

Chapter 45 - Your First Frame Loop

A demo is usually a loop with state. The state changes a little, the machine waits for a frame boundary, the picture is drawn, and the loop begins again.

The smallest useful loop has five jobs:

1. Choose a display mode.
2. Keep a frame counter.
3. Clear or cover the old frame.
4. Draw the new frame from the current state.
5. Wait for VBlank before continuing.

This chapter uses VideoChip because it gives a direct framebuffer and a hardware blitter. Later chapters use the same loop shape with Mode 7, music timing, copper bands, and multiple CPUs.

45.1 The Basic Shape

Type this programme:

```
10 REM FIRST FRAME LOOP
20 FB=&H00100000:ST=320*4
30 POKE32 &H000F0004,4
40 POKE32 &H000F0080,0
50 POKE32 &H000F0084,FB
60 POKE32 &H000F0000,1
70 X=0:DX=4:F=0
80 POKE32 &H000F2580,1
90 BLIT FILL FB,320,200,&H00000000,ST
100 BLIT FILL FB+80*ST+X*4,24,24,&H0000C878,ST
110 X=X+DX
120 IF X<0 THEN X=0:DX=4
130 IF X>296 THEN X=296:DX=-4
140 F=F+1
150 IF F<180 THEN GOTO 80
160 PRINT "FRAMES ";F
```

Expected result: a small green block moves across the VideoChip layer and bounces at the edges. After 180 frames the programme prints the frame count.

Lines 20 to 60 set the screen. Line 80 waits for the next frame edge by writing to WAIT_VBLANK. Line 90 clears the old picture. Line 100 draws the block at the current X position. Lines 110 to 140 update the state for the next frame.

45.2 Why VBlank Comes First

It is tempting to draw and then wait. That works for many small experiments, but the habit used in this guide is:

```
WAIT FOR FRAME
DRAW FRAME
ADVANCE STATE
```

The wait gives the loop a stable beat. The drawing that follows belongs to one frame. If the drawing later becomes too expensive, the failure is obvious: the loop misses the next beat.

VSYNC is the friendly BASIC spelling. POKE32 &H000F2580, 1 is the MMIO spelling. They are the same kind of idea: wait for the display clock rather than running as fast as the CPU can execute BASIC.

45.3 Sine Motion

Straight-line motion uses $X=X+DX$. Many demo motions use a phase and a sine function:

```
10 REM SINE MOTION
20 FB=&H00100000:ST=320*4
30 POKE32 &H000F0004,4:POKE32 &H000F0080,0
40 POKE32 &H000F0084,FB:POKE32 &H000F0000,1
50 A=0:F=0
60 POKE32 &H000F2580,1
70 BLIT FILL FB,320,200,&H00000000,ST
80 X=148+INT(120*SIN(A))
90 Y=88+INT(50*SIN(A*1.7))
100 BLIT FILL FB+Y*ST+X*4,24,24,&H00C88040,ST
110 A=A+0.06:IF A>6.28318 THEN A=A-6.28318
120 F=F+1:IF F<240 THEN GOTO 60
```

Expected result: the block follows a curved path. A is not an angle you see on screen. It is a phase. The phase is advanced every frame and then used to derive visible positions.

45.4 Clearing, Covering, And Dirty Rectangles

The examples clear the whole screen because it is easy to understand. That is not the only method.

Method	Use it when
Full clear	The whole screen changes, or the programme is simple.
Cover old object	Only one or two objects move.
Dirty rectangles	Many small objects move and the background is stable.
Back buffer	Drawing takes several steps and should not be seen half-finished.

The blitter makes full clears cheap enough for many first effects. Later, when the picture becomes denser, you will choose a back buffer or dirty rectangles.

45.5 State Is The Demo

A demo loop is mostly state:

State	Example
Frame counter	$F=F+1$

State	Example
Position	X, Y
Velocity	DX, DY
Phase	A, Z, T
Intensity	IN, PU, PB
Section	Intro, build-up, peak, ending

The rest of Part VII keeps this rule. A rotozoomer changes angle and scale. A wobble effect changes row offsets. A music-synchronised intro changes intensity and section from the playback clock.

45.6 Limits

- BASIC frame loops teach the machine clearly, but they are not the fastest way to run a heavy effect.
- SIN and COS are convenient in BASIC. Machine-code chapters replace them with lookup tables.
- A frame loop should not wait for keys, disk, or long calculations inside the visible part of the frame.
- If the blitter is doing the heavy work, poll or wait for its done bit before using the result.

Chapter 46 uses this loop shape for the first full-screen demo effect: a hardware Mode 7 rotozoomer.