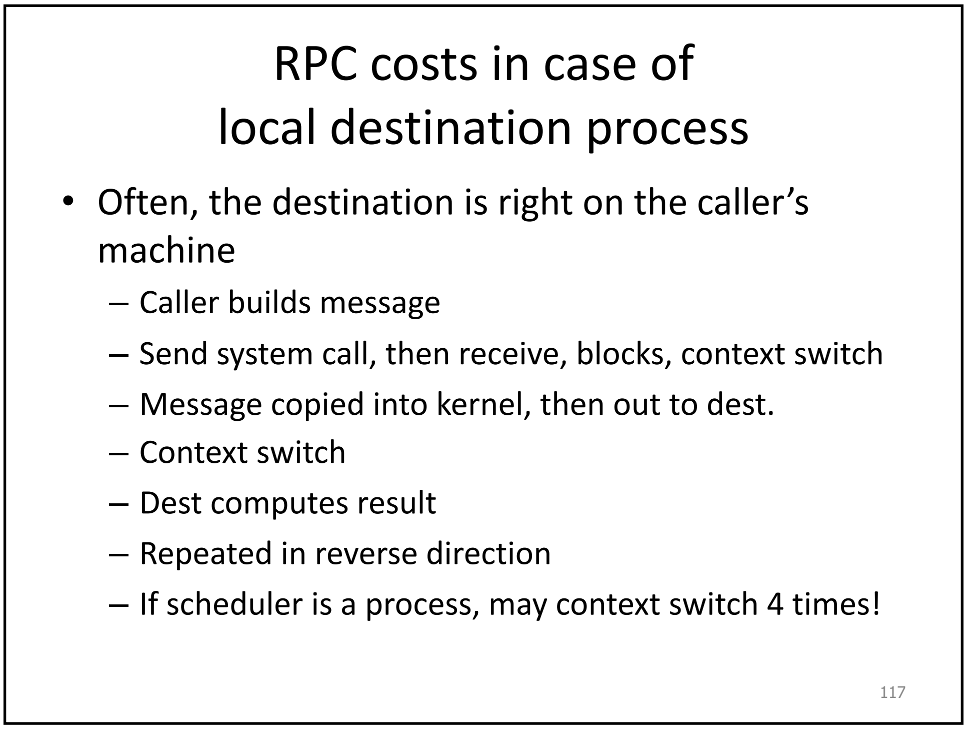
LOCAL RPC

RPC versus local procedure call

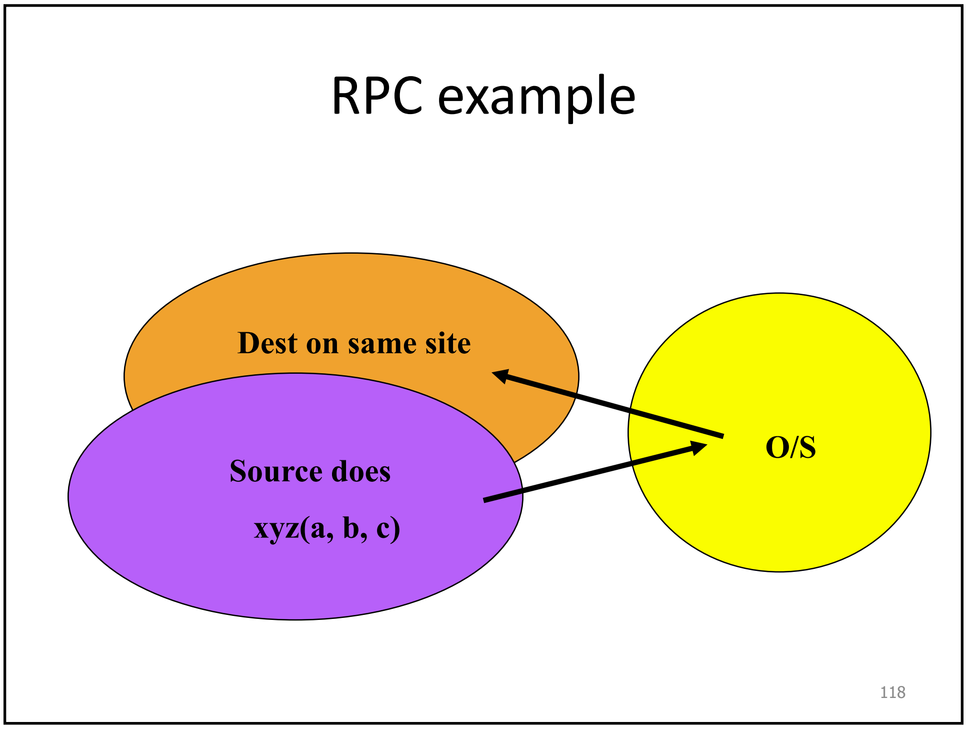
- Restrictions on argument sizes and types
- New error cases:
  - Bind operation failed
  - Request timed out
  - Argument “too large”
- Costs may be very high



