In English, please

PSR, SSR, MSSR
MODE A, C, AND NOW S

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PIL: Any Approach, G-ABCD, good morning, Pa 28 on a VFR flight from Southampton to Gerona, FL 55, estimating your area in 5 minutes, requesting transit.
CTL: G-ABCD, Any Approach, good morning. Squawk 4730.
PIL: Squawking 4730, G-CD
CTL: … G-CD, radar identified, transit is approved.

These routine messages are now commonly heard on ATC radio frequencies. However not more than 20 years ago, radar identification was not to be taken for granted. Control towers at French medium-sized airports didn't always have radar displays, and the "technology" in use there and then was hardly more advanced than the plotting tables of a time long gone.
The principle of radio detection and ranging was already known at the beginning of the last century, but it was just before and during WW II that applications were developed as highly classified projects by several countries.
The first radar displays appeared in civil aviation in the mid-50s, and since then the never-ending quest for improvements, fuelled by the never-ending growth in air traffic, has transformed the initial small monochrome circular scope into the present-day square flat screens, able to provide air traffic controllers with a mass of color-coded information.

PSR

Primary Surveillance Radar is the basic, oldest system. A transmitter emits a burst of electromagnetic energy. If the energy strikes an object, it is scattered in all directions. A small fraction of that scattered energy finds its way back to the radar where it is captured by a co-implanted receiver. Electromagnetic waves travel through the air in a straight line and at a constant speed, which allows the radar to determine the distance, direction and height of the reflecting object. Distance, or range, is calculated from the time it takes the wave to travel to the object and come back. Direction and height are deduced from the antenna's position.
A primary radar is what ICAO calls "a non-cooperative surveillance system": many objects (rain drops, birds, aircraft, etc) can passively reflect some of the energy.

SSR

On the contrary, Secondary Surveillance Radar is a cooperative surveillance system. The aircraft plays an active part in the detection process, it cooperates. The radar becomes an interrogator that questions an on-board instrument: the transponder. ATC systems allocate each flight a transponder Mode A code, which is a 4-digit number specific to that flight.
SSR interrogations take the form of pulses. The time between two pulses defines the mode. At 8µs it is Mode A, and the aircraft answers with its transponder code. If the time between two pulses is 21µs then it is Mode C, and the aircraft answers with its altitude. Then sophisticated computers link radar data and flight plan information to create a labeled target. Only aircraft with an operating transponder are displayed on the radar screen, and the controller can work in a less cluttered radar environment.
SSR also has some limitations. The first generation of SSR radars needed to question each aircraft several times to get an accurate position. Too many interrogations lead to problems such as garbling - when the answers from two different aircraft get entangled - or fruit - when a radar receives the answer from another radar's interrogation and creates a ghost target. Another drawback is the limited number of Mode A codes. With only 4096 of them, it is hardly enough in busy areas.

MSSR

The Monopulse SSR is the second generation of SSRs. Instead of having to question an aircraft several times to get an accurate position, the MSSR needs only one interrogation, one pulse, hence the name "monopulse". This improvement limits the number of interrogations, and therefore the number of transponder answers, thus alleviating the problem of garbling, without getting rid of it altogether. Nor does it solve the problem of Mode A code shortage, which is reaching a critical stage in high-traffic density airspace.

MSSR Mode S

It is the latest generation of radars. Mode S technology allows aircraft and radars to establish an unambiguous connection. Once the link has been set up the radar will question the aircraft selectively, and the aircraft will answer only to that specific radar. With MSSR Mode S garbling and fruit are things of the past.
A new concept appears with Mode S detection: the aircraft identification or AID. The AID is either the flight number as it appears in field 7 of the flight plan, or the aircraft registration. It is set on the Mode S transponder. It replaces the Mode A code in the correlation process between radar track and flight plan data. It also corresponds to the R/T callsign used in flight, and is displayed on the controller's position.
The AID becomes more important for ATC systems than the Mode A code. Mode S equipped IFR flights, operating within Mode S declared airspace, can all be given the same Mode A code, 1000, relieving the pressure on code allocation.

VFR

It is quite obvious that Mode S technology was not developed with VFR flights in mind, but the improvements it brings about, namely better detection, identification, and precision, will benefit all airspace users. Last, but not least, MSSR Mode S is compatible with SSR Mode A/C , meaning that VFR pilots don't have to worry about radar identification if they have not yet made the leap forward to Mode S technology. •

Vocabulary

TO ALLEVIATE	alléger
A BURST	un jet, un éclat
TO CLUTTER	encombrer
A DIGIT	un chiffre
A DRAWBACK	un inconvénient
ENTANGLED	entremêlé
A LABEL	une étiquette
TO MAKE THE LEAP	sauter le pas
TO SCATTER	disperser
TO TAKE FOR GRANTED	considérer comme acquis