out}(n-1) * e^{-\lambda n}$$

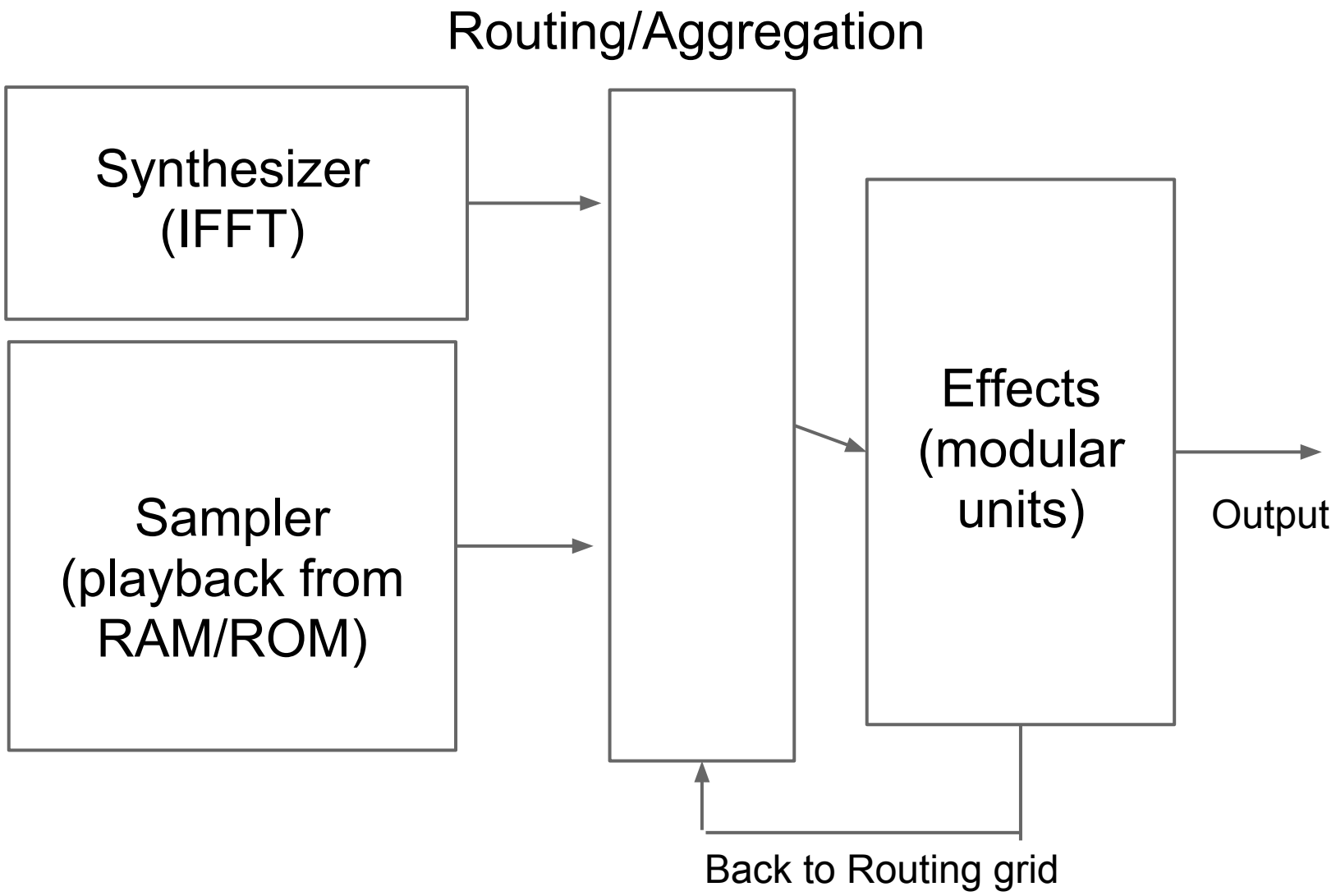
$$\alpha \Rightarrow Rate\ of\ change\ of\ video$$

$$\alpha \rightarrow 0 \quad then\ \lambda \rightarrow .1$$

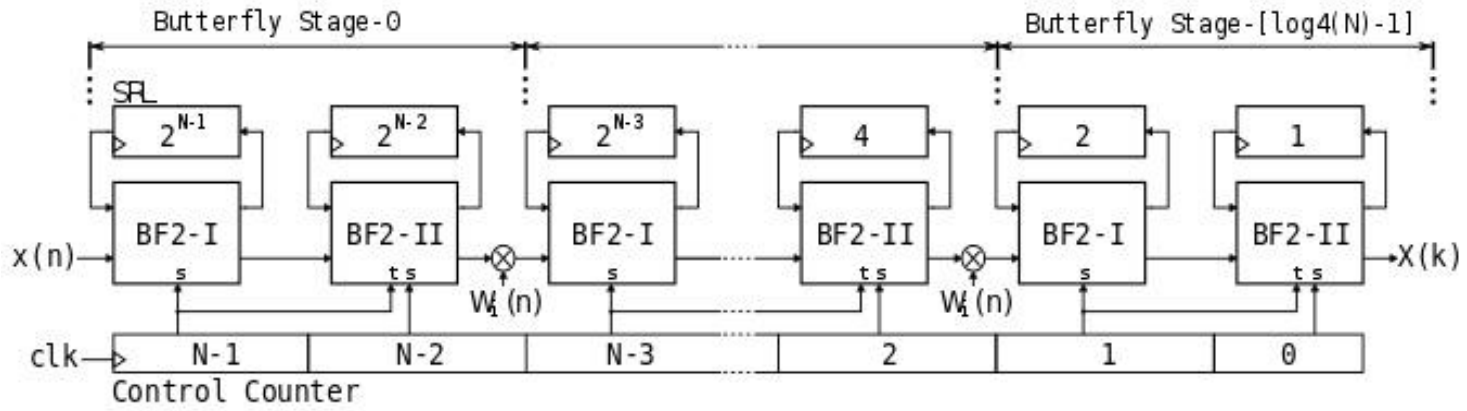
$$\alpha \rightarrow \infty\ then\ \lambda \rightarrow 10$$