RPC costs in case of local destination process

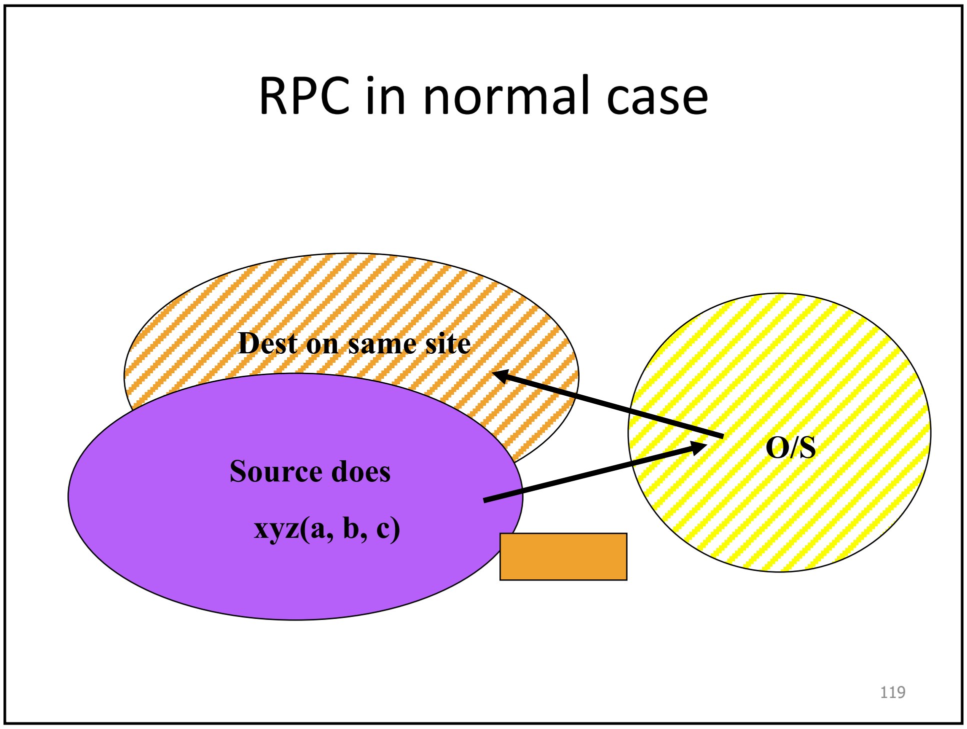
- Often, the destination is right on the caller's machine
  - Caller builds message
  - Send system call, then receive, blocks, context switch
  - Message copied into kernel, then out to dest.
  - Context switch
  - Dest computes result
  - Repeated in reverse direction
  - If scheduler is a process, may context switch 4 times!

