Investigation Report: Emitter Status & HLI Plans

Date: January 30, 2026
Investigator: DeepAgent
Repository: /home/ubuntu/stunir_repo/

1. Syntax Error Fix (✅ COMPLETED)

Issue

- **File:** `/home/ubuntu/stunir_repo/targets/embedded/emitter.py`
- **Line:** 432 (original), now 433
- **Error:** `SyntaxError: f-string: single '}' is not allowed`

Root Cause

The f-string in `_emit_readme()` method contained a dictionary lookup with nested braces that broke Python 3.12+ f-string parsing:

```
# BROKEN:
Requires `{{'arm': 'arm-none-eabi', ...}.get(self.arch, 'arm-none-eabi')}` toolchain.
```

Solution Applied

Extracted the dictionary lookup to a variable before the f-string:

```
toolchain = {'arm': 'arm-none-eabi', 'avr': 'avr', 'mips': 'mips-elf'}.get(self.arch,
'arm-none-eabi')
return f"""...
Requires `{toolchain}` toolchain.
..."""
```

Verification

```
python3 -m py_compile targets/embedded/emitter.py  # ✅ Syntax OK
```

Commit

`e4353d1` - Fix f-string syntax error in embedded emitter

2. Ada SPARK Emitter Status

Current State

Location	Content	Implementation
`tools/spark/`	Core tools (spec_to_ir, ir_to_code)	✅ Ada SPARK
`targets/`	**28 target emitters**	❌ Python only

Analysis

The SPARK migration covered **core tools only**:
- `stunir_spec_to_ir` - converts specs to IR
- `stunir_ir_to_code` - generic code emission

However, **28 target-specific emitters remain Python-only**:

Category	Emitters	SPARK Version
Assembly	arm, x86	❌ None
Embedded	embedded	❌ None
GPU	gpu	❌ None
WASM	wasm	❌ None
Mobile	mobile	❌ None
FPGA	fpga	❌ None
Polyglot	c89, c99, rust	❌ None
Lisp	8 variants	❌ None
Prolog	multiple	❌ None
Other	asm, lexer, parser, grammar, planning, etc.	❌ None

Why Python Emitter Is Being Used

The workflow falls back to Python because:
1. Ada SPARK `stunir_ir_to_code` only handles generic emission
2. **No SPARK emitters exist for specific targets** like `embedded`
3. Build scripts detect missing SPARK binaries and fall back to Python

Migration Gap

The `MIGRATION_SUMMARY_ADA_SPARK.md` claims migration is "COMPLETED" but only covers:
- 2 core tools in `tools/spark/`
- Documentation updates
- Build script fallback logic

NOT migrated: All 28 target-specific emitters in `targets/` directory.

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3. HLI Plans Status

Found Documents

Document	Phase	Status
`HLI_SPARK_MIGRATION_PHASE1.md`	Core Utilities	✅ Complete
`HLI_SPARK_MIGRATION_PHASE2.md`	Build System	⚠️ **MISSING**
`HLI_SPARK_MIGRATION_PHASE3.md`	Test Infrastructure	🔄 In Progress
`HLI_SPARK_MIGRATION_PHASE4.md`	Tool Integration	✅ Complete

Missing Documents

1. `HLI_SPARK_MIGRATION_PHASE2.md` - Build System migration document is missing
   - Phase 3 document claims Phase 2 is "Complete" but no documentation exists

2. `stunir_implementation_framework/` - Referenced in multiple README files but directory doesn't exist:
   - `phase6/HLI_GRAMMAR_IR.md`
   - `phase8/HLI_BEAM_VM.md`
   - `phase8/HLI_FUNCTIONAL_LANGUAGES.md`
   - `phase8/HLI_FSHARP.md`
   - Multiple other HLI documents

HLI References Found

Files referencing HLI documents (14 total):
- `/home/ubuntu/stunir_repo/ir/grammar/README.md`
- `/home/ubuntu/stunir_repo/ir/oop/README.md`
- `/home/ubuntu/stunir_repo/ir/actor/README.md`
- `/home/ubuntu/stunir_repo/targets/functional/README.md`
- `/home/ubuntu/stunir_repo/targets/beam/README.md`
- `/home/ubuntu/stunir_repo/targets/oop/README.md`
- `/home/ubuntu/stunir_repo/targets/systems/README.md`
- `/home/ubuntu/stunir_repo/targets/lisp/README.md`

- `/home/ubuntu/stunir_repo/targets/grammar/README.md`
- And others...

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4. Recommendations

Immediate Actions

1. ✅ **DONE:** Syntax error fixed - Ardupilot test can now proceed

2. **Create Phase 2 HLI Document:**
   ```bash
   # Create the missing Phase 2 document
   touch docs/migration/HLI_SPARK_MIGRATION_PHASE2.md
   ```

Short-Term (1-2 weeks)

1. **Prioritize Embedded SPARK Emitter:**
   - Create `tools/spark/src/stunir_embedded_emitter.ads`
   - Create `tools/spark/src/stunir_embedded_emitter.adb`
   - This unblocks Ardupilot test from using SPARK end-to-end

2. **Create Missing Framework Directory:**
   ```bash
   mkdir -p /home/ubuntu/stunir_implementation_framework/phase6
   mkdir -p /home/ubuntu/stunir_implementation_framework/phase8
   ```
   - Either create the referenced HLI documents or fix the broken links

Medium-Term (1-3 months)

1. **Target Emitter Migration Plan:**

Priority	Emitter	Justification
HIGH	embedded	Safety-critical (Ardupilot)
HIGH	c89, c99	Common targets
MEDIUM	rust	Modern systems
MEDIUM	wasm	Web deployment
LOW	lisp variants	Specialized use

1. **Complete Phase 3 Migration:**
   - Test infrastructure SPARK migration is still in progress
   - Complete before adding new target emitters

Documentation Updates Needed

1. **Update `MIGRATION_SUMMARY_ADA_SPARK.md`:**
   - Change status from "COMPLETED" to "CORE TOOLS COMPLETED"
   - Add section on target emitter migration roadmap
   - List which emitters still need SPARK versions

Summary

Item	Status
Syntax Error	✅ Fixed
Core SPARK Tools	✅ Complete
Target SPARK Emitters	❌ 0/28 migrated
HLI Phase 1	✅ Complete
HLI Phase 2	⚠️ Document missing
HLI Phase 3	🔄 In Progress
HLI Phase 4	✅ Complete
Implementation Framework	❌ Directory missing

Next Priority: Create SPARK version of embedded emitter for Ardupilot test.