Enhanced Model Architecture (2D): Parameters per Module

Input CSI
(T×C×F)

Conv1
Kernels=32
Kernel=3×3, Stride=1

Conv2
Kernels=64
Kernel=3×3, Stride=2

Conv3
Kernels=128
Kernel=3×3, Stride=2

SE Block
Reduction r=16
GAP→FC(128→8)→ReLU
FC(8→128)→Sigmoid

BiLSTM
Hidden=128×2
Output=256 (concat)

Temporal Attention
Heads=4
d_model=256, Window=5
Dropout=0.1

Classifier
FC(256→H)
Softmax
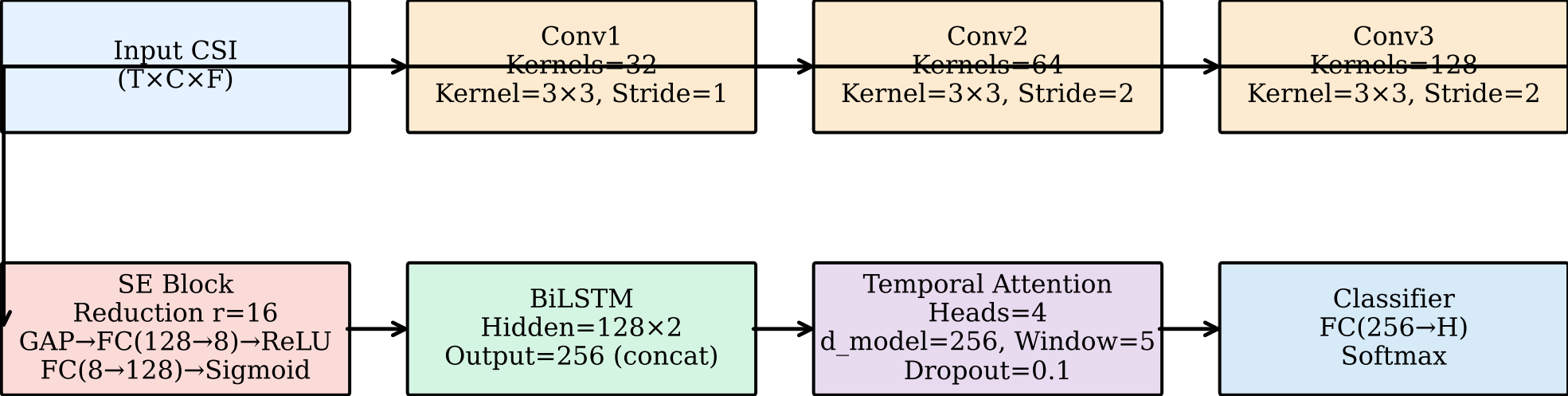
Training: AdamW, lr=3e-4, batch=64; 20% labels.
Metrics: LOSO/LORO Macro-F1, ECE calibration; Stability Index; Deployment Readiness.