117



RPC example

118



RPC in normal case

Dest on same site

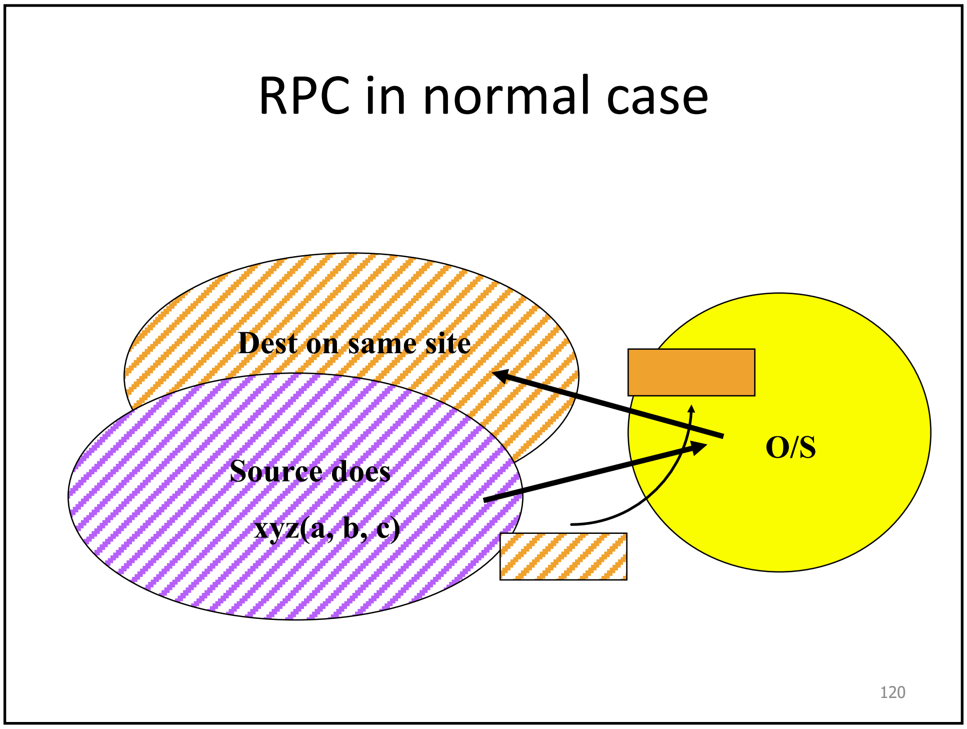
Source does

xyz(a, b, c)

O/S

119

119



RPC in normal case

Dest on same site

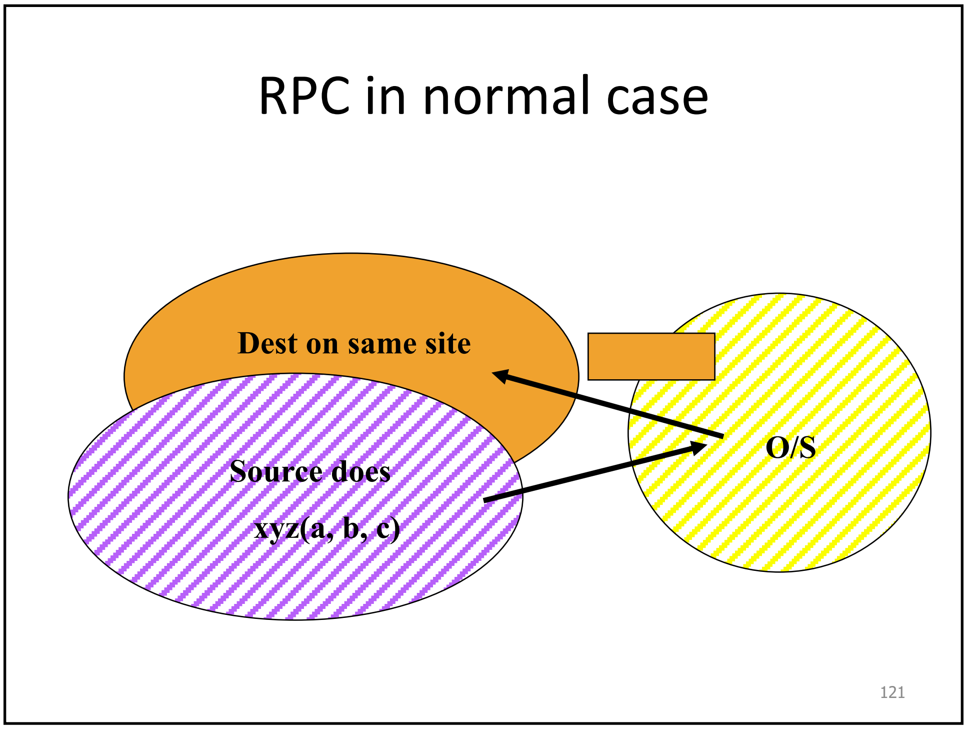
Source does

xyz(a, b, c)