Audio Generation



Synthesizer / IFFT

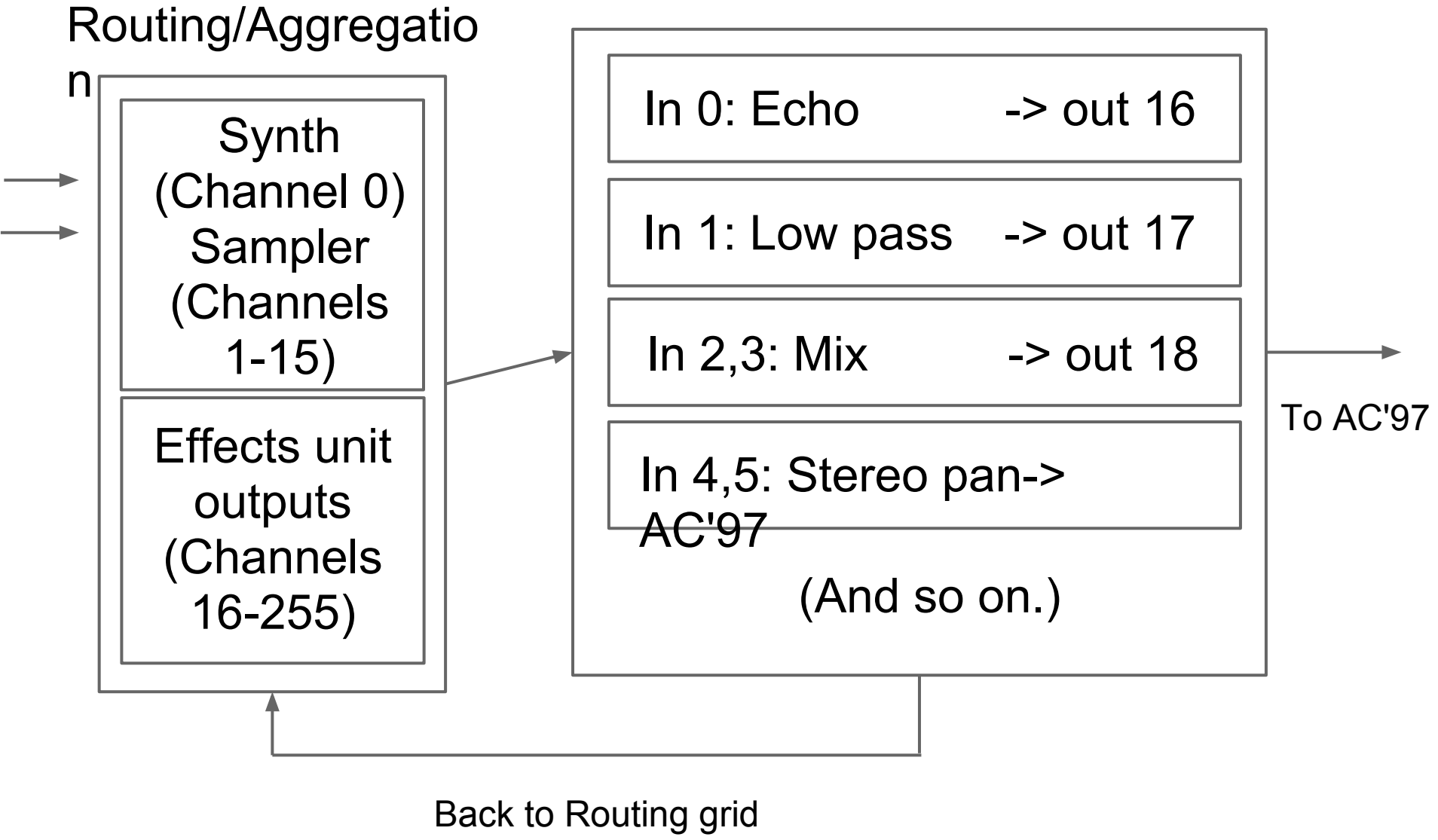


Radix 2^2 Single Delay Feedback architecture.

Fully multiplex hardware (can fit 2^{16} point FFT, for exceptional frequency resolution.)

Use twiddle multipliers to match phase between frames. (for exceptional time resolution.)

Routing and Effects



Timeline

Week of:

11/12 - FFT / Synthesizer finished + tested
- Sampler + channel routing implemented.
- Data Conversion Module and Reverb Module implemented
- Camera + NTSC -> HSV finished and tested.

11/19 - Chromatic analysis implemented
- Blob detection implemented.
- Sequencer Module implemented, Reverb and data conv Tested
- Effects units implemented, routing tested.

11/26 - All video units finished and tested.
- Data Conversion and Sequencer tested,
- integrate data, sequencer, reverb, test as a whole, debug
- All Audio units finished and tested together.

12/3 - Full system integration. Debug module-module issues.
- UI tweaks. Artistic and musical tweaks. Practice using the system.
- Any additional polishing as time allows.