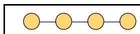
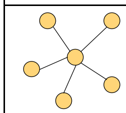
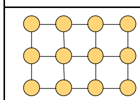
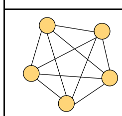
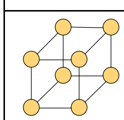
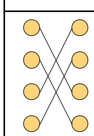
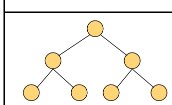
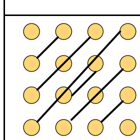
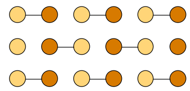
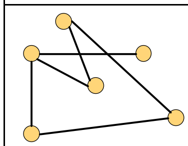
Communication Concerns

1. Topology

 Pipeline	Matrix Multiplication, Backward-Substitution, Insertion Sort, Adding Number, Sieve of Eratosthenes
 Star	Pixel-by-Pixel Image Processing, Monte-Carlo Simulations,
 Mesh	Finite Difference Method, Matrix Multiplication, Jacobi Iteration, Celluar Automata
 Full Mesh	LU Factorization.
 Hypercubic	Hypercube Quicksort, Hypercube Mergesort, Reduction, Broadcast and Multicast, Find Maximum
 Butterfly	FFT, Prefix Sum
 Tree	Mergesort, Barnes-Hutt, Bucket Sort, Adaptive Quadrature Numerical Integration
 Transpositional	Transpositional FFT, Shear Sort *Special case of mesh, butterfly*

 Odd-Even	Gauss-Seidel Method, Odd-Even Insertion Sort Special case of pipeline.
 Irregular	Cholesky Factorization, Sparse matrix operations, Event-driven, Discrete Event Simulations, Fock Matrix Computations.
	Multigrid solver

**** some topology is more primitive than others.***

2. Determination

a) Topology determined statically.

Communication pattern is well defined from the start, fixed at some kind of a topology. The set of nodes who will participate in the process (local, global) are predetermined.

b) Topology determined dynamically.

→ Topology stay fixed.

Program starts with speculative communication, depending on the outcome of the previous computations. After the dependent values are computed, communication topology is determined, and it stays fixed throughout the life cycle of execution.

→ Topology changes in phases.

Determined dynamically, but periodically change during phases.

3. Frequency

a) Periodic in phases. (a.k.a. loosely synchronous)

There is periodic global communication step after each computational phase.

Until all other processes are done, a process cannot go into the communication step.

This is enforced strictly in *each* of the phases, thus each process will start the subsequent computational phases with exactly same updated values.

b) Relaxed Periodic

For processes, some relaxation of the constraint is introduced to enter the global communication phase or the next phase early, so that it does not have to wait for all other processes. However, periodicity of the program is still maintained through some window size, so that one process will not go too far out of sync from other processes.

c) Chaotic Periodic

The phases still exists, but a process is almost careless on where other processes stand in the computation. No window size or any constraint is enforced, thus a process does not wait for other processes. This can only be used if convergence is still guaranteed, or dependency relationship automatically enforces order of computation.

4. Volume

a) Logarithmic change in subsequent communication

As the phase advances in the program, a node is responsible for communicating logarithmically increasing/decreasing volume of data (1,2,4,8 …). In many cases received data is processed in *concatenation*. (Prevalent in divide-and-conquer algorithms Mergesort, Quicksort)

b) Additively incremental change

Subsequent phases require additively incremental volume to be communicated. (Prevalent in pipeline algorithms)

c) Pairwise / One-To-One at fixed volume

Communication volume is always fixed at certain amount throughout the life cycle of the program. Previous received data is *accumulated* rather than concatenated in the next communication volume. (adding number in pipeline, prefix sum)

d) Aggregated amount

Volume is aggregated, and does not portray any specific pattern.

e) Scattered amount

Large amount of data is scattered to individual pairwise data amount.

5. Initiation

a) Sender-Initiated : Definer knows user

Sender knows the exact identity (i.e. node number) of the receiving process.

b) Receiver-Initiated : User knows definer

Receiver requests data to the sender. Sender, upon blindly listening for any request, responds by sending desired data.

c) Neither knows

Neither side knows who is receiving what. (* mechanism).

d) Both (Collective)

Sender and receiver both participates in a collective call. (i.e. broadcast, multicast, etc)

* discuss in relation to library calls and programming primitives.
(send/recv, put/get, assignment)