O/S

120

120



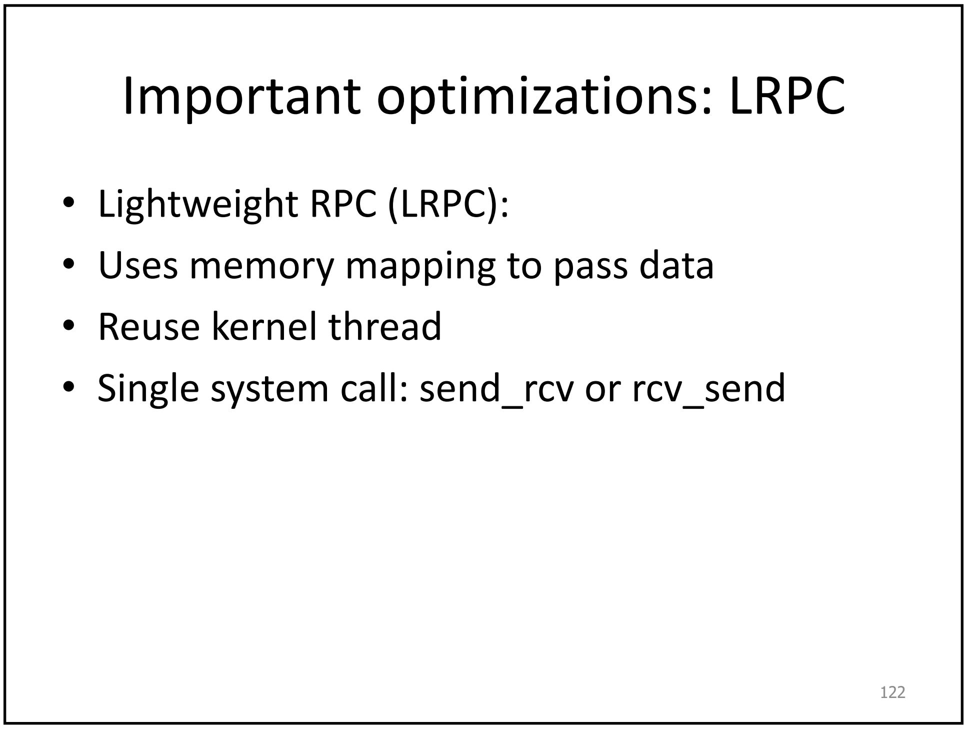
RPC in normal case

Dest on same site

O/S

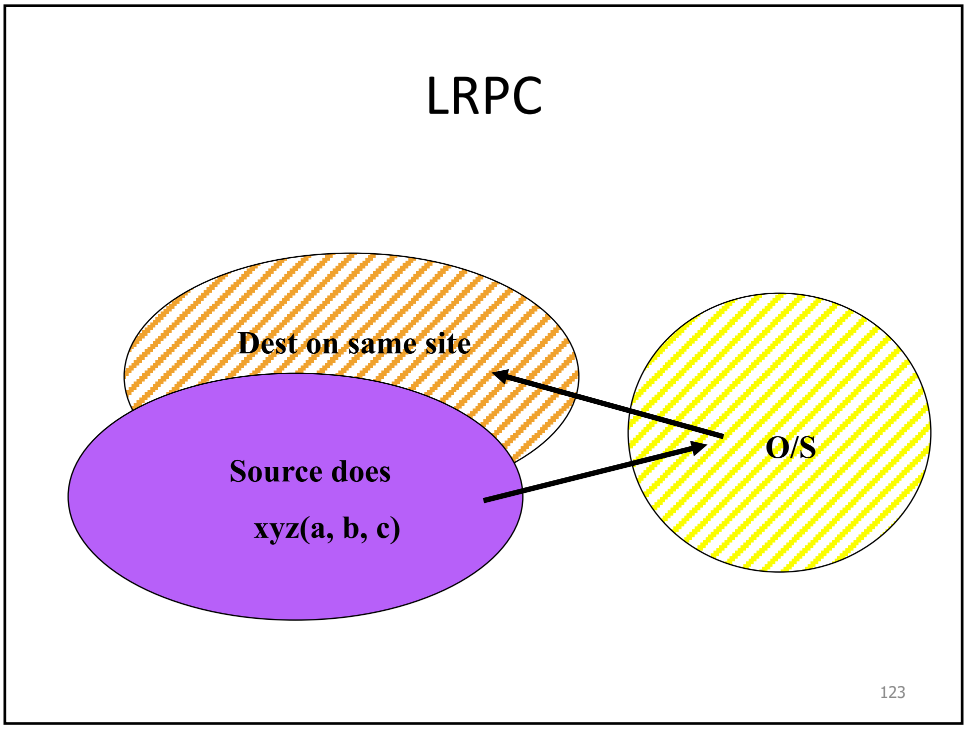
Source does

xyz(a, b, c)



Important optimizations: LRPC

- Lightweight RPC (LRPC):
- Uses memory mapping to pass data
- Reuse kernel thread
- Single system call: send_rcv or rcv_send



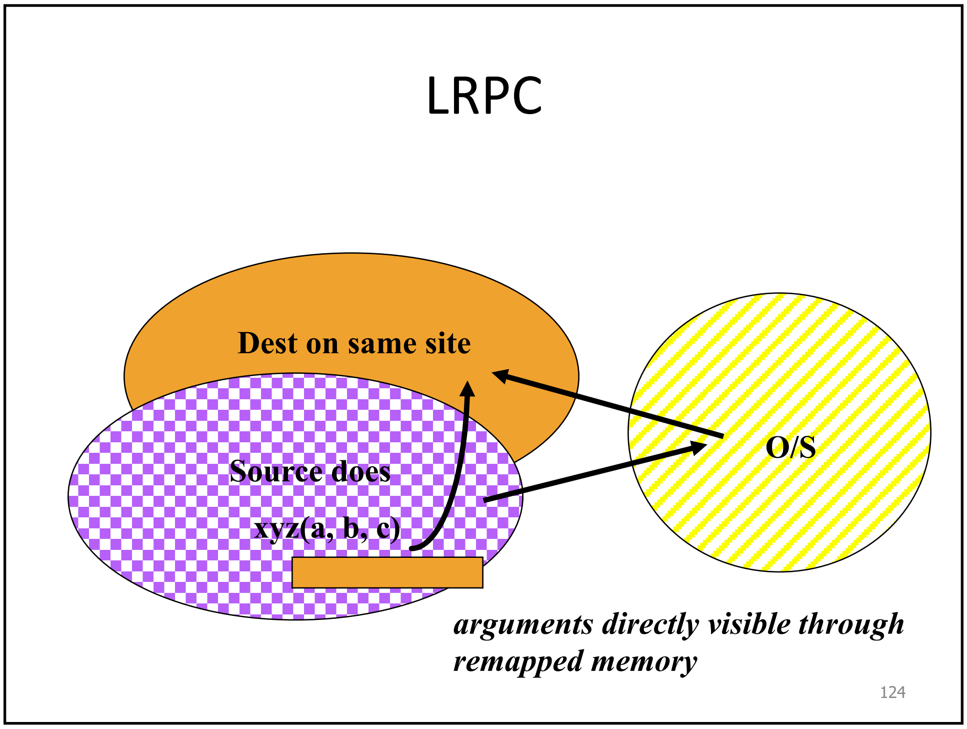
LRPC

Dest on same site

Source does

xyz(a, b, c)

O/S



LRPC

Dest on same site

Source does

xyz(a, b, c)

O/S

arguments directly visible through remapped memory

LRPC performance impact

- 10-fold improvement over hand-optimized RPC implementation
- Two memory remappings, no context switch
- 50 times faster than standard RPC
- Easy to ensure exactly once

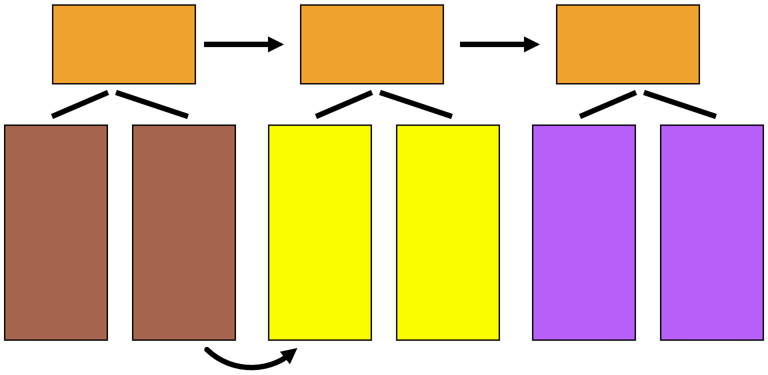
FBUFS

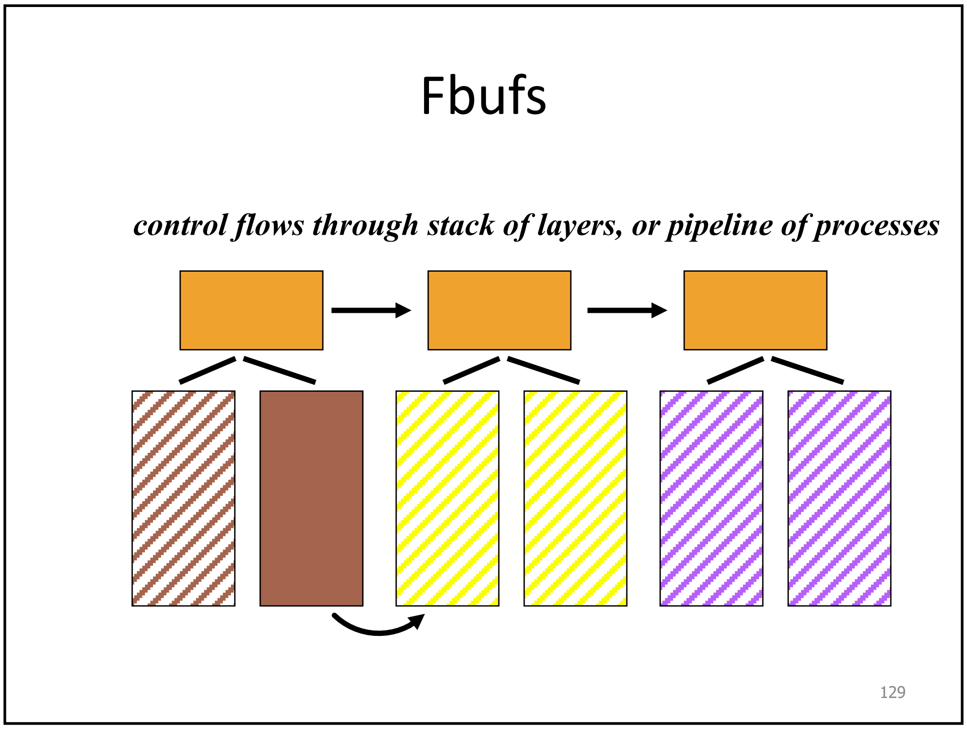
Fbufs

- Speed up layered protocols
- Buffer management overhead
- Solution: “cache” buffers
  - – memory management & protection
- Stack layers share memory

Fbufs

control flows through stack of layers, or pipeline of processes



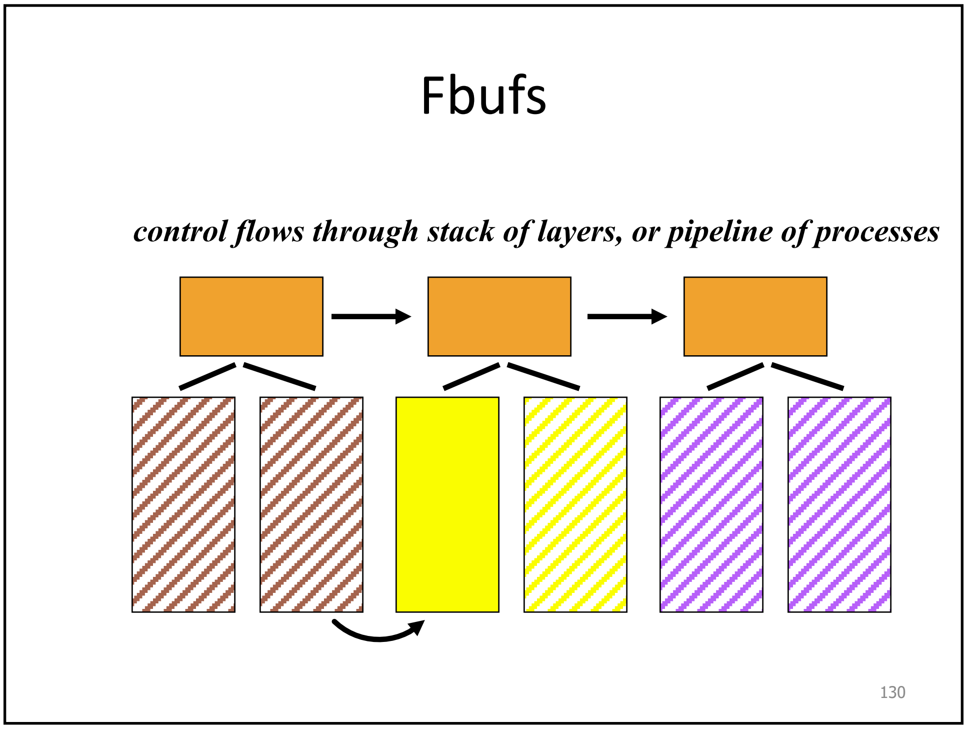


Fbufs

control flows through stack of layers, or pipeline of processes

129

129

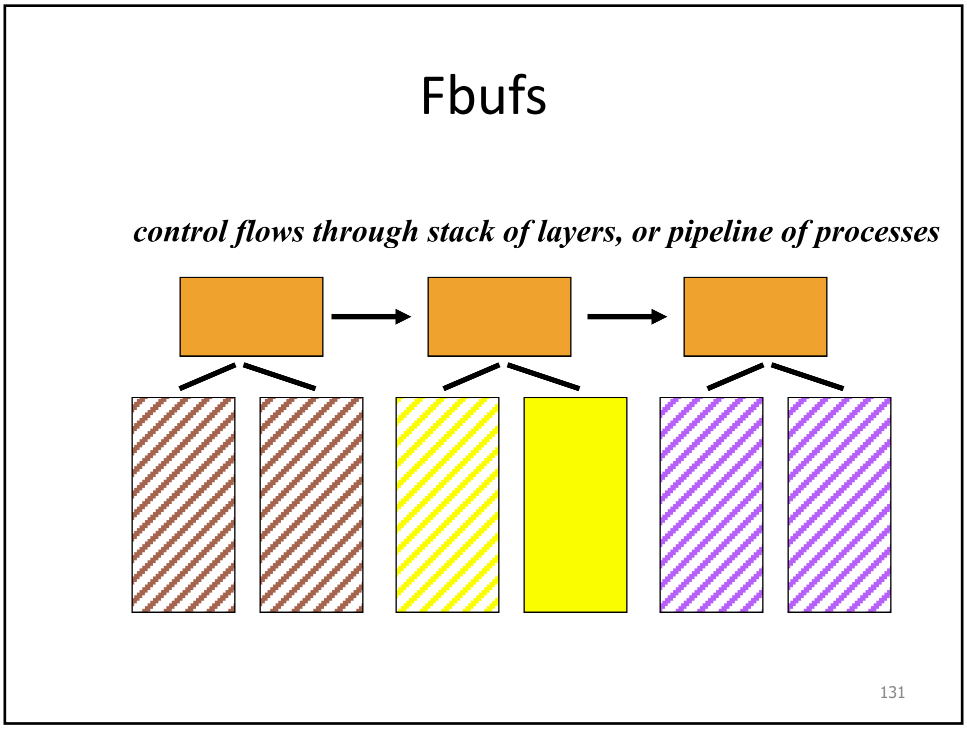


Fbufs

control flows through stack of layers, or pipeline of processes

130

130

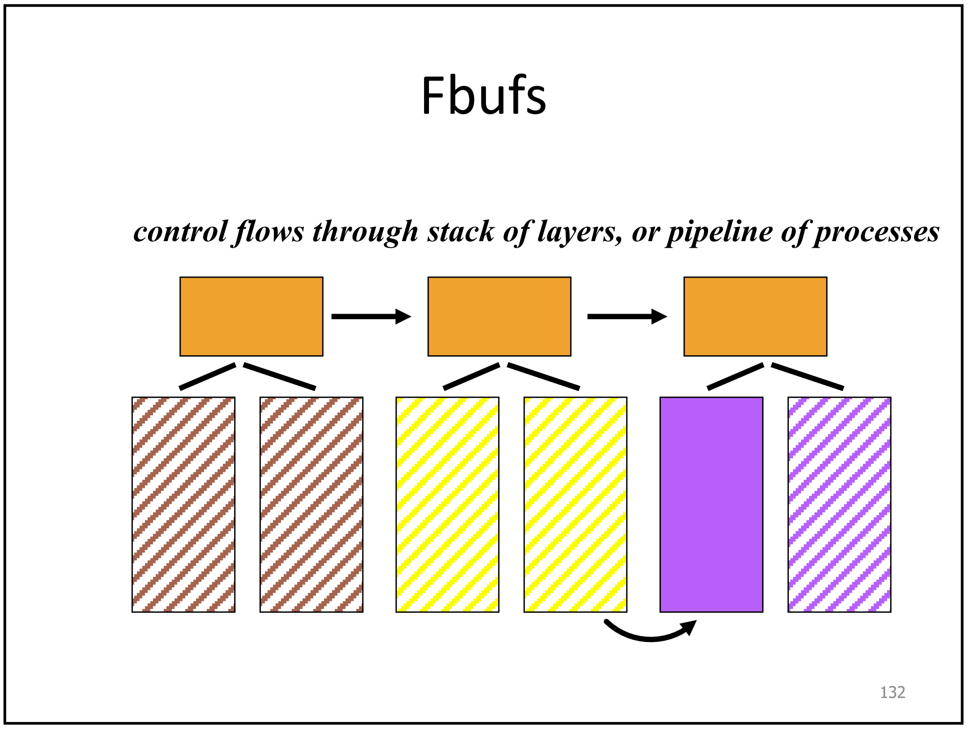


Fbufs

control flows through stack of layers, or pipeline of processes

131

131

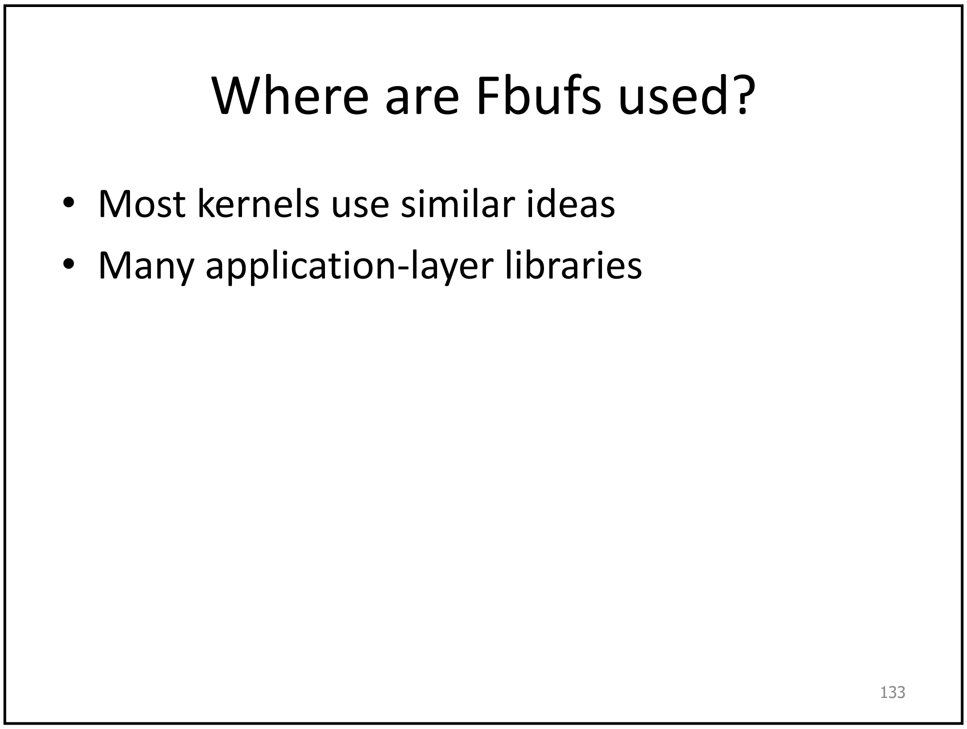


Fbufs

control flows through stack of layers, or pipeline of processes

132

132



Where are Fbufs used?

- Most kernels use similar ideas
- Many application-layer libraries